JMD design

Catherine McAuley & Parramatta Marist High Schools

LANDSCAPE REHABILITATION PLAN & VEGETATION MANAGEMENT PLAN

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1. Introduction

1.1 Background

James Mather Delaney Design (JMDD), Landscape Architects were commissioned by Thompson Adsett on behalf of the Catholic Education Office to prepare a Landscape Rehabilitation Plan (LRP) including a Vegetation Management Plan (VMP) for riparian areas of the site. The project site is the Catherine McAuley (Lot 1, DP 1095407) and Parramatta Marist High Schools (Lot 8, DP 1077852) Westmead Campus, including Milson Creek riparian corridor.

Reference material used includes:

Guidelines for controlled activities; Vegetation Management Plan (Dated: February 2008) Department of Water and Energy (DWE)

Guidelines for controlled activities; Riparian Areas (February 2008). DWE

Guidelines for controlled activities; Instream works (February 2008). DWE

Guidelines for controlled activities; Outlet structure (February 2008). DWE

Recovering bushland on the Cumberland Plain, Best practice guidelines for the management and restoration of bushland, Department of Environment and Conservation (NSW) 2005.

1.2 Consent Requirements

Parramatta Council is the consent authority for the project and have issued Conditions of Consent for the School upgrade works. A statutatory requirement of these works being triggered as the works are within 40 metres of the watercourse banks, the works are a controlled activity under the Water Management Act 2000. The NSW government, Department of Water and Energy issued general terms of approval for Catherine McAuley and Parramatta Marist High Schools which require:

Condition 2 Prior to the commencement of any works a controlled activity approval must be obtained by DWE. This approval is for land within 40m of the top of the bank of Milson Creek.

Landscape Rehabilitation Plan

Condition 3 The consent holder must prepare or commission the preparation of

(i) Rehabilitation Plan
(ii) Works Schedule
(iii) Erosion and Sediment Control Plan
(iv) Soil and water management plan

Condition 4 The following plans must be prepared in accordance with Department of Water and Energy guidelines

i) Vegetation Management Plans
ii) Riparian Corridors
iii) Outlet Structures
iv) Watercourse crossing plans

The report addresses condition 3 items i & ii; Items iii & iv are to be addressed by Northrop Engineers on their plans. Correspondence between Kevan Meldrum of

Northrop Engineers and Mohammed Ismail of the Department of Natural Resources dated 19.07.2009 in regards to the stormwater outlet works at the subject site. states that; the proposed works are considered to be minor that the Department has deemed that, in this instance, no Controlled Activity Approval (CAA) is necessary.

Condition 5 Conditioned that if site contamination was found through the additional site investigation required by this condition, then remediation works are to be carried out and those works are to be verified by a site audit statement.

A Site Assessment & Remedial Action Plan has been prepared by EIS Environmental Investigation Services. Contaminants were found in 2 areas, Area B falls partially under the proposed road and carpark as well as the riparian rehabilitation zone

Refer Figure 1 for location of Area B

1.3 Objectives

The purpose of rehabilitation is to achieve environmental benefits. The proposed rehabilitation works are intended to increase the baseline environmental and landscape values of the site from their present level.

To prepare a Vegetation Management Plan (VMP) as required by the Department of Water and Energy (DWE) for application for a 3A Permit to undertake works 'within 40m of a foreshore, or the top of a "river", as defined under the Rivers and Foreshores Improvement Act 1948 ("Part 3A permit").

1.4 Structure of the Landscape Rehabilitation Plan (LRP) and Vegetation Management Plan (VMP)

Section 1 – Introduction
Outlines the background, reference material, conditions of consent applying to the school campus works and objectives for the project.

Section 2 – Existing Site Conditions
Describes existing site conditions including soils, drainage, plant communities, weeds present, fauna habitat, pests, existing activities and infrastructure.

Section 3 – Vegetation Management & Rehabilitation Principles, Strategies, Activities, Performance Targets and Monitoring
Outlines management principles, strategies and activities for each treatment zone with performance targets and monitoring mechanisms for each strategy area including a summary monitoring schedule.

Section 4 – Rehabilitation Schedule
Timing for of activities for each treatment zone.

Appendix A Water Management Act 2000 – Guidelines for controlled activities
Appendix B NPWS -Plant Species List
Appendix C Landscape Drawings
Technical Specification

2. Existing Site Conditions

2.1 Land Extent & Ownership

The subject site forms part of the Catherine McAuley and Parramatta Marist High Schools Westmead Campus. The school site is roughly trapezoidal in shape and approximately 12.0 hectares in area and is located on Darcy Road at the western edge of the school property. The site address is No. 2 Darcy Road, Westmead, being Lot 1 in DP 1095407 and Lot 8in DP 107785) Westmead Campus, in Parramatta LGA.

The Marist Brothers Westmead and Catherine McAuley Catholic Girls Colleges are located on Darcy Road Westmead, south of Westmead Hospital. To the west of the site is medium to high density housing consisting of hospital accommodation and high rise apartments. To the east is a University of Western Sydney Campus. The site is bounded to the south by the Western, Richmond and Cumberland Rail Lines and to the west by Milson Creek.

The majority of school buildings are located in the north east corner of the site with the remainder of the site being large open sports fields, entry roads and car parking. The future development of the campus includes the re-development of the school facilities and a new primary school and day care facility.

The study site for this Landscape Rehabilitation and Vegetation Management Plan is the riparian area of Milson Creek a tributary of Finaysons Creek, which joins Toongabbie creek before flowing into the Parramatta River. Figure 1 shows the location of the school campus and its surrounding localities. The study area is the western boundary of the property depicted in Figure 1. Part of the study area in Zone 5 is owned by the adjacent landholder. As car park works are within 40m of the creekline in this area under the Water Management Act 2000 this land forms part of the subject site and will be rehabilitated by the school in accordance with this report.

2.2 Microclimate[1]

The average annual rainfall at Parramatta, approximately 2.5 kilometres east of the site, is 921.2mm. Parramatta has a Latitude of 33.82 °S, and a Longitude of 151.00 °E. The Upper Parramatta River Catchment Trust defines the site by Easting 313257.2 and Northing 6257375.

The mean daily maximum temperatures range from 28.1ºC (highest recorded 38.9ºC) in January to 17.0ºC (highest recorded 22.1ºC) in July at Parramatta. The mean daily minimum temperatures range from 16.7ºC (lowest recorded 10.1ºC) in January to 4.5ºC (lowest recorded -1.0ºC) in July at Parramatta. Relative humidity varies little throughout the year, ranging from 66% (9am)-53%(3pm) in January to 77%(9am)-54%(3pm) in July at Parramatta.

2.3 Topography & Drainage

The topography of the site is gently undulating. The topography of the site adjacent to the riparian corridor has been modified with a filled embankment adjacent to the river banks to enable a flat playing field adjacent to the river bank. The school campus site falls gradually from a high point in the east of RL 28.0 AHD towards Milson Creek at about RL 12.0AHD in the west.

The creek flows in a northerly direction for the entire western boundary of the school

1 Bureau of Meterology Web site , Station 066046 Parramatta

site and collects drainage from the campus. The creek flows from the Cumberland city rail train line through the site. In the north-western corner of the site the creek is diverted through a culvert under Darcy Road and Westmead private hospital before entering Finlaysons Creek close to the junction with Toongabbie Creek a tributary of Parramatta River. The Upper Parramatta River Catchment Trust notes this creek as part of the Toongabbie Creek catchment.

The landform immediately adjacent to the creek bed has been modified. An embankment approximately 2 metres in height enables the adjacent playing fields to be relatively flat, previously this land would have gradually slopped towards the creek bed. The creek banks are stable and the creek channel show no evidence of recent erosion or over topping. Both the batters and the invert of the creek do however containing a number of weed species. Figure 2 and 3 show the creek bed profile. The western side of Milson Creek also appears to have been regraded during the development of hospital accommodation, creating a deeply defined creek channel. The flow regime for Milson Creek is low with intermittent flow rates dependant on the rainfall.

There is no flooding on the subject site property however the floodplain for the catchment is in the parkland areas adjacent to the Toongabbie Creek and Parramatta river. The Flood Risk Precincts as adopted from the Upper Parramatta River Catchment FRMP 2003 identifies this parkland area as designated Low Flood Risk. The FRMP provides a number of specific recommendations which are relevant to the Westmead Precinct, inclusive of the following:

New “Sensitive Use and Facilities” (inclusive of hospitals and educational facilities) should be discouraged from locating within the flood plain (i.e. either the Low, Medium or High Flood Risk Precincts). Where such uses exist, additions and redevelopment could be acceptable subject to compliance with various criteria generally directed towards reducing flood risk to property and persons. Most other forms of development would be permissible in either Low or Medium Flood Risk Precincts.

Figure 1: Site Location Catherine McAuley and Parramatta Marist High Schools campus. source Google Earth 3.07.09

2.4 Soils

The original site soils are recorded as being from the soil group, Blacktown and fit the descriptions provided in Soil Landscapes of the Sydney 1:100,000 Sheet, (Chapman & Murphy, 1989). The soil landscape concept integrates geological and soil data with topographic or landform information of an area into one inclusive unit. Each soil landscape grouping has specific features, which are described and are capable of being presented on a map.

The Blacktown Soil landscape soils are generally of shallow to moderately deep with low to very low fertility, with low cation exchange capacity values, low to very low nitrogen and phosphorous, strongly acidic with moderate erodibility. The soil group has a high capacity for urban development derived from the Wianamatta group of shales these soils have poor drainage.

2.5 Contamination

The Site Assessment & Remedial Action Plan has been prepared by EIS Environmental Investigation Services. Contaminants were found in 2 areas, Area B falls partially under the proposed road and carpark as well as the riparian rehabilitation zone and requires remediation.

The above report notes Area B having contamination the contaminants including as Lead, Polycyclic Aromatic Hydrocarbons (PAH), including benzo(a)pyrene and Heavy fraction TPH (C10 – C36).

2.6 Existing Vegetation

The original vegetation based on vegetation remnants mapped by NPWS in their Native Vegetation of the Cumberland Plan Sheet 9 of 16 October 2002 would have been Shale / Sandstone Transition Forest (high sandstone influence) (SSTF) and Sydney Coastal River Flat Forest (Alluvial Woodland) (SCRFF) – both endangered ecological community. There are only a few remnant locally native trees within the study area of the site.

Existing vegetation within and adjoining the Milson Creek site consists of a mix of indigenous, introduced native & exotic species and weed species. The site has been extensively cleared of vegetation for development and filled in particular for the construction of the adjacent playing fields and carpark.

An arborist report of trees on the site has been undertaken by Integrated Vegetation Management Pty Ltd (IVM) dated 22nd September 2008. This report review the works for the entire school site, in this report IVM have observed that:

“Site vegetation consists largely of amenity tree species. Australian native species include: Corymbia citriodora (Lemon-scented Gum tree), Eucalyptus microcorys (Tallowwood), Eucalyptus sideroxylon (Red Ironbark) Callistemon spp (Bottle Brush), Casuarina sp (she Oak) and Lophostemon confertus (Brush Box). The trees appear to be planted specimens. Exotic tree species such as Cupressus spp (Cypress Pine), Jacaranda mimosifolia (Jacaranda) Platanus x hybrida (London Plane) Prunus sp. and Erythrina crista-galli (Cockscomb Coral) are also located throughout the site

.

The subject trees provide good canopy cover and a shady pleasant environment for students and staff. However, it appears that the species selection and planting locations have not been guided by a formal design concept or tree planting plan. A wide variety of types and styles of trees have been planted in an irregular fashion

resulting in an ambiguous landscape character.

Generally, the subject trees are considered to be of good to fair health, and good to fair structure."

The arborist report notes that some of the trees located in the vicinity of the creek and wetland area have structural defects, and they could be considered a potential hazard.

The areas within the Milson Creek site have been categorised into site zones based on

Photo 1: Depicts view along Milson Creek Corridor edge looking North.
At approximate CH 225.

Photo 2: Depicts View along Milson Creek showing typical depth of creekline.
At approximate CH 200.

50m chainage intervals for species identification and remediation works. These zones begin at the Darcy Road culvert and are located on FIGURE 2: Site Zones.

Figure 2: Site Zones

Zone 1 (Chainage 0-50m) From Darcy Road Culvert

The vegetation along Milson Creek invert & creek banks in Zone 1 is heavily weed invested with the first 30 metres from the culvert dominated by Arundo donax a class 4 noxious weed. Other weed species exist in the lower eastern river bank including; Morus species, Cynodon dactylon, Erythrina christa-galli. The vegetated component of the riparian zone is eastern embankment is formally planted with a row of Corymbia maculata. along the driveway and Casuarina glauca further down the embankment as shown in Photo 5 of Zone 2. This area has an understorey of Kikuyu which is overgrown and spreading into the riparian zone.

Photo 3 show the heavy weed infestation in the lower chainages of Zone 1. The water in Milson Creek leaves the site through a culvert under Darcy Road it is then piped under the Westmead Private Hospital before entering Finlaysons creek in Milson Park close to the junction with Toongabbie creek.

Photo 3: Image from school Driveway looking towards culvert.
At approximate CH 10

Photo 4: Darcy Road Culvert.
At approximate CH 0

Zone 2 (Chainage 50-100m)
The vegetation along Zone 2 is also heavily weed infested. A formal row of Corymbia maculata has been planted adjacent to the driveway leading from Gate 4 to the carparking. These trees are planted in kikuyu turf. Approximately 6 meter down the steep embankment leading to Milson creek a row of Casuarina's have been planted. Weed species in Zone 2 inlcude; Pennisteum clandestinum, Tropaeolum majus, Bidens pilosa.

Photo 5: Top of eastern embankment looking south.
At approximate CH 100

Photo 6: 450mm diameter Inlet pipe headwall and concrete apron.
At approximate CH 65

Zone 3 (Chainage 100-150m)
The vegetation in zone 3 is made up of native and weed species. This area contains thick growth of Rubus fruiticosa and Tradescantia fluminensis on the eastern side of the creek. This zone is bound by the road on the eastern side of Milson Creek.

Photo 7: School driveway looking south towards Milson Creek.
At approximate CH 110

Photo 8: looking towards creek from fence line.
At approximate CH 110

Zone 4 (Chainage 150-200m)
The vegetation in Zone 4 of a mix of weed species and locally native riparian vegetation. The western creek bank is planted with Casuarina glauca species, this vegetation is generally of high quality there are some localised weed species and rubbish. The creek bed and lower eastern bank areas have a mix of native riparian vegetation species and weed species, most of these weed species are localised and can be restored with some bush regeneration. Photo 12 shows Milson creek in Zone 5. The upper eastern embankment is heavily covered in weed species including Lantana camara, Ligustrum lucidum, Ligustrum sinensis, Pennisetum clandestinum, Phenoix canarinesis and Tradescantia fluminensis. Photo 10 illustrates this weed infestation. A constructed wetland exists between the eastern edge of the riparian corridor and the driveway, as shown on the zoning plan. This wetland is fenced on all sides and contains mostly good quality native species, however some exotic species have been planted including; Acacia baileyana, Liquaidamber stryracifua, Quercus robur.

There is evidence of school bush regeneration program planting around chainage 170. These planting include native species of Dianella sp. Isolepsis and Lomandra species. This vegetation should be retained and protected throughout any works.

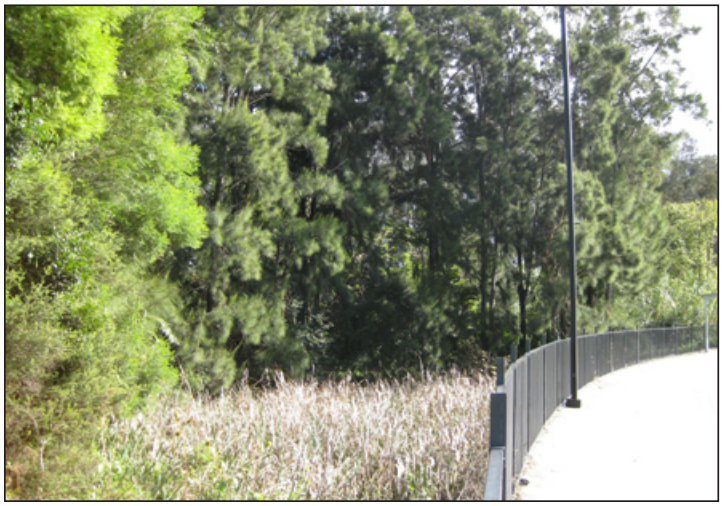

Photo 9: Wetland taken from the driveway
At approximate CH 180

Photo 10: View of Creek line looking North
At approximate CH 200

Zone 5 (Chainage 200-330m)
The vegetation at the southern end of the creek is of good quality. The western creek bank is planted with Casuarina glauca species which retain the bank and provide privacy between the Health Department residential units and the school, this vegetation requires a little work to remove some spot weeds and rubbish but is generally of good quality. The creek bed and lower bank areas are sparsely planted with a mix of native riparian vegetation species and weed species, most of these weed species are localised and can be removed with some bush regeneration. Photo 12 shows Milson creek in Zone 5. The upper eastern embankment is heavily infested in weed species including Lantana camara, Ligustrum lucidum, Ligustrum sinensis, Pennisetum clandestinum, Phenoix canarinesis and Tradescantia fluminensis Photo 11 illustrates this weed infestation. There are a few remnant mature trees on the edge of the embankment which contribute significant to the amenity of the area are protected under the Parramatta Council TPO. Zone 5 is bound by playing fields on the east Kikuyu turf from these fields has grown down into the riparian corridor.

Photo 11: Top of eastern embankment looking west towards Milson Creek showing heavy weed infestation. Approximate Chainage of photo is 250

Photo 12: Milson creek looking south.
Approximate Chainage of photo is 250

2.7 Summary of threatening processes affecting remnant Native vegetation

This section provides an overview of the generic threatening processes and management issues which currently affect the native vegetation at the study site and the local area.

The remnant vegetation within the Westmead Campus has been subject to various levels of disturbance and modification for residential and public service development. The most significant threatening processes that have influenced and in some case continue to degrade the remnant native vegetation in the study site include:

- The extensive extent of filling, which has occurred at the site to accommodate the existing college sports field facilities and road access. This has had a significant impact on native plant resilience at the site resulting in a steep batter on the eastern creek bank which is dominated by weed species.
- Weed competition and weed seed and vegetation propagule spread from within the site, residential gardens and development sites throughout the local area. Weed infestation ranging on percentage cover levels now occur within the site. The eastern embankments of the creek are heavily infested with Giant Reed (Arundo donax)and Cockspur Coral Tree (Erythrina crista-galli) infestations in two locations and the northern end of the creek heavily dominated by weed species. Many of the weeds found on the site are listed as noxious weeds for the Parramatta Local government area. A list of the weeds found on the site is listed in TABLE 1. This table gives a description of the weed classification.
    - Weed sources are as follows:
        - Weed seed in site soils,
        - Water borne weeds from upstream,
        - Adjacent land holdings,
- Erosion of topsoil and soil-stored native seed banks from localised heavy rainfall events.
- Edge effects and intrusion of Kikuyu turf into the riparian corridor
- Localised increase in soil nutrients and soil moisture levels from run-off from the surrounding catchment, creating localised soil conditions that favour the colonisation and establishment of naturalised plant species and associations.

Native vegetation in the study site is restricted to only a few scattered remnant trees and a low percentage of ground laver plants, it can be expect that both a more diverse range of species and the percentage cover of key native plant species can be increased in response to a combination of bushland regeneration and reconstruction strategies.

Family	Species	Common Name	Weed Classification
Fabaceae	Acacia baileyana	Cootamundra Wattle	Environmental (parra)
Basellaceae	Anredera cordifolia	Madeira Vine	NSW Noxious Weed Control Class 4
Umbelliferae	Ammi majus	Bishops Weed	
Poaceae	Arundo donax	Giant Reed	NSW Noxious Weed Control Class 4
Asclepiadaceae	Araujia hortorum	Moth Plant	NSW Noxious Weed Control Class 4
Compositae	Bidens pilosa	Cobblers Peg/ Farmers Friend	
Cannaceae	Canna indica	Canna	
Solanaceae	Cestrum parqui	Green Cestrum	NSW Noxious Weed Control Class 3
Chenopodium	Chenopodium sp		
	Cinnimonum camphora	Camphor Laural	NSW Noxious Weed Control Class 4
Compositae	Cirsium vulgare	Spear Thistle	
Compositae	Conyna bonariensis	Fax-leaf Fleabane	
Poaceae	Cynodon dactylon	Common Couch	
Cyperaceae	Cyperus eragrostis	Umbrella Sedge	
Papilionacea(Fabaceae)	Erythrina christa galla	Coskspur Coral Tree	NSW Noxious Weed Control Class 4
Compositae	Eupatorium adenophorus	Crofton Weed	
Poaceae	Echinochloa crus-galli	Barnyard Grass	
Umbelliferae	Foeniculum valgare	Fennel	
Apiaceae	Hydrocotyle bonariensis		
Convolvulaceae	Ipomoea indica	Morning Glory	NSW Noxious Weed Control Class 4
Bignoniaceae	Jacaranda mimosifolia	Jacaranda	Garden escape
Verbenaceae	Lantana camara	Lantana	NSW Noxious Weed Control Class 4
	Liquidamber stryraciflua	Sweet Liquidamber	Environmental Weed
Oleaceae	Ligustrum lucidum	Broad Leaf Privet	NSW Noxious Weed Control Class 4
Oleaceae	Ligustrum sinensis	Small Leaf Privet	NSW Noxious Weed Control Class 4
Labiatae	Mentha sp (spicata)	Mint	Garden escape
Moraceae	Morus sp	Mulberry	
	Parietaria judaica	Asthma weed/ Pellitory	NSW Noxious Weed Control Class 4
Poaceae	Pennisetum clandestinum	Kikuyu Grass	
Palmae	Phoenix canarinensis	Canary Is Date Palm	Environmental Weed
Fagaceae	Quercus rober	English Oak	Garden Escape/ planted?
	Robinia pseudoacacia	Robinia	Garden Escape
Euphorbeaceae	Ricinus communis	Caster Oil Plant/ Rice Plant	NSW Noxious Weed Control Class 4
Polygonaceae	Rumex sp (could be native	Dock	
Rosaceae	Rubus fruiticosa	Blackberry	
Compositae	Senecio mikanioides	Cape Vine	
Solanaceae	Solanum nigrum	Black Nightshade	
Compositae	Soliva pterosperma	Jo-Jo /Bindii	
Salicaceae	Salix babalonica	Weeping Willow	NSW Noxious Weed Control Class 5
Fabaceae	Tripholium repens sp	White Clover	
Tropaeolaceae	Tropaeolum majus	Nasturtium	Garden Escape
Compositae	Taraxacum officinale	Dandelion	
Commelinaceae	Tradescantia fluminensis	Wandering Jew	
Apocynaceae	Vinca major	Blue Periwinkle	
Verbenaceae	Verbena bonariensis	Purple Top	
Liliaceae	Yucca sp	Yucca	Garden Escape
Araceae	Zantedeschia aethiopica	Arum Lily	Environmental weed

Table 1: Weed species noted on site by Author 29th May 2009

2.8 The Proposed Development

The Catherine McAuley Secondary College and Marist Brothers Secondary College Proposal is a stage development based on the Masterplan DA (DA/853/2008) prepared by Thompson Adsett and JMD Design approved by Parramatta Council on 20/4/09.

The school campus is divided into four discreet schools catering to;

- Pre-school boys and girls
- Primary boys and girls (Years K to 6)
- Catherine McAuley Secondary College for girls (Years 7 to 12)
- Marist Brothers Secondary College for boys (Years 7 to 12)

The aim of these works is to cater for future student numbers and to provide a uniformed treatment throughout the school campus. The works in the vicinity of the Riparian area include the widening of the driveway from Darcy Road at gate 4 to the car park extension to allow for bus parking and pickup bay, additional car parking to facilitate a future childcare centre building, which does not lie within 40m zone of influence.

The proposed works are to be staged and developed in accordance with the master plan as the funding and school needs require. Figure 3 shows the proposed works in the Catherine McAuley High School Westmead Campus site. The effects of the proposed development on the existing riparian corridor can be described as follow;

- In Zone 1 & 2 the widening of the driveway from gate 4 off Darcy Road to allow for a bus parking lane adjacent to the riparian corridor embankment. This proposed widening of the road will dictate the removal the row of existing Eucalyptus trees. There will be no increase in grade of this embankment.
- In Zone 4 is proposed roadway to facilitate access to the proposed car park is to be suspended over the south eastern portion existing wetland which will be retained and supplemented for sediment control during construction works. Refer Northrop Engineers Stage 1 Soil and sediment Erosion Control Plan Dwg No. S1 C10.01 Issue C.
- In Zone 5 a temporary drop-off and bus turning will be provided for the duration of the construction period and will be removed on completion.
- The Area B remediation works proposed by EIS are :

- remove soil to minimum depth of 500mm
- cap area with a geo-barrier
- Reinstate the area with “clean “ natural soil
- Prepare a Plan of Management for this area

The Plan of Management (part 3 of the Green Corridors Management Strategy) prepared for the Upper Parramatta River Trust states that Parking facilities may be provided in association with the provision of recreation facilities on already cleared land in revegetation zones only. They shall be designed and constructed to minimise runoff and erosion and any other impact on the natural environment. The proposed work fall within acceptable uses of this land.

Figure 3: Proposed works plan (Thompson Adsett)

3. Vegetation Management & Rehabilitation Principles, Strategies, Activities, Performance Targets and Monitoring

3.1 Overview

The purpose of rehabilitation is to achieve environmental benefits through increase of the baseline environmental and landscape values of the site. To protect and restore the vegetated riparian areas of Milson Creek within the Westmead Campus to maintain and improve the geomorphic form and ecological functions of the watercourse. These principles are in alignment with the key objectives of the Upper Parramatta River Catchment Trust, Green Corridors Management Strategy prepared by Oculus, 1997.

In principle the approach to vegetation management and rehabilitation is to maintain and regenerate or reconstruct the original riparian corridor vegetation and to rehabilitate the areas which have been degraded through the proposed school development.

Milson Creek is categorised as a first order water course defined by the Water Management Act 2000 Guidelines for controlled activities: Riparian Corridors as a defined channel where water flows intermittently or permanently. The guideline recommends a core riparian zone of 10m for this type of watercourse with vegetated buffer of 10m and asset protection zone (as required by proximity to assets) before any built works. Refer APPENDIX A for full guidelines

The existing creek invert and batter are currently stable, therefore it is not proposed to carry out any weed management or revegetation works within the creek channel. All works proposed are on the eastern side of the creek above the creek bank and within the Catherin McAuley High School site.

The terminology used to describe the management and rehabilitation techniques are as outlined in the Department of Environment and Conservation (NSW) (DEC) publication Recovering Bushland on the Cumberland Plain, Best practice guideline for management and restoration of bushland, 2005.

The areas being considered in detail in this report comprise two (2) distinct categories:

a) Good quality planting which requires some bush regeneration triggers and as such the approach adopted for management is Regeneration through the removal of weed species to allow for natural regeneration of native species.

b) Existing highly disturbed zones, requiring compensatory planting to supplement and improve riparian vegetation. The native vegetation in this zone is considered depauperate with little potential for natural recruitment and low ecosystem resilience. The management regime proposed for this area is reconstruction through revegetation using local native species grown from propagules collected from local remnant or regrowth native vegetation to maintain local biodiversity.

The UPRCT Management strategy outlines three management zone; bush regeneration, bush restoration and revegetation. For the purposes of this report the terminology detailed in the DEC report has been adopted. The definition of bush regeneration is the process of restoring degraded bushland where resilience is depleted to a healthier condition… restoration focuses on repair and rehabilitation of degraded sites in order to reinstate ecological process and enhance biodiversity. The term bush regeneration is defined in a similar way to the DEC term Regeneration. The UPRCT definition of Revegetation is the planting or establishment of plants on a site with a variety of purposes and uses

whilst enhancing processes… in most cases revegetation will take place on land that is already cleared or extensively disturbed land. The term revegetation is defined in a similar way tot eh DEC term Reconstruction

Zone	Management regime
1	Reconstruction
2	Reconstruction
3	Reconstruction
4	Regeneration & Reconstruction
5	Regeneration & Reconstruction

3.2 Reconstruction of Riparian Corridor

The creek corridors can be broadly described in two way, Zones 1 to 3 are highly infested with weed species which out compete the native species which have resulting in very limited pockets of native vegetation. The nature of the vegetation within the creek corridor and the low level of species resilience has required the management regime proposed for this area to be reconstruction by revegetation with a fully structured suite of locally native species (ie trees, shrubs, groundcovers and grasses).

DEC (2005) define “Reconstruction” as being: where more active steps of planting out stock of native seedlings and/or reseeding are undertaken to start the process of native plant restoration.

Approach

Reconstruction relies on building upon the remaining elements of a damaged ecological system such as original soil profile with possible partially intact seed bank, remnant vegetation elements, and intact hydrological character. These conditions are present within the Milson Creek area with the added driving factor of providing a buffer between the proposed carpark and the Milson Creek Core Riparian Zone.

By combining regeneration techniques with revegetation a more rapid ecological restoration may be achieved.

3.2.1 Reconstruction Principles

The vegetation management of the Creek aims to:

- Protect existing native vegetation and ensure the survival and enhancement of the ecological communities scheduled under the TSC Act 1995;
- Increase biodiversity and habitat potential, protect and enhance the riparian ecosystem;
- Minimise impacts of the landfill operation on the creek ecosystem and remnant ecological communities;
- Enhance the visual quality of the floodplain landscape to improve the capacity of those areas to ameliorate the visual impacts of the landfill operations;
- Address General terms of approval issued by the Department of Water and Energy
- Comply with DWE Guidelines:

- Vegetation Management Plan (February 2008),
- Riparian Corridors (February 2008)
- Outlet structures (February 2008)
- Watercourse crossing plans (February 2008)

3.2.2 Reconstruction Strategies

- Erect appropriate fencing and signage to ensure all personnel working on site do not unknowingly compromise the Riparian Protection Area;
- Actively control weeds in a zone along the edges of the riparian corridor where there is potential for weeds to further invade the riparian vegetation;
- Carry out weed control using qualified and experience personnel;
- Carry out follow-up weed control using minimum impact bush regeneration techniques to encourage natural recruitment and ensure the successful establishment of native vegetation along the edge of existing riparian areas;
- Remove weed using accepted techniques including manual removal or spot spraying with herbicide;
- Remove rubbish from areas from CPW areas and dispose of it in operating landfill areas;
- Consider leaving fallen wood that is acting as habitat for native wildlife in place until alternative habitat is created through the establishment of regenerating vegetation;
- Establish appropriate native species, especially groundcovers, to stability soil where existing groundcovers is poor and natural recovery unreliable;
- Establish plantings as soon as possible after weed removal to avoid potential erosion; and
- Use mulch or erosion control fabric in areas subject to water flow in the short -term to minimise soil erosion.

3.2.3 Reconstruction Activities

A. Collection & Propagation of Locally Native Species

The Contractor shall arrange for seed/ propagule collection from site and neighbouring riparian corridors with relevant remnant bush in parkland along Toongabbie Creek within 10 km of site. The contractor is responsible for gaining all necessary approvals including application for a scientific licence DEC (NPWS) 132C to procure seed/propagule material for propagation purposes.

Plant material shall be collected in accordance with the guidelines developed in "Model Code of Practice for Community-Based Collectors and Suppliers of Native Plant Seed" as prepared by FloraBank (www.florabank.org.au).

Sufficient seed/plant propagule quantities shall be collected and stored to allow for plant failures.

Seed/plant propagation material shall be stored properly for type of seed and plant propagule to preserve the viability of the seed material.

B. Primary Weeding

Primary weeding is the first stage of reconstruction works. Primary weeding may involve techniques such as: the selective spraying of weeds with herbicides and follow up spraying of naturalised grasses; cutting/scraping and painting deep rooted woody weeds and climbers with hand tools, chainsaws and brushcutters and painting cut stumps with herbicide; target drilling and injecting naturalised shrubs and trees and selective hand removal of weeds.

These selective techniques are focused on avoiding disturbance to remnant native plants and to soil stored seed banks.

The proposed works have been staged to minimise areas of exposed soil prone to erosion, ensuring the long term success of the planting.

C. Maintenance Weeding

It can be expected that the study area site will always require a certain level of bush regeneration maintenance weeding, as weed seeds and vegetative propagules make their way on site from the soil stored seedbank, and via floods, wind and bird droppings. However, it can be expected that, the amount of weeding required will decrease once the planted locally native plants grow and with assistance from natural recruitment become more resistant to disturbance and weed colonisation. The most vulnerable edge will be the edge to the creekline , particularly in Zones 1-3 where the creekline is badly infested with vigorous weeds.

Maintenance weeding levels within the site should be in related to the amount of natural recruitment that occurs in the area.

Site preparation and planning

DWE attributes good ground preparation and pre-planting weed control are the most important factors for ensuring the survival of planted tubestock. Erosion control measures including silt fencing need to be undertaken limit sediment movement weeds have been removed. The planting of fast growing locally native colonising species including Acacia sp. And other legumes, grasses, sedges and groundcovers spread by vegetative means

Mulching of area in the riparian corridor is recommended to conserve moisture while plants are establishing. The best mulch is the original leaf little however it is unlikely that sufficient quantities will be available in the Milson Creek corridor within the Westmead Campus. Alternatively site chipped material or a suitable recycled product may be used.

Tree guards are recommended to protect seedlings from fauna such as rabbits and extremities of weather.

D. New Vegetation

Local native Cumberland Plain Woodland plant communities structure needs to be maintained or re-established through the entire riparian corridor. Figure 4 illustrates a typical riparian cross section (take from VMP Guidelines p.1)

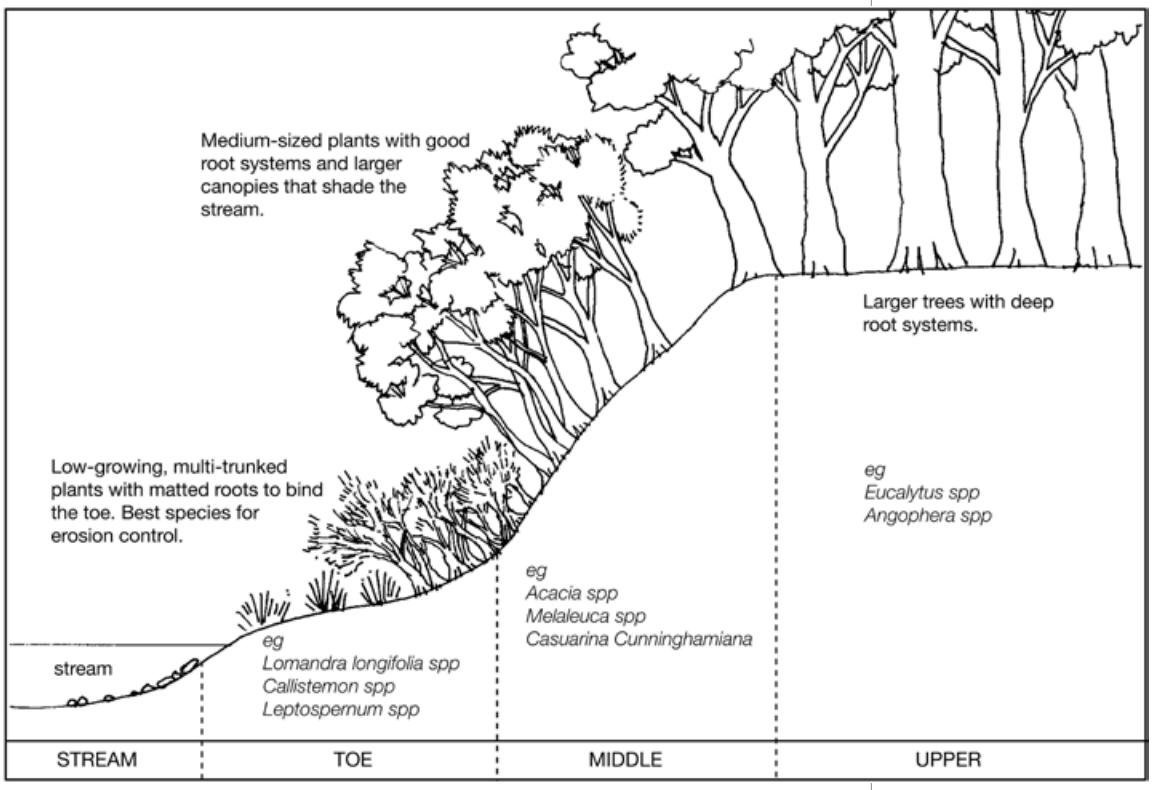

Figure 4: Typical riparian cross section
(Source: Department of Energy and Water Feburary 2008)

Trees are proposed to be planted to achieve a final density of 1 per 16 square metres. Shrubs should be planted to achieve a final density of 1 per 2 square metres. Groundcovers should be planted to achieve 6 per square metre. Plants are to be arranged to create the complex layering which mimics the structure of the naturally occurring in plant association with canopy species, shrub and grassy herbaceous understorey. Plant a mixture of locally native tree and shrub species during autumn in mulched areas where weeds have been removed (refer plans) within the works area. Within Sydney, autumn provides the most favourable soil moisture levels and soil temperatures ideal for plant growth (Buchanan, 1999);

It is recommended that plant species characteristic of the Shale / Sandstone Transition Forest (SSTF) community (refer Appendix B) are planted above the creek batters as species of this community generally prefer elevated/dry areas. Species characteristic of the SCRFF community are generally water tolerant and as such should be planted in these areas. A list of species characteristic of the SCRFF community and recommended for use in these areas is located in Appendix B.

Plant trees, shrub and groundcovers species in autumn (between March and August) to fabricate native vegetation communities on selected locations in the riparian corridor as illustrated in Planting Plans APPENDIX C. Planting shall be undertaken primarily on the side slopes of the mounds.

Establish a polythene or recycled cardboard tree guard around each plant to facilitate the use of herbicides in maintenance, to protect young plants from weed invasion and damage by fauna and to facilitate monitoring of plant survival rates. Plant guards can also assist in rapid plant growth by acting as a miniature glass house.

E Skill levels to Implement Reconstruction Works

Experienced and qualified (TAFE bushland regeneration certificate iv or ii), bush regeneration contractors should be engaged to implement the any bushland regeneration works.

The removal of sized small trees and smaller woody weeds can be undertaken by appropriately certified bush regenerators with Chainsaw Operator Level 2 qualifications.

Planting works should be undertaken by a qualified horticulturist.

F. Rubbish Removal

During reconstruction and maintenance works all non-compostable domestic and industrial rubbish items that have accumulated over a long period of time at the study site should be removed and deposited at the waste transfer station, in a one-off event, prior to the implementation of the reconstruction activities.

If fauna is observed on the site, contact a local organisations such as WIRES or the Sydney Metropolitan Wildlife Services to remove this fauna from rubbish habitat during the proposed rubbish removal phase of the site works.

G. Mitigating the Impacts of Proposed Reconstruction and Associated Works on Fauna Habitat

Proposed reconstruct works, which will involve the removal of non- SSTF plant species, should be implemented in a manner that will preserve some of these species if they are providing temporary fauna habitat for locally native fauna, until a greater density of SSTF plant species have replaced habitat niches. In general, the preservation of fauna habitat has been a major consideration in determining the extent of proposed primary weeding works and relevant timing of these work.

In general, the proposed reconstruction works outlined in this report is expected to have a medium to long term positive impact on the locally native fauna through providing increased areas of habitat and linking sections of habitat..

Specifically, the following fauna habitat conservation measures should be implemented during proposed bush regeneration works:

- Any trees or shrubs with existing birds nests or possum dreys should not be removed in the initial bush regeneration works period. Weedy trees and shrubs with nests can be treated once the nests or dreys have been vacated. It is preferable that these vacated nests and dreys are removed prior to treating weeds and replaced in adjoining native trees or shrubs for potential utilization in following seasons;
- Limit the extent of physical woody weed removal in spring to minimise impacts on nesting native bird species, as required;

- Leaving and laying local habitat resources such as felled local weed tree logs (no more than 10%) and hollow tree logs for local terrestrial fauna habitat elements within the SSTF remnants and adjoining areas. Excessive stacking of such material should be avoided, so that SSTF regeneration is not inhibited and not to pose an OH & S risk for people working on the remnants;
- Ensure that fauna, particularly reptiles are given maximum opportunity to escape from rubbish material habitat during the proposed rubbish removal phase of the site works. It may be necessary to contact local organisations such as WIRES or the Sydney Metropolitan Wildlife Services to remove this fauna from rubbish habitat during the proposed rubbish removal phase of the site works; and
- Herbicides not registered for use near waterways should not be applied in the lower sections of the riparian zone to protect native fish and amphibian species.

3.2.4 Reconstruction Performance Targets and Monitoring

A. Facilitate Natural Recruitment

Performance

The targets for the proposed reconstruction works consist of the following:

- Minimise, limit or eliminate identified threats affecting the health of remnant SSTF which inhibit the regeneration potential of the plant communities. Including limiting machinery access, rubbish accumulation and reducing weed infestation;
- Increase ecological connectivity by removing invasive weeds such as Arundo donax which inhibits passage;
- Eradicate all mature woody weeds in stages Target: 100% reduction in woody weeds in 2 years;
- Reduce the extent of and suppress the regrowth of woody weed and noxious weeds throughout the management period. Target: 100% elimination of noxious weeds in 3 years;
- Reduce the extent of flowering and seeding annual and perennial grasses and herbaceous weeds in areas treated to primary and follow-up weeding strategies throughout the management periods. (NB: It is recognised that grasses and herbaceous weed species can not be fully eradicated in the 2 year management period). Target: 30-50% reduction in annual and exotic grasses in 3 years;
- Increase the percentage cover of local provenance SSTF plant species. Supplement natural recruitment with revegetation with local provenance plant stock, using full structure of ecosystem species (ie trees, shrubs, groundcovers and grasses). Target plant densities are to consist of 1 tree per 16 square metres, 1 shrub per 2 square metres and 6 groundcovers per square metre; and
- Remove fill and other rubbish from the site in a one-off clean up by the end of year 1, (using techniques that minimise disturbance to remnant native vegetation and fauna).

Monitoring

- To monitor the response of SSTF and SCRFF and weed species to recommended restoration treatments on a regular basis through:
  - Maintain a species list for the site of flora and fauna noted - update every 6 months,
  - Establish a number of representative quadrants (10m x 10m) at suitable points within riparian corridor for the duration of the monitoring period to review progressive performance through number of native plant species and weed species, and
  - Review progress of weed removal and regeneration for whole Riparian Zone - review annually;
- To keep an accurate record of works undertaken at all SSTF and SCRFF and surrounding sites to assist with determining future restoration treatments.

Review extent of weed infestations- annually; and

- Comparison of photographic records over time to monitor native plant recruitment in quadrants.

B. Seed Collection & Plant Propagation

Performance

- Required quantities and species of local provenance seed as outlined in drawings in Appendix C in collected and stored to NPWS & Florabank guidelines held and dedicated to the Catholic Education Office at Westmead.

Monitoring

- Report on seed stocks for use on the subject site -every 12 months; and
- Report on nursery(s) stocks in relation to site requirements - every 6 months.

C. Establish New Vegetation

Performance

- Increase percentage cover of SSTF plants within riparian corridor to be evident in 5 years;
- Plant survival rates in new revegetation is greater than 80% after 5 year; and
- Plant densities are to consist of trees planted to achieve a final density of 1 per 16 square metres. Shrubs should be planted to achieve a final density of 1 per 2 square metres. Groundcovers should be planted to achieve 6 per square metre are established after 5 years.

Monitoring

- To monitor the response of SSTF and weed species to recommended restoration treatments establish transect lines or quadrats in representative locations for the duration of monitoring, record occurrence of natural recruitment, planted species growth and survival rates, weed occurrence - Inspect every 6 months.

D. Maintain Vegetation

Performance

- Plant survival rates in new revegetation is greater than 80% after 24 months; and
- Revegetation is at a competitive advantage and competitive weed species are controlled for at least 24 months from the date of planting.

Monitoring

- Inspection established transect/ quadrants and to record occurrence of natural recruitment, planted species growth and survival rates, weed occurrence - every 2 months (scaled down after 2 years to annual inspections); and
- Overview performance by visual assessment via aerial photo comparison – every 12 months.

E. Riparian Protection

Performance

- Successful regeneration in the Riparian Environment Buffer Area;
- Reduction in vigour of weeds in the buffer zone; and
- No increase in creek line erosion.

Monitoring

- As for maintaining vegetation above;
- Inspect creek line and assess sediment deposition and erosion occurrences,

update every 6 months; and
- Rubbish occurrence ; update every 6 months.

F. Water Quality

Performance
- Maintain or improve the water quality recorded by the Upper Parramatta River Catchment Trust (UPRCT) for the two test sites within the study area described as 'wetland' and 'downstream school wetland' (see www.waterwatch.nsw.gov.au)

Monitoring
- Inspect and sample water quality using the senior waterwatch methodology as outlined by the UPRCT every 6 months.

3.3 Rehabilitation Regraded & Filled Land

Approach

The riparian corridor is in a degraded condition following years of neglect and subsequent regrading to facilitate a flat playing field adjacent to the riparian corridor. The Catholic Education Office has developed a masterplan for the school campus which will be implemented over the next decade as students numbers increase and demand for the facilities necessitates their development.

The dilapidated nature of the riparian corridor increases the risk of erosion and sedimentation of Milson Creek if careful treatment strategies are not in place. It is not intended at this tine the treat the creek channel proper. At no time will there be large areas of bare soil left exposed.

The rehabilitation of the riparian corridor will occur in three (3) stages, those stages can be outlined as follows;
Stage 1 - removal of woody noxious weeds, using the cut and paint technique which allows the woody roots to be left in place to stabilise the embankment.
Stage 2 – Rehabilitation of riparian areas upstream Zones 4 & 5;
Stage 3 – Rehabilitation of wetland and riparian areas in Zones 1,2 & 3

The staging of these works will result in an overall establishment of vegetation communities which contributes to the long term rehabilitation goals of the site and is compatible with future uses on the site. There is an opportunity for the school to use riparian corridor as an outdoor environmental education lesion for the students of Catherine McAuley and Marist Brothers High Schools, instilling the environmental value of riparian corridors, biodiversity and connectivity with the wider environment.

3.3.1 Rehabilitation Principles

The rehabilitation of the riparian landfill aims to:
- Make a positive visual and environmental contribution to the local landscape;
- Provide a buffer between the school and riparian corridor;
- Achieve environmental benefits through increase of the baseline environmental and landscape values of the site;
- Address the general terms of approval requirement for the preparation of a Landscape Rehabilitation Plan and Vegetation Management Plan Conditions 3 and 4

The altered landform adjacent to the creek and high percent of weed species in the creek resulting adjacent development in the school property and proposed future development requires a reconstruction approach to vegetation which will be installed.

3.3.2 Rehabilitation Strategies

A. Stabilise Soil Profiles

- Maintain soil cover throughout works and during weed removal to minimize erosion potential;
- Install soil profile of sufficient depth for successful plant establishment and long term survival;
- Combine required additives at time of planting; and

B. Maintain Drainage and Erosion Control Structures

- Prevent weed seed and high nutrient content sediment entering the riparian zone and creek within the site;
- Repair and maintain all drainage and erosion control structure on the landfill mounds, roads, tracks and stockpile areas; and
- Monitor and control new weed establishment.

C. Seed Collection & Plant Propagation

- Grow plants from seed collected from local provenance propagules;
- In acknowledgment of the highly degraded site conditions consider a range of locally native plant species that have the potential to achieve stated objectives;
- Formulate plant species planting list of hardy locally native species; and
- Propagate trees, shrubs and groundcovers in an off site nursery with experience in growing plants for revegetation.

D. Planting

- Use compost to increase soil organic content in preparation for final planting works;
- Establish plantings as soon as possible after weed removal to avoid potential erosion; and
- Consider the use of mulch in the short term as a means of minimising soil erosion where planting is to occur.

E. Vegetation Maintenance

- Provide a level of maintenance that ensures the survival and growth of vegetation;
- At minimum control weeds and domestic escape species competition with planting within 1m radius of each plant for a period of not less than 24 months after planting; and
- Supply emergency irrigation to prevent unacceptable plant losses for not less than 24 months after planting. Ensure watering is infrequent and deep to encourage sustainable and well developed root systems.

F. Weed Control

- Maintain a list of target weed species and a list of potential weed species for the site;
- Record weed occurrences within the site and assign priority to weed control activities; and
- Minimise the off-target damage while applying the most effective weed control techniques to target weeds.

G. Unauthorized access and Feral Pest Control

- Protect rehabilitation planting from herbivorous animal pests by the provision of plant guards;
- Maintain boundary fences to exclude unauthorised pedestrian access from rehabilitation areas;
- Consult the Rural Lands and Protection Board (RLPB) for control measures before damage levels compromise the achievement of rehabilitation objectives.

H. Collection & Propagation of Locally Native Species

The Contractor shall arrange for seed/ propagule collection from site and from relevant bush remnants within 10 km of site. The contractor is responsible for gaining all necessary approvals including application for a scientific licence DEC (NPWS) 132C to procure seed/propagule material for propagation purposes. Where possible, seed should be sourced from remnant vegetation within 5 kilometres (km) of the site and not from beyond 10km of the site.

Plant material shall be collected in line with the guidelines developed in "Model Code of Practice for Community-Based Collectors and Suppliers of Native Plant Seed" as prepared by FloraBank (www.florabank.org.au). Seeds must be labelled and stored as set out in the Florabank Guidelines as relevant for type of seed and plant propagule to preserve the viability of the seed material. In this way seed with short-term viability can be kept for up to 5 years and many species kept for a decade. Fresh seed of species may need to be collected as viability declines in storage.

Suitable revegetation species are specified in APPENDIX B of this report. These species have been selected from the SSTF community and other relevant communities;

- Collect seeds for at least 24 months prior to the date of revegetation activities to allow a suitable range and quality of seed to be secured. Seeds must be labelled and stored as set out in the Florabank Guidelines (see Specification APPENDIX C). In this way seed with short-term viability can be kept for up to 5 years and many species kept for a decade. Fresh seed of species may need to be collected as viability declines in storage;
- Suitable revegetation species might also be considered from other Cumberland Plain vegetation communities, especially the SSTF and SCRFF communities (refer APPENDIX B) are planted. Shrub and groundcover species should be scattered throughout (see APPENDIX B);
- Grow plants in a grow-tube or equivalent container;
- Allow approximately 26 weeks from germination to planting date. Grow enough trees and shrubs to achieve a density of 1 per hectare; (As scheduled in APPENDIX C)
- Ensure that seeds are propagated and grown under conditions similar to those experienced at the Westmead Campus. This will ensure that the plants will be able to cope successfully with their new environment; and
- Grow 50% more plants than the required amount each year to cover unexpected losses in the field. Unexpected failure in the nursery of one or more species, and to have excess plants available to enable the early programming of works if good conditions prevail.

I. New Vegetation

- Tree planting should achieve a final density of 1 per 16 square metres. Shrubs should be planted to achieve a final density of 1 per 2 square metres. Prepare planting sites by removing existing weed cover, limit works area to ensure the risk of soil erosion is not increased;
- Plant a mixture of locally native tree and shrub species during autumn in mulched informally arranged blocks (refer plans). Within Sydney, autumn provides the most favourable soil moisture levels and soil temperatures ideal for plant growth (Buchanan, 1999);
- It is recommended that plant species characteristic of the SSTF and SCRFF communities (refer APPENDIX B) are planted. Shrub and groundcover species should be scattered throughout the area in order to create a divers and well-structured community; and

- Where water tolerant plants are recommended to be planted on the creek banks. Species characteristic of the SCRFF community are generally water tolerant and as such should be planted in these areas. A list of species characteristic of the SCRFF community and recommended for use in these areas is located in APPENDIX B.
- Establish a polythene or recycled cardboard tree guard around each plant to facilitate the use of herbicides in maintenance, to protect young plants from weed invasion and damage by rabbits/hares and to facilitate monitoring of plant survival rates. Plant guards can also assist in rapid plant growth by acting as a miniature glass house.

J. Maintaining Vegetation

The level of maintenance applied to revegetation is a strong determinant of the survival and growth rate. The specific nature and timing of maintenance is determined by the season, the prevailing environmental conditions and the weed species present on a site. It is important that maintenance supports the rehabilitation objective.

Removing exotic/invasive groundcover plants to reduce competition to revegetation must be balanced against maintaining the overall stability and manageability of the site.

Supply emergency watering to prevent unacceptable losses for 24 months from planting. Watering should be deep and infrequent in order to ensure plants develop a strong sustainable root system.

Mulch can act as a weed suppressant, minimise soil erosion and conserve moisture levels in the ground. Maintain a 75mm layer of mulch along ripped rows as shown on plan until plants are established. (Refer Appendix C)

Performance Specifications

Vigorous grasses and broadleaf weeds growing in proximity to revegetation species can compete for water, nutrients and sunlight. The maintenance program should control grasses and broadleaf weeds before they reach maturity:

- Weeds should be controlled within 1m of the revegetation. Weed control can be achieved by periodically applying herbicides via rope wick applicator or spray equipment. Herbicides should be chosen to be effective on the target plants and have the lease environmental risk. Glyphosate herbicides are most commonly used. However, selective herbicides are useful in targeting broadleaf weeds such as Scotch Thistle at the rosette stage;
- The standard for weed control relates to the survival and growth rate for the revegetation. Bare earth weed control is not relevant in this situation. Weeds need to be treated before they impact on growth and survival rates of the revegetation. Weeds should be prevented from producing seed;
- Herbicide should be applied to the same confined area each time. Wider application of herbicide is likely to “open up” new areas to weedy species that are adapted to germinate post disturbance; and
- Some species, such as Couch in winter months may be tolerated within the weed control area if they are slow growing or shallow rooted. The presence of these weeds may help prevent the establishment of more vigorous or more intransigent species, thus reducing the need to use herbicides.

K. Noxious and Environmental Weed Control

Legislation concerning weeds is covered by the Noxious Weeds Act 1993. The Act is administered by NSW Agriculture with Local Control Authorities (eg. local councils) responsible for implementing noxious weed control functions of the Act. Private

landowners and managers are responsible for control of noxious weeds on their land to prevent spread to other lands.

An Environmental Weed is not necessarily a "noxious weed" but is a plant that by virtue of its fecundity and growth habit has the potential to establish large infestations that dominate and eventually exclude the native vegetation and other desirable vegetation.

Performance Specifications

- Personnel must have skills and qualifications that enable them to correctly identify target and non-target species;
- Personnel must be trained in correct control methods, especially the use and application of chemical herbicides and non chemical control techniques;
- Selective herbicides are designed to work on a specific group of plants. The correct choice of herbicide may improve control of target species and minimise off-target damage. For example: metasulfuron methyl applied to blackberry will not kill grasses beneath the briar; and
- Non selective herbicides such as Glyphosate should be used in carefully controlled application to minimise off target damage as these kill all plants to which they are applied.

L. Feral Pest Control

Rabbits and hares, can inflict damage to regeneration. Foxes, cats and wild dogs are major threats to native wildlife and recreation use.

Consult the Rural Lands Protection Board for control measures before damage levels compromise the achievement of rehabilitation objectives.

3.4.4 Rehabilitation Performance Targets & Monitoring

The targets for the proposed reconstruction works consist of the following:

A. Maintain Drainage and Erosion Control Structures

Performance

- Temporary sediment control structures (eg sediment control fences, straw bales, geofabric barriers) should be installed on site prior to the commencement of excavation and should be adequately maintained until completion of rehabilitation works;
- Water entering Toongabbie Creek is of an acceptable quality in relation to sediment and nutrient load;

Monitoring

- Water quality assessment in accordance with environmental protection licence;
- Inspect sediment control structures--every 2 months or more frequently if required – after any significant rain events; and
- Note occurrences of surface ponding one week after storm events.

B. Seed Collection & Plant Propagation

Performance

- Required quantities and species of local provenance seed as outlined in Appendix B in collected and stored to NPWS & Florabank guidelines held and dedicated to CEO Westmead; and
- Dedicated plant stock in the nursery(s) grown from the certified local provenance seed and total stock in nursery(s) is between 125% and 150% of requirements at the commencement of planting.

Monitoring

- Report on seed stocks for use in CEO Westmead -every 12 months; and
- Report on nursery(s) stocks in relation to site requirements - every 6 months.

C. Establish New Vegetation

Performance

- Improved visual fit of Riparian corridor landscape within the surrounding landscape to be evident in 2 years;
- Improved capacity of the landscape to absorb the riparian landscape to be evident in 2 years;
- Plant survival rates in new revegetation is greater than 80% after 2 year; and
- 1 stems per 16 square metres (trees) 1 stem per 2 square metres (shrub) are established after 2 years.

Monitoring

- To monitor plant performance and weed occurrence establish transect lines or quadrats in representative locations for the duration of monitoring, record occurrence of any natural recruitment, planted species growth and survival rates, weed occurrence - Inspect every 6 months; and
- Overview performance by visual assessment via aerial photo comparison – every 12 months.

D. Maintain Vegetation

Performance

- Plant survival rates in new revegetation is greater than 80% after 24 months; and
- Revegetation is at a competitive advantage and competitive weed species are controlled for at least 24 months from the date of planting.

Monitoring

- Inspection established transect/ quadrants to record weed occurrence in revegetation areas throughout the site - every 2 months (scaled down after 2 years to annual inspections); and
- Overview performance by visual assessment via aerial photo comparison – every 12 months.

E. Weed Control

Performance

- Reduction in extent and abundance of target weeds;
- Resources required for weed control diminishing in any given area over 2 years; and
- Reduction of the impact (ecological and visual) of target weeds.

Monitoring

- Visual assessment – every 6 months; and
- Monitor to record presence/absence of target weeds - every 6 months.

F. Feral Pest Control

Performance

Revegetation is not impacted by feral pests.

Monitoring

Assess damage to revegetation and grasslands – every 6 months; and
Visual inspection of sites for evidence of pests, scratchings, excavations, scats and tracks.

3.4 VEGETATION MAINTENANCE, WATERING, WEED AND PEST CONTROL

3.4.1 Maintenance & Management Regimes

Plant Establishment & Maintenance will be carried out by the landscape or bush regeneration contractor for a two-year period.

VEGETATION MANAGEMENT TASK	MONTHLY MONITORING/ **ACTIVITIES**	BIMONTHLY MONITORING/ ACTIVITIES	6 MONTHLY ACTIVITIES	YEARLY ACTIVITIES
Plant Replacements	As required for two year establishment period		Supplement mulch in years 1 – 2	Recurrent if required
Weeding	As required for two year establishment period	As required for Years 1 - 2		Recurrent if required
Watering	As required for two year establishment period			
Mulching			Supplement mulch in years 1 – 2	
Pest & Disease Monitoring	As required for two year establishment period	As required for Years 1 - 2		Recurrent
Attack of vegetation by rabbits/hares, birds etc		Monitor and record occurrence		
Vandalism		Monitor and record occurrence		
Storm events	Additional inspection on occurrence			

The Landscape Contractor shall submit reports every six moths during the two-year maintenance period addressing the above issues.

3.4.2 Monitoring and Review of Terrestrial Vegetation

A monitoring program will be carried out by a suitably trained organisation to provide data for maintenance and establishment program including plant replacement, weed control and pest & disease control. Vegetation establishment to be monitored and reviewed over a period of 2 years initially. Annually review of performance and procedures and amend as necessary.

SPECIFIC PERFORMANCE MEASURES AND MONITORING OF TERRESTRIAL VEGETATION

AREA	PERFORMANCE MEASURES	METHOD AND PARAMETERS	FREQUENCY OF MONITORING	RESPONSIBILITY
Planting of trees, shrubs & grasses	Establishment of vigorous growth of trees, shrubs and grasses	Establishment of 1 tree or shrub per 1m² or 4 grasses per m²	Initial recording at time of planting 2 monthly assessment and reporting immediately after each storm event	Bushland Supervisor
Weed control	Control weed infestation to satisfactory levels	Nil Noxious Weeds 20% Visible Perennial Weeds 20% Visible Annual Weeds	Initial treatment at time of planting 2 monthly assessment and reporting immediately after each storm event	Bushland Supervisor
Pest and disease control	Control pests and diseases to satisfactory levels utilising integrated pest management strategies	20 – 30% Visible Damage	2 monthly assessment and reporting immediately after each storm event	Bushland Supervisor

4. Rehabilitation Staging

This section outlines a staging for the rehabilitation works to be undertaken on the Westmead Campus Milson Creek Riparian corridor site.

Figure 5 provides a staging of the works for the rehabilitation of the riparian corridor indicating the sequence of work to be undertaken.

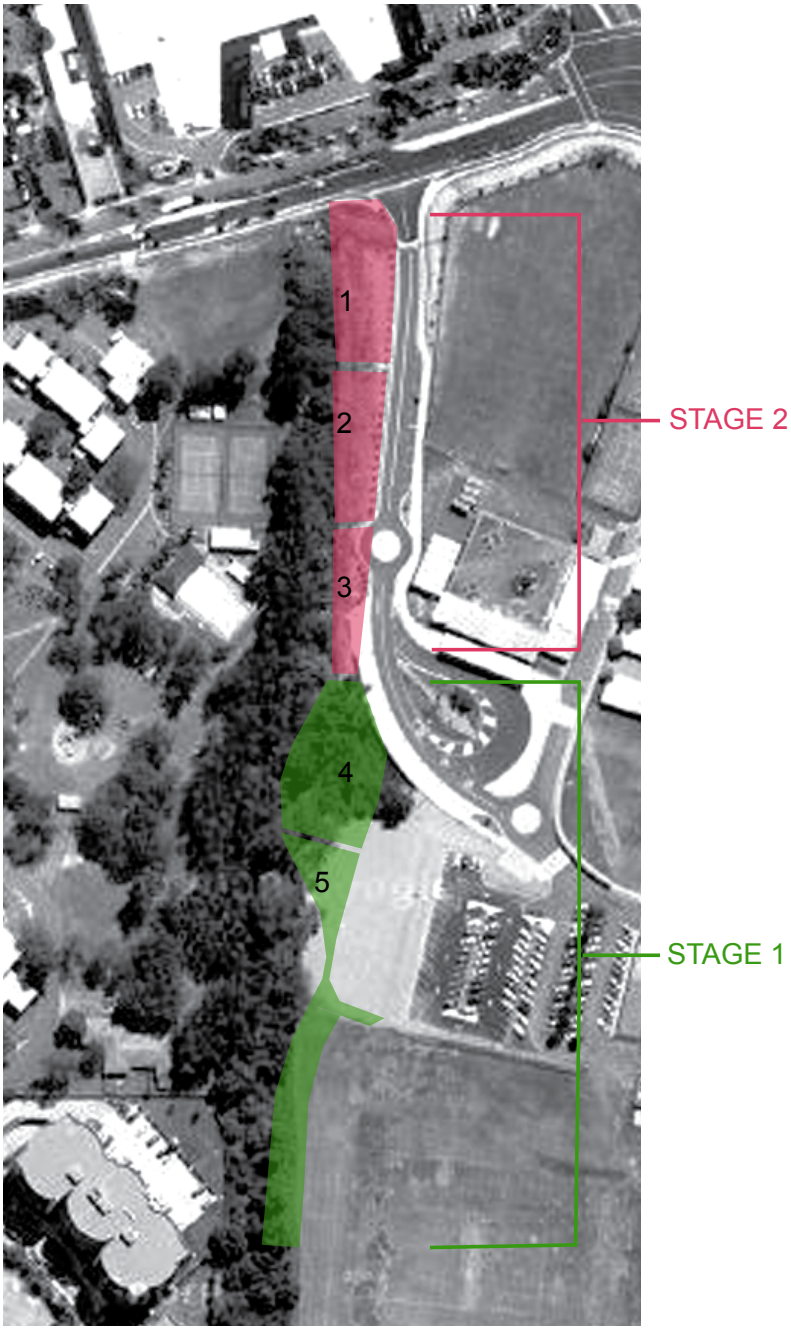

Figure 5: Proposed staging for rehabilitation works

JMD design

Catherine McAuley & Parramatta Marist High Schools

APPENDIX A

Water Management Act 2000 - Guidelines for controlled activities

December 2009

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Guidelines for controlled activities
Vegetation Management Plans

Controlled activities carried out in, on or under waterfront land are now regulated by the *Water Management Act 2000* (WMA). The Department of Water and Energy is required to assess the impact of a controlled activity to ensure that minimal harm will be done to any waterfront land, ie the bed and a distance inland of 40 metres from a river, lake or estuary.

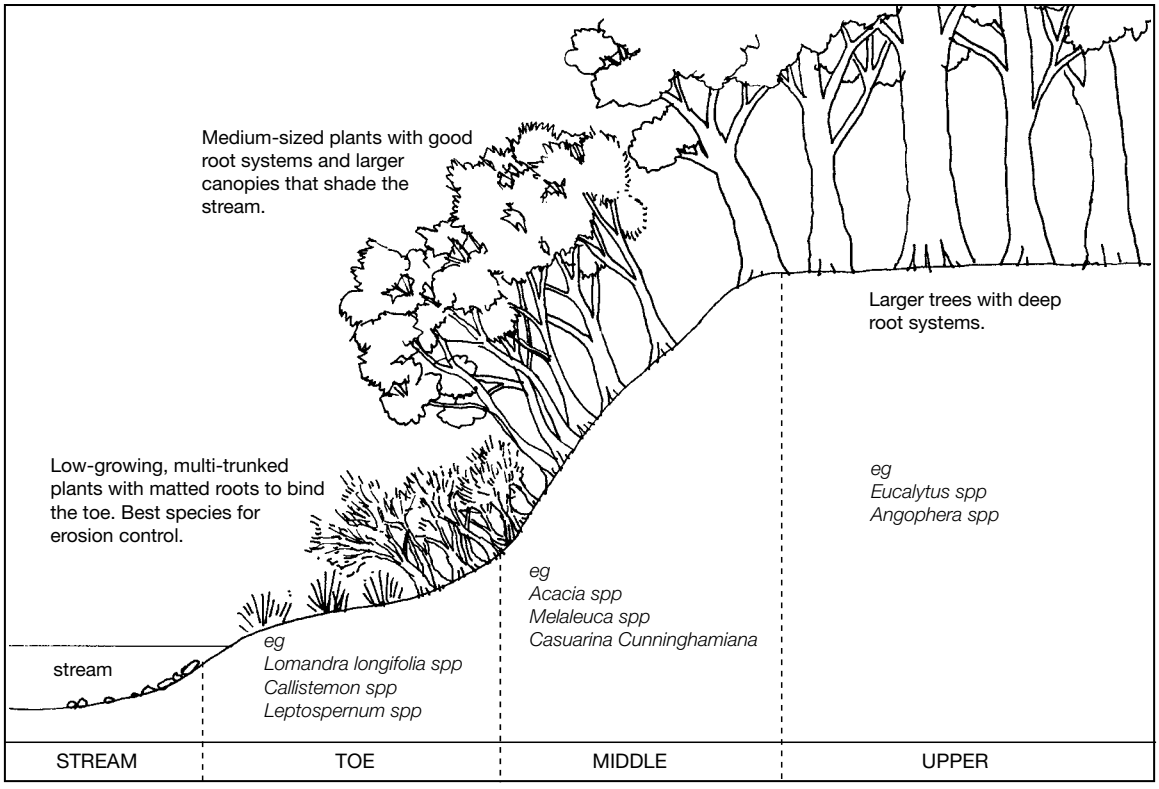
This means that a controlled activity approval must be obtained from the Department prior to carrying out a controlled activity.

Riparian corridors form a transition zone between terrestrial and aquatic environments and perform a range of important environmental functions. The protection or restoration of vegetated riparian areas is important to maintain or improve the geomorphic form and ecological functions of watercourses through a range of hydrologic conditions in normal seasons and also in extreme events.

A Vegetation Management Plan (VMP) which outlines the criteria for the establishment and management of a riparian corridor may be required to be prepared and submitted to the Department for assessment and approval prior to the issuing of a controlled activity approval for works in or within 40 metres of a river, lake or estuary.

The objective of a VMP is to provide for a stable watercourse and riparian corridor which emulates the native vegetation communities in the area. Figure 1 illustrates a typical riparian cross section.

Figure 1. Typical riparian cross section



Adapted from *Rivercare: Guidelines for Ecological Sustainable Management of Rivers and Riparian Vegetation:* Raine, A.W & Gardiner, J.N, (1995), LWRRDC, Canberra.

NSW Government
Department of Water & Energy

A VMP should be prepared by a suitably qualified person and should consider but not be limited to the following criteria:

- An appropriate width for the riparian corridor should be identified in accordance with the Department's *Guidelines for controlled activities – Riparian corridors*. The VMP should consider the full width of the riparian corridor and its functions including accommodating fully structured native vegetation.
- The location of the bed and banks or foreshore of waterfront land and the footprint of the riparian corridor should be clearly identified.
- Measures for controlling access and encroachments (bollards, fences, etc.) into the riparian corridor should be identified.
- Vegetation species composition, planting layout and densities should be identified. Plantings should emulate the ecotone of vegetation naturally or previously occurring along the waterfront land. Mature vegetation communities are generally well structured, comprising trees, shrubs and groundcover species. The required mix of these species relates to the actual community to be emulated and the size of the area/s to be rehabilitated. Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse.
- Seed/plant sources should be identified and where possible native plants and seed sources of local provenance should be utilised.
- Exotic vegetation should be avoided. Use of exotic species for the purposes of temporary soil stabilisation is permitted provided they are sterile, non-invasive and easily eradicated when permanent vegetation is established.
- Details of the planting program, rehabilitation methods and staging should be provided. Other revegetation techniques such as hydro-seeding, direct seeding, brush matting or assisted natural regeneration may be considered.
- Maintenance requirements should extend for a minimum of two years after the completion of works or until such time as a minimum 80% survival rate for all plantings and a maximum five percent (5%) weed cover for the treated riparian corridor (controlled activity) is achieved.
- Project tasks should be defined and described, including a schedule detailing the sequence and duration of works necessary for the implementation of the VMP.
- Maps or diagrams which identify the proposed riparian area, existing vegetation, vegetation to be retained, vegetation to be cleared, footprint of construction activities, areas of proposed revegetation etc should be prepared.
- Photographs of the site should be supplied and photo points should be identified for future monitoring and reporting purposes. The photo points should be identified by GPS coordinates or by survey particularly for large scale earthworks or extractive industries.
- Costings for the implementation of all components and stages of the work including materials, labour, watering, maintenance, monitoring and reporting, etc should be prepared.
- Processes for monitoring and review, including a method of performance evaluation, should be identified. This should include assessing the need for replacing plant losses, addressing deficiencies, problems, climatic conditions, successful completion of works, etc.

Further information

If you require more information about controlled activity approvals please contact your local DWE office or visit our website www.dwe.nsw.gov.au

Important notes

DWE has prepared these guidelines in good faith. In the case of any inconsistency between the guidelines and the controlled activity approval or legislation, the controlled activity approval or legislation will prevail to the extent of that inconsistency.

Nothing in these guidelines is taken to authorise a controlled activity. These guidelines are designed to provide information to assist in the design of any development or work that constitutes a controlled activity and the preparation of an application for a controlled activity approval. Users are advised to seek professional advice and to refer to the legislation and any relevant approvals, as necessary, before taking action in relation to any matters covered by the guidelines.

Disclaimer

While every reasonable effort has been made to ensure that this document is correct at the time of publication, the State of New South Wales, its agencies and employees, disclaim any and all liability to any person in respect of anything or the consequences of anything done or omitted to be done in reliance upon the whole or any part of this document.

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Catherine McAuley & Parramatta Marist High Schools

APPENDIX B

NPWS - Plant Species List

December 2009

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Cumberland Plain Woodland in the Sydney Basin Bioregion - proposed critically endangered ecological community listing

NSW Scientific Committee - preliminary determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Preliminary Determination to support a proposal to list the Cumberland Plain Woodland in the Sydney Basin Bioregion as a CRITICALLY ENDANGERED ECOLOGICAL COMMUNITY on Part 2 of Schedule 1A of the Act and as a consequence, to omit reference to Cumberland Plain Woodland from Part 3 of Schedule 1 (Endangered Ecological Communities) of the Act. The listing of Critically Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Cumberland Plain Woodland was listed as an Endangered Ecological Community under the *Threatened Species Conservation Act* 1995 in June 1997 (NSW Scientific Committee 1997). Since this listing, a large volume of new data and analyses have become available. In addition, a nomination to change the status of Cumberland Woodland to Critically Endangered status has been received. This Determination addresses additional information now available in accordance with current listing criteria under the *Threatened Species Conservation Regulation* 2002.

2. Cumberland Plain Woodland is the name given to the ecological community in the Sydney Basin bioregion associated with clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain, a rainshadow area to the west of Sydney's Central Business District. The mean annual rainfall of this area is typically in the range of 700-900 mm, and is generally lower than that received on more elevated terrain that partially surrounds the Plain. The community typically occurs on flat to undulating or hilly terrain up to about 350 m elevation but may also occur on locally steep sites and at slightly higher elevations. Cumberland Plain Woodland is characterised by the assemblage of species listed in paragraph 3 and typically comprises an open tree canopy, a near-continuous groundcover dominated by grasses and herbs, sometimes with layers of shrubs and/or small trees. Shrubs may sometimes occur in locally dense stands. Less disturbed stands of the community may have a woodland or forest structure. Small trees or saplings may dominate the community in relatively high densities after partial or total clearing, and the groundcover may be relatively sparse, especially where densities of trees or shrubs are high. The community also includes ‘derived’ native grasslands which result from removal of the woody strata from the woodlands and forests.

3. Cumberland Plain Woodland is characterised by the following assemblage of species:

Acacia implexa	*Ajuga australis*
Aristida ramosa	*Aristida vagans*
Arthropodium milleflorum	*Arthropodium minus*
Asperula conferta	*Austrodanthonia caespitosa*
Austrodanthonia racemosa var. *racemosa*	*Austrodanthonia tenuior*
Bossiaea prostrata	*Bothriochloa decipiens*
Bothriochloa macra	*Brunoniella australis*
Bursaria spinosa	*Carex inversa*
Centaurium spicatum	*Centella asiatica*
Cheilanthes distans	*Cheilanthes sieberi* subsp. *sieberi*
Chloris truncata	*Chloris ventricosa*
Chorizema parviflorum	*Chrysocephalum apiculatum*

Clematis glycinoides var. *glycinoides*	*Commelina cyanea*
Crassula sieberiana	*Cymbonotus lawsonianus*
Cymbopogon refractus	*Cyperus gracilis*
Daucus glochidiatus	*Daviesia ulicifolia*
Desmodium brachypodium	*Desmodium varians*
Dianella longifolia	*Dichanthium sericeum*
Dichelachne micrantha	*Dichelachne parva*
Dichondra repens	*Dichopogon fimbriatus*
Dichopogon strictus	*Digitaria diffusa*
Dillwynia sieberi	*Dodonaea viscosa* subsp. *cuneata*
Echinopogon caespitosus var. *caespitosus*	*Echinopogon ovatus*
Einadia hastata	*Einadia nutans*
Einadia polygonoides	*Einadia trigonos*
Elymus scaber var. *scaber*	*Eragrostis leptostachya*
Eremophila debilis	*Eriochloa pseudoacrotricha*
Eucalyptus crebra	*Eucalyptus eugenioides*
Eucalyptus moluccana	*Eucalyptus tereticornis*
Euchiton sphaericus	*Exocarpus cupressiformis*
Fimbristylis dichotoma	*Galium migrans*
Galium propinquum	*Geranium homeanum*
Geranium solanderi var. *solanderi*	*Glossogyne tannensis*
Glycina clandestina	*Glycine microphylla*
Glycine tabacina	*Goodenia hederacea* subsp. *hederacea*
Hardenbergia violacea	*Hypericum gramineum*
Hypoxis hygrometrica	*Hypoxis pratensis* var. *pratensis*
Indigofera australis	*Juncus usitatus*
Lachnagrostis avenacea var. *avenacea*	*Lomandra filiformis* subsp. *filiformis*
Lomandra multiflora subsp. *multiflora*	*Mentha diemenica*
Microlaena stipoides var. *stipoides*	*Opercularia diphylla*
Oxalis perennans	*Panicum effusum*
Paspalidium distans	*Phyllanthus virgatus*
Plantago debilis	*Plantago gaudichaudii*
Plectranthus parviflorus	*Poa labillardieri* var. *labillardieri*
Pratia purpurascens	*Pultenaea microphylla*
Rubus parvifolius	*Scleria mackaviensis*

Scutellaria humilis	*Senecio diaschides*
Senecio hispidulus var. *hispidulus*	*Sida corrugata*
Solanum cinereum	*Solanum prinophyllum*
Sorghum leiocladum	*Sporobolus creber*
Sporobolus elongatus	*Stackhousia viminea*
Themeda australis	*Tricoryne elatior*
Vernonia cinerea var. *cinerea*	*Veronica plebeia*
Wahlenbergia gracilis	*Wahlenbergia stricta* subsp. *stricta*
Wurmbea dioica subsp. dioica	*Zornia dyctiocarpa* var. *dyctiocarpa*

Other tree species occurring less frequently in this community include:

Angophora bakeri	*Angophora floribunda*
Angophora subvelutina	*Corymbia maculata*
Eucalyptus amplifolia	*Eucalyptus baueriana*
Eucalyptus bosistoana	*Eucalyptus fibrosa*
Eucalyptus globoidea	*Eucalyptus longifolia*
Eucalyptus paniculata	*Eucalyptus punctata*
Syncarpia glomulifera	

4. The total species list of the community is larger than that given above, with many species present in only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including grazing, land clearing and fire) history. The number and relative abundance of species will change with time since fire, and may also change in response to changes in fire frequency or grazing regime. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. Benson and Howell (2002) and Benson & von Richter (2008) document the temporal variability in the species composition of the community. The list of species given above is mainly of vascular plant species, however the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. The mammalian and avian components of the fauna have been described by Leary (*in litt.* August 2007) and Farrell (*in litt*. June 2007). Other components of the community are poorly documented (although see Benson & von Richter 2008).

5. Cumberland Plain Woodland is characterised by an upper-storey that is usually dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), often with *E. crebra* (Grey Ironbark), *E. eugenioides* (Narrow-leaved Stringybark), *Corymbia maculata* (Spotted Gum) or other less frequently occurring eucalypts, including *Angophora floribunda, A. subvelutina* (Broad-leaved Apple), *E. amplifolia* (Cabbage Gum) and *E. fibrosa* (Broad-leaved Ironbark). The community may have an open stratum of small trees that may include any of these eucalypts, as well as species such as *Acacia decurrens* (Black Wattle), *A. parramattensis* (Parramatta Wattle), *A.implexa* (Hickory Wattle) or *Exocarpos cupressiformis* (Native Cherry). Shrubs are typically scattered in the understorey but may be absent or locally dense as a result of clearing activity or changes in grazing or fire regimes. *Bursaria spinosa* (Blackthorn) is usually dominant, while other species include *Daviesia ulicifolia* (Gorse Bitter Pea), *Dillwynia sieberi, Dodonaea viscosa* subsp. *cuneata* and *Indigofera australis* (Native Indigo). The ground cover is dominated by a diverse range of grasses including *Aristida ramosa* (Purple Wiregrass), *A. vagans* (Threeawn Speargrass), *Cymbopogon refractus* (Barbed Wire Grass), *Dichelachne micrantha* (Plumegrass), *Echinopogon caespitosus* (Forest Hedgehog Grass), *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Grass), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass), and with graminoids *Carex inversa* (Knob Sedge), *Cyperus gracilis*, *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush) and *L. multiflorus* subsp. *multiflorus* (Many-flowered Mat-rush). The ground cover also includes a diversity of forbs such as *Asperula conferta* (Common Woodruff), *Brunoniella australis* (Blue Trumpet), *Desmodium varians* (Slender Tick Trefoil), *Dianella longifolia* (Blue Flax Lily), *Dichondra repens* (Kidney Weed), *Opercularia diphylla*, *Oxalis perennans* and *Wahlenbergia gracilis* (Australian Bluebell), as well as scramblers, *Glycine* spp. and *Hardenbergia violacea* (Native Sarsaparilla) and the fern *Cheilanthes sieberi* (Poison Rock Fern).

6. The structure of the community varies depending on past and current disturbances, particularly clearing, fire and grazing. Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy groundcover. At some sites, mature trees may exceed 30m tall, although regrowth stands may be shorter than 10 m tall. After total or partial clearing, the tree canopy may remain sparse or may regrow to form dense stands of saplings and small trees, which are typically associated with a ground layer of reduced cover and diversity. Either or both of the upper-storey and mid-storey may be absent from the community. Native grasslands derived from clearing of the woodland and forest are also part of this community if they contain characteristic non-woody species listed in paragraph 3.

7. Cumberland Plain Woodland includes: 'Shale Hills Woodland' (map unit 9) and 'Shale Plains Woodland' (map unit 10) of Tozer (2003); 'Spotted Gum Forest' (map unit 9b), 'Grey Box Woodland' (map unit 10c) and 'Grey Box – Ironbark Woodland' (map unit 10d) of Benson (1992); and 'Cumberland Plain Woodlands' of Benson & Howell (1990a; b). Tindall *et al.* (2004) and Tozer et al. (2006) subsequently reproduced Tozer's (2003) classification and mapping, re-labelling map units 9 and 10 as 'Cumberland Shale Hills Woodland' (map unit GW p28) and 'Cumberland Shale Plains Woodland' (map unit GW p29), respectively. Cumberland Plain Woodland belongs to the Coastal Valley Grassy Woodlands vegetation class (Keith 2004).

8. Several other ecological communities listed under the *Threatened Species Conservation Act* 1995 may intergrade with Cumberland Plain Woodland. These include Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion; Moist Shale Woodland in the Sydney Basin Bioregion; Shale / Sandstone Transition Forest; Shale Gravel Transition Forest in the Sydney Basin Bioregion; and Sydney Turpentine-Ironbark Forest. While Tozer (2003) provides information on the features that distinguish these communities, some transitional stands will be difficult to assign to a single community with a high level of confidence (Keith in press). Transitional stands between Cumberland Plain Woodland and other communities listed under the *Threatened Species Conservation Act* 1995 are considered part of a listed community, and should be assigned to the community with which they share greatest resemblance in species composition and other properties.

9. The following threatened species have been recorded from Cumberland Plain Woodland:

Invertebrates

Cumberland Land Snail	*Meridolum corneovirens*	Endangered

Birds

Gang Gang Cockatoo	*Callocephalon fimbriatum*	Vulnerable
Glossy Black-cockatoo	*Calyptorhynchus lathami*	Vulnerable
Brown Treecreeper	*Climacteris picumnus*	Vulnerable
Painted Honeyeater	*Grantiella picta*	Vulnerable
Swift Parrot	*Lathamus discolour*	Endangered
Square-tailed Kite	*Lophoictinia isura*	Vulnerable
Hooded Robin	*Melanodryas cucullata cucullata*	Vulnerable
Black-chinned Honeyeater	*Melithreptus gularis gularis*	Vulnerable
Turquoise Parrot	*Neophema pulchella*	Vulnerable
Barking Owl	*Ninox connivens*	Vulnerable
Powerful Owl	*Ninox strenua*	Vulnerable
Speckled Warbler	*Pyrrholaemus sagittatus*	Vulnerable
Diamond Firetail	*Stagonopleura guttata*	Vulnerable
Masked Owl	*Tyto novaehollandiae*	Vulnerable
Sooty Owl	*Tyto tenebricosa*	Vulnerable

Regent Honeyeater	*Xanthomyza phrygia*	Endangered

Mammals

Large-eared Pied Bat	*Chalinolobus dwyeri*	Vulnerable
Spotted-tail Quoll	*Dasyurus maculata*	Vulnerable
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Vulnerable
Eastern Bent-wing Bat	*Miniopterus schreibersii*	Vulnerable
Eastern Freetail Bat	*Mormopterus norfolkensis*	Vulnerable
Large-footed Myotis	*Myotis adversus*	Vulnerable
Yellow-bellied Glider	*Petaurus australis*	Vulnerable
Squirrel Glider	*Petaurus norfolkensis*	Vulnerable
Koala	*Phascolarctus cinnereus*	Vulnerable
Grey-headed Flying Fox	*Pteropus poliocephalus*	Vulnerable
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	Vulnerable
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Vulnerable

Plants

Downy Wattle	*Acacia pubescens*	Vulnerable
Juniper-leaved Grevillea	*Grevillea juniperina* subsp. *juniperina*	Vulnerable
Native Pear	*Marsdenia viridiflora* subsp. *viridiflora*	Endangered Population
Narrow-leaved Geebung	*Persoonia nutans*	Endangered
Spiked Riceflower	*Pimelea spicata*	Endangered
Matted Bush-pea	*Pultenaea pedunculata*	Endangered
Sydney Plains Greenhood	*Pterostylis saxicola*	Endangered

10. Cumberland Plain Woodland is restricted to the Sydney Basin bioregion and is currently known to occur within the local government areas of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly, but may occur elsewhere within the bioregion. Using map data from Tozer (2003), Cumberland Plain Woodland was estimated to occur within an extent of occurrence of 2810 km2, and an area of occupancy of just under 2 100 km2 based on 2 x 2 km grid cells, the spatial scale recommended by IUCN (2008) for assessing species' areas of occupancy.

11. Small areas of Cumberland Plain Woodland have been recorded from Kemps Creek, Mulgoa and Windsor Downs Nature Reserves, Scheyville National Park, and Leacock, Rouse Hill and Western Sydney Regional Parks.

12. Based on aerial photography flown in November 1998, Tozer (2003) estimated the total extent of woody vegetation referred to Cumberland Plain Woodland was 11 054 (±1 564) ha (upper and lower plausible bounds), representing 8.8 (±1.2)% of the pre-European distribution of the community. For that part of the community's distribution to the east of the Hawkesbury-Nepean River, earlier mapping at coarser resolution by Benson & Howell (1990b) suggests a similar level of depletion, with an estimated 6 420 ha of 'Cumberland Plain Woodlands', representing 6% of the pre-European distribution east of the Hawkesbury-Nepean River. An update of Tozer's (2003) map, based on interpretation of imagery flown in January-March 2007 shows that the extent of Cumberland Plain Woodland east of the Hawkesbury – Nepean River had

declined by 442±46 ha, a reduction of 5.2±0.6% in 9 years (NSW Scientific Committee & Simpson 2008). These estimates indicate that the geographic distribution of the community has undergone a very large reduction over a time frame appropriate to the life cycle and habitat characteristics of its component species.

13. Some areas of Cumberland Plain Woodland subjected to a history of partial clearing and grazing have recently undergone a change in management to conserve the community. Examples include Mt Annan Botanic Garden, Scheyville National Park, Western Sydney Regional Park, Elizabeth Macarthur Agricultural Institue, Orchard Hills Defence Site and the former Australian Defence Industries site at St Marys. Experience from these areas suggests that the community is capable of some recovery, provided the soil has not been disturbed by earthworks, cultivation, fertiliser application or other means of nutrient or moisture enrichment (Benson & Howell 2002; Pellow 2003; Keith *et al.* 2005; J. Howell *in litt*. August 2007; J. Sanders *in litt*. January 2008). In contrast, restoration of Cumberland Plain Woodland has proved to be problematic on sites that have been exposed to such soil disturbance. At Western Sydney Regional Park, for example, Wilkins *et al*. (2003), Nicholls (2005) and Nichols *et al*. (2005) studied the recovery of abandoned pastures that had been planted with more than 20 native tree and shrub species of Cumberland Plain Woodland. Over 10 years they found no evidence of convergence in species composition with nearby remnant stands of the community and the species composition of restored areas remained indistinguishable from untreated pastures. There was some evidence that restored vegetation had begun to develop more species-rich assemblages of moths and butterfiles compared to untreated pastures, although after 10 years, it lacked a number of species characteristic of remnant woodland (Lomov *et al*. 2006). Ant communities also showed marked differences between restored and remnant vegetation although some ecological processes, such as pollination and seed dispersal, showed some evidence of development at restored sites (Lomov 2005). These results suggest that sites with a history of soil disturbance will be extremely slow to recover characteristics of Cumberland Plain Woodland, if at all, and that experimentation with alternative restoration technologies is required. As a large proportion of the former distribution of the community has either undergone similar histories of soil disturbance or are now occupied by urban development, opportunities for restoration of the community across significant areas appear limited.

14. The reduction in the geographic distribution of Cumberland Plain Woodland was initially due to tree-felling for timber and clearing for crops and pastures (Benson & Howell 1990a). Benson & Howell (1990b) estimated that the community had been reduced to approximately half of its pre-European extent by 1850. Following World War II, there was a marked acceleration in urban and industrial development, which continues to deplete the distribution of the community to the present day. These trends appear likely to continue into the future as the urban area continues to expand to accommodate Sydney's increasing population, which is projected to grow by 1.0-1.1 million people during the 20 years 2007-2026 and 2.2-3.3 million during the 50 years 2007-2056 (Australian Bureau of Statistics 2008). Recent draft plans to develop growth centres in north-west and south-west Sydney, for example, identify staged release of land for residential and employment development over the next 25 years. These areas contain approximately 2000 ha (one-fifth) of the remaining Cumberland Plain Woodland, of which about two-thirds will be available for development, the loss of which is planned for offsetting through restoration of the community at other sites (Growth Centres Commission 2007). While important examples of Cumberland Plain Woodland are represented within conservation reserves, much of the remaining area of the community occurs on private land or on public easements, where it is at risk from small-scale clearing associated with housing, industrial development and transport infrastructure. The logistic and technological constraints and time lags associated with restoration of the community are likely to limit the success of plans to offset any further losses of Cumberland Plain Woodland that may occur (Wilkins *et al*. 2003; Nicholls 2005; Nichols *et al.* 2005). 'Clearing of native vegetation' is listed as a Key Threatening Process under the *Threatened Species Conservation Act* 1995.

15. Fragmentation of habitat associated with clearing has resulted in a very large reduction in the ecological function of Cumberland Plain Woodland. The remaining area of the community is severely fragmented, with more than half of the remaining tree cover mapped by Tozer (2003) occurring in patches of less than 80 ha and half of all mapped patches being smaller than 3 ha (Tozer *in litt*. October 2007). The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations (Young *et al*. 1996, Young & Clarke 2000). The impacts of fragmentation and associated processes are most evident in the loss of vertebrate fauna from the community (Farrell 2005; Farrell *in litt*. June 2007; Leary 2005; *in litt*, August 2007). As well, some invertebrate species, such as the Endangered Cumberland Land Snail appear to be in decline, at least in the smaller fragments (M. Shea *in litt*. June 2007). The dieback of eucalypt canopies observed in stands of Cumberland Plain Woodland at Scheyville (D. Keith pers. comm. October 2008) may be a result of complex interactions involving insect attack, weed invasion, nutrient enrichment and drought, in which fragmentation also plays a role (Reid & Landsberg 2000; Wardell-Johnson *et al.* 2006). Despite their history of fragmentation, some very small and apparently degraded remnants may contain a surprisingly high diversity of species and important examples of rare species, particularly plants (James *et al.* 1999; Benson & Keith 1984; McBarron *et al*. 1988; Benson & Howell 1990a; Kirkpatrick & Gilfedder 1995). However, clearing and continuing degradation of these patches reduces the likelihood that all of these species will persist, particularly because a large proportion of species are known from very few locations which are not clustered in predictable ways (Benson & Howell 2002; Tozer 2003). Fragmentation also results in reduced fire frequencies within some patches, which may reduce the viability of some native plant populations, and hence the diversity of species within the patches (Clarke 2000; Watson 2005).

16. Changes in structure contribute to a very large reduction in the ecological function of Cumberland Plain Woodland. Almost all of the remaining area of the community is regrowth forest and woodland from past clearing activities (Benson & Howell 1990a). Mean tree densities in contemporary stands of the community were found to be substantially higher than historical estimates and tree sizes were thought to be smaller (Benson 1992). Large trees approximating the stature of the community prior to European settlement occur very sparsely within remnant patches of vegetation or remain as isolated individuals within paddocks or urban areas. Scheyville National Park, for example, which contains the largest remaining example of Cumberland Plain Woodland (*c*. 1000 ha), was extensively logged and partially cleared over many decades prior to its reservation and is thought to contain as few as five large old trees likely to date from pre-European times (J. Sanders,

in litt. January 2008). Loss of these large trees, which provide habitat resources for a range of fauna, is associated with declines and local extinctions of numerous birds and mammals that were once more common on the Cumberland Plain (Farrell 2005; T. Leary *in litt*. August 2007). Changes in understorey are difficult to assess, as responses to anthropogenic disturbances are confounded with responses to climatic variability (Benson & Howell 2002). Nevertheless, other structural changes to the community include the removal of fallen woody debris and standing dead trees, the removal of woody understorey plants, or conversely the development of regrowth stands with very high densities of eucalypt saplings or shrubs, notably *Bursaria spinosa*, which may suppress the ground flora. Botanist, Allan Cunningham noted high densities of *B. spinosa* in farmland near Liverpool as early as 1817 (Lee 1927; Benson 1992), while similar phases of high shrub abundance have been observed recently at Mt Annan and Scheyville in response to abandonment of farming practices (Benson & Howell 2002; J. Sanders, *in litt*. January 2008). Some areas of the community now devoid of woody plant species may retain a substantial suite of native grasses and herbs in the ground layer. The Orchard Hills Defence Site includes outstanding examples of this phenomenon (Pellow 2003; Keith *et al*. 2005). 'Loss of hollow-bearing trees' and 'Removal of dead wood and dead trees' are listed as Key Threatening Processes under the *Threatened Species Conservation Act* 1995.

17. While a sample of the original fauna of Cumberland Plain Woodland persists, some components have already been lost and others continue to decline (Leary 2005; *in litt.* Aug. 2008). The original mammal fauna of the Cumberland Plain was estimated to include approximately 60 species (NPWS 1997), of which less than 40 were detected in recent intensive surveys and only 14 species are now considered to be relatively common and widespread (Leary 2005; *in litt*. August 2008). The majority of these latter species are micro-bats, while small ground-dwelling mammals are unexpectedly scarce. A systematic survey involving 22 000 trap nights and 14 000 hair tube nights across conservation reserves containing Cumberland Plain Woodland failed to detect any native rodents or dasyurids, except at sites on the periphery of the plain, close to larger vegetated areas on sandstone (Leary 2005; *in litt*. August 2008). Long-nosed Bandicoots have recently been recorded in inner western Sydney (NSW Scientific Committee 2008), but remain scarce and have not been recorded during the systematic fauna surveys of Cumberland Plain Woodland. A number of bird species have also disappeared from or markedly declined on the Cumberland Plain (Keast 1995; Farrell 2005; Leary 2005; *in litt*. August 2008). A sequence of repeated surveys in Scheyville National Park, the largest remnant of Cumberland Plain Woodland, have documented disappearance of the Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Zebra Finch, Hooded Robin, Red-capped Robin, Scarlet Robin, Flame Robin and Black-eared Cuckoo, while declines have been observed in populations of the Speckled Warbler, Fuscous Honeyeater, Jacky Winter, Weebill and Buff-rumped Thornbill (Farrell 2005; *in litt*. June 2008). Repeated surveys of Nurragingy Reserve near Blacktown indicate that all of these species have also been lost from the reserve, except for the Fuscous Honeyeater and Weebill (Farrell 2005; *in litt.* June 2008). Many of these species either feed or nest on or near the ground. Declines of reptiles and amphibians on the Cumberland Plain have been less well documented, but include at least three species of frog, one species of turtle, one skink, possibly two species of goanna and one species of snake (Leary 2005; *in litt*. August 2008). Two species of plants, *Swainsona monticola* and *Thesium australe*, are presumed to have gone extinct in Cumberland Plain Woodland, (Benson & Howell 2002), while James *et al*. (1999) list many other species that have undergone substantial declines, including threatened species such as *Acacia pubescens*, *Pimelea spicata* and *Pterostylis saxicola*. In addition to these losses and declines across a wide range of biota within the community, Benson & Howell (1990a; 2002) describe other changes in species composition that indicate a very large reduction in the ecological function of Cumberland Plain Woodland.

18. Weed invasion also poses a major threat to Cumberland Plain Woodland. While very large numbers of weed species have invaded many different areas of the community, principal weed species include (Benson 1992; Tozer 2003; Benson & von Richter 2008):

Anagallis arvensis	Scarlet Pimpernell
Araujia serciflora	Moth Vine
Asparagus asparagoides	Bridal Creeper
Aster subulatus	Wild Aster, Bushy Starwort
Centaurium tenuiflorum	
Chloris gayana	Rhodes Grass
Cyclospermum leptophyllum	Slender Celery
Cirsium vulgare	Thistle
Conyza sumatrensis	Tall Fleabane
Ehrharta erecta	Panic Veldtgrass

Eragrostis curvula	African Lovegrass
Heliotropium amplexicaule	Blue Heliotrope
Hypochaeris radicata	Catsear
Leontodon taraxacoides subsp. *taraxacoides*	Lesser Hawksbit, Hairy Hawkbit
Olea europea subsp. *cuspidata*	African Olive
Paspalum dilatatum	Paspalum
Plantago lanceolata	Lamb's Tongue, Plantain
Richardia stellaris	
Senecio madagascariensis	Fireweed
Setaria gracilis	Slender Pigeon Grass
Sida rhombifolia	Paddy's Lucerne
Solanum spp.	Nightshades
Sonchus oleraceus	Common Sowthistle
Sporobolus africanus	Parramatta Grass

Several of these species, particularly grasses, form a dense ground layer capable of smothering indigenous plants, reducing both reproduction and survival, and inhibiting emergence and establishment of their seedlings. The propagules of weeds are spread into Cumberland Plain Woodland by stormwater, dumping of refuse, frugivorous birds and wind (Benson & Howell 1990b), making it difficult to abate the invasion process, especially for those species capable of establishing in sites that have been exposed to relatively little disturbance (J. Sanders, *in litt*. January 2008). Hill *et al*. (2005) found that high species richness and abundance of weeds was associated with remnants that either had a history of clearing and grazing, were in close proximity to creeks or downslope from sealed roads. They also found some relationship between weeds and elevated total soil phosphorus, conductivity and water retention capacity, but relationships with these soil properties were weak and varied between sites with different types of disturbance history. The dramatic recent expansion of African Olive poses the greatest invasive threat to Cumberland Plain Woodland. Initially introduced to south-western Sydney in the 1820s, it was generally confined to the Camden-Picton area until the 1970s and now occurs frequently throughout the distribution of the community (Tozer 2003; Cuneo & Leishman 2006). Roberts (1999) mapped approximately 1000 ha of Cumberland Plain Woodland (c. 10% of total remaining) which had a dense understorey of African Olive that was visible on aerial photographs flown in November 1997. Tozer (2003) recorded African Olive in 43% of 198 plots surveyed throughout the distribution of Cumberland Plain Woodland. The species is highly fecund, with fleshy fruit spread widely by a range of frugivorous birds, and seedlings establish readily in relatively undisturbed bushland, as well as fragmented edges (Cuneo & Leishman 2006). As shrubs grow, their canopies cast deep shade and shed copious leaf litter which suppress and ultimately eliminate most native shrub and groundcover species. Cook *et al*. (2005) and Tozer (*in litt*. October 2007, based on data from Tozer 2003), both recorded strong inverse relationships between the cover abundance of African Olive and the diversity and cover of native ground layer species. Other weeds that pose future threats to the community include *Asparagus asparagoides*, *Acer neguno*, *Gelditsia triacanthos* and *Nasella neesiana* (Benson & Howell 2002; J. Howell *in litt*. August 2007; J. Sanders *in litt*. January 2008). The invasion and establishment of exotic weeds is resulting in a very large reduction in the ecological function of Cumberland Plain Woodland. 'Invasion of exotic perennial grasses' and 'Invasion and establishment of exotic vines and scramblers' are listed as Key Threatening Processes under the *Threatened Species Conservation Act* 1995.

19. Moderate to heavy grazing of Cumberland Plain Woodland by livestock and rabbits results in the decline and disappearance of palatable plant species, including shrubs and herbs, and compaction and erosion of topsoil, making re-establishment of a diverse native understorey problematic. The effects of such overgrazing may be exacerbated under drought conditions. Habitat degradation associated with overgrazing and erosion contributes to a large reduction in ecological function of the community.

20. The soils of Cumberland Plain Woodland have undergone chemical and structural modification associated with agricultural land uses. Trampling by livestock has resulted in localised areas of soil compaction, primarily around watering

points. Research carried out at the University of Western Sydney found that mean soil inorganic nitrogen levels were two to three times higher in areas of former agricultural land use than in remnant woodland, but was unable to detect differences in other soil properties (E. C. Morris *in litt*. June 2007). Addition of carbon and burning reduced soil inorganic nitrogen and reduced growth of exotic ground layer species relative to native species, suggesting that elevated soil inorganic nitrogen could favour exotics to the detriment of natives in Cumberland Plain Woodland (E. C. Morris *in litt*. June 2007). Hill *et al*. (2005) found elevated levels of phosphorus and conductivity in former agricultural areas compared to remnant woodland, but did not examine soil nitrogen. The sources of nutrient addition to soils of Cumberland Plain Woodland include addition of fertilisers during previous agricultural land use, deposition of livestock dung, rubbish dumping and stormwater runoff from urban areas. Expansion of urban land uses across the Cumberland Plain is likely to increase urban runoff from sealed surfaces into remaining bushland fragments, resulting in further nutrient enrichment of soils and associated replacemernt of native flora by exotic species. Disruption of ecological processes and degradation of habitat associated with nutrient enrichment contributes to a very large reduction in ecological function of the community.

21. Fire regimes influence the plant species composition and vegetation structure of Cumberland Plain Woodland (Benson & Howell 2002; Watson 2005) and are also likely to influence other components of the biota. Based on a study of Cumberland Plain Woodland remnants with varying fire histories, Watson (2005) found that variable intervals of 4 - 12 years between successive fires are likely to maintain populations of most understorey species in the community, including resprouting and obligate-seeding shrubs, grasses and herbs. Fragmentation of Cumberland Plain Woodland may exclude fire from some patches for extended periods by reducing fire spread. The consequent reduction in fire frequency sometimes leads to increased dominance of shrubs and associated declines in diversity of grasses and herbs (Watson 2005), as well as increased abundance of woody exotic species, such as African Olive (Benson & Howell 2002; Watson 2005; von Richter *et al*. 2005), which is likely to further reduce the flammability of the community. Conversely, high frequencies of fires may result where fragmentation increases the interface between urban areas and bushland, as this results in increased arson, car dumping, planned fuel-reduction fires and accidental ignitions. High fire frequencies are associated with reduced diversity of native plant species in Cumberland Plain Woodland (Watson 2005). 'High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the *Threatened Species Conservation Act* 1995. The season of fire, which may be altered as a consequence of hazard reduction fires, may also influence the species composition of the grassy woodland understorey (Knox & Clarke 2006; Benson & von Richter 2008). Disruption of ecological processes associated with alteration of fire regimes contributes to a very large reduction in ecological function of the community.

22. Cumberland Plain Woodland in the Sydney Basin Bioregion is eligible to be listed as a critically endangered ecological community as, in the opinion of the Scientific Committee, it is facing an extremely high risk of extinction in New South Wales in the immediate future, as determined in accordance with the following criteria as prescribed by the *Threatened Species Conservation Regulation* 2002:

Clause 25

The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:

(a) a very large reduction in geographic distribution.

Clause 27

The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:

(a) a very large reduction in ecological function,

as indicated by any of the following:

(d) a change in community structure

(e) a change in species composition

(f) disruption of ecological processes

(g) invasion and establishment of exotic species

(h) degradation of habitat

(i) fragmentation of habitat

Professor Lesley Hughes

Chairperson

Scientific Committee

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River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing

NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act, and as a consequence to omit reference to Sydney Coastal River-Flat Forest from Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). River-Flat Eucalypt Forest on Coastal Floodplains generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically these forests and woodlands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Goodrick 1970).

The composition of River-Flat Eucalypt Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, nutrient and moisture content of the soil. Composition also varies with latitude. The community is characterised by the following assemblage of species:

Acacia floribunda	*Acacia parramattensis*
Acmena smithii	*Adiantum aethiopicum*
Angophora floribunda	*Angophora subvelutina*
Austrostipa ramosissima	*Backhousia myrtifolia*
Breynia oblongifolia	*Bursaria spinosa*
Casuarina cunninghamiana subsp. *cunninghamiana*	*Casuarina glauca*
Cayratia clematidea	*Centella asiatica*
Cheilanthes sieberi subsp. *sieberi*	*Clematis aristata*
Clematis glycinoides	*Commelina cyanea*
Cymbopogon refractus	*Desmodium varians*
Dichelachne micrantha	*Dichondra repens*
Digitaria parviflora	*Doodia aspera*
Echinopogon caespitosus var. *caespitosus*	*Echinopogon ovatus*
Einadia hastata	*Einadia trigonos*
Entolasia marginata	*Entolasia stricta*
Eragrostis leptostachya	*Eucalyptus amplifolia*
Eucalyptus baueriana	*Eucalyptus benthamii*
Eucalyptus botryoides	*Eucalyptus elata*
Eucalyptus grandis	*Eucalyptus longifolia*
Eucalyptus moluccana	*Eucalyptus ovata*
Eucalyptus saligna	*Eucalyptus tereticornis*
Eucalyptus viminalis	*Euchiton sphaericus*
Eustrephus latifolius	*Galium propinquum*
Geitonoplesium cymosum	*Geranium solanderi*
Glycine clandestina	*Glycine microphylla*
Glycine tabacina	*Hardenbergia violacea*
Hydrocotyle peduncularis	*Hymenanthera dentata*
Hypolepis muelleri	*Imperata cylindrica* var. *major*
Livistona australis	*Lomandra filiformis*
Lomandra longifolia	*Lomandra multiflora* subsp. *multiflora*
Melaleuca decora	*Melaleuca linariifolia*
Melaleuca styphelioides	*Melia azedarach*
Microlaena stipoides var. *stipoides*	*Opercularia diphylla*
Oplismenus aemulus	*Oxalis perennans*
Ozothamnus diosmifolius	*Pandorea pandorana*
Paspalidium distans	*Persicaria decipiens*
Phyllanthus gunnii	*Plectranthus parviflorus*
Poranthera microphylla	*Pratia purpurascens*
Pteridium esculentum	*Rubus parvifolius*

Sigesbeckia orientalis subsp. *orientalis*	*Solanum prinophyllum*
Stephania japonica var. *discolor*	*Themeda australis*
Trema aspera	*Tristaniopsis laurina*
Vernonia cinerea	*Veronica plebeia*
Viola hederacea	*Wahlenbergia gracilis*

2. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire, grazing, flooding and land clearing) history. The number and relative abundance of species will change with time since fire, flooding or significant rainfall, and may also change in response to changes in grazing regimes. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Eastern Capital City Regional, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Major examples once occurred on the floodplains of the Hunter, Hawkesbury, Moruya, Bega and Towamba Rivers, although many smaller floodplains and river flats also contain examples of the community.

4. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. amplifolia* (cabbage gum), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). *Eucalyptus baueriana* (blue box), *E. botryoides* (bangalay) and *E. elata* (river perppermint) may be common south from Sydney, *E. ovat*a (swamp gum) occurs on the far south coast, *E. saligna* (Sydney blue gum) and *E. grandis* (flooded gum) may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury floodplain. Other eucalypts including *Eucalyptus longifolia* (woollybutt), *E. moluccana* (grey box) and *E. viminalis* (ribbon gum) may be present in low abundance or dominant in limited areas of the distribution. A layer of small trees may be present, including *Melaleuca decora, M. styphelioides* (prickly-leaved teatree), *Backhousia myrtifolia* (grey myrtle), *Melia azaderach* (white cedar), *Casuarina cunninghamiana* subsp. *cunninghamiana* (river oak) and *C. glauca* (swamp oak). Scattered shrubs include *Bursaria spinosa* subsp. *spinosa* (blackthorn), *Solanum prinophyllum* (forest nightshade), *Rubus parvifolius* (native raspberry), *Breynia oblongifolia* (coffee bush), *Ozothamnus diosmifolius, Hymenanthera dentata* (tree violet), *Acacia floribunda* (white sally) and *Phyllanthus gunnii*. The groundcover is composed of abundant forbs, scramblers and grasses including *Microlaena stipoides* (weeping grass), *Dichondra repens* (kidney weed), *Glycine clandestina, Oplismenus aemulus, Desmodium gunnii, Pratia purpurascens* (whiteroot), *Entolasia marginata* (bordered panic), *Oxalis perennans* and *Veronica plebeia* (trailing speedwell). The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic shrubs, grasses, vines and forbs.

5. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting (Law *et al*. 2000a, b). These include cormorants (*Phalacrocorax* spp.) and egrets (*Ardea* spp. and *Egrettia* spp.), the Osprey (*Pandion haliaetus*), Whistling Kite (*Haliastur sphenurus*), White-bellied Sea-eagle (*Haliaeetus leucogaster*), as well as the Brush-tailed Phascogale (*Phascogale tapoatafa*), Yellow-bellied Glider (*Petaurus australis*), Squirrel Glider (*Petaurus norfolcensis*) (Law *et al*. 2000a), Sugar Glider (*Petaurus breviceps*) and Grey-headed Flying Fox (*Pteropus poliocephalus*). The fauna of River-Flat Eucalypt Forest also includes a number of species of frogs in the families Myobatrachidae and Hylidae, particularly *Litoria* spp., and many species of forest birds including honeyeaters, kingfishers, cuckoos, owls, doves, whistlers and fantails.

6. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested wetland and treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish River-Flat Eucalypt Forest on Coastal Floodplains from other endangered communities on the coastal floodplains include: its dominance by either a mixed eucalypt canopy or by a single species of eucalypt belonging to either the genus *Angophora* or the sections *Exsertaria* or *Transversaria* of the genus *Eucalyptus* (Hill 2002); the relatively low abundance or sub-dominance of *Casuarina* and *Melaleuca* species; the relatively low abundance of *Eucalyptus robusta*; and the prominent groundcover of soft-leaved forbs and grasses. It generally occupies central parts of floodplains and raised levees; habitats where flooding is periodic and soils are rich in silt, without deep humic horizons and show little or no influence of saline ground water.

7. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions includes and replaces Sydney Coastal River-Flat Forest Endangered Ecological Community. River-Flat Eucalypt Forest on Coastal Floodplains may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, Subtropical Floodplain Forest of the NSW North Coast bioregion, Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion), Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. For example, northwards from the Hunter valley, River-Flat Eucalypt Forest on Coastal Floodplains may intergrade with, or be replaced by, Subtropical Floodplain Forest of the NSW North Coast bioregion. As soil salinity increases, River-Flat Eucalypt Forest may adjoin or intergrade with Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. The

boundaries between all of these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices. The Determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats.

8. A number of vegetation surveys and mapping studies have been conducted across the range of River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. In the Comprehensive Regional Assessment of the north-eastern NSW (NPWS 1999), areas that were mapped on coastal floodplains of the Manning River as 'Forest Ecosystem 47, Escarpment Red Gums' are included within this community. In the lower Hunter valley, 'Central Hunter Riparian Forest' (map unit 13), 'Wollombi Redgum-River Oak Woodland' (map unit 14) and 'Redgum Roughbarked Apple Swamp Forest' (map unit 38) of NPWS (2000) fall within this community. On the Cumberland Plain, 'Riparian Forest' (map unit 12) of Tozer (2003) and parts of 'Alluvial Woodland' (map unit 11) that are dominated by eucalypts (Tozer 2003) are included within this community. Benson's (1992) 'Camden White Gum Forest' (map unit 6d) and those parts of 'River Flat Forest' (map unit 9f) dominated by eucalypts also fall within this community, as do parts of the 'River-flat forests' of Benson and Howell (1990) and Benson *et al.* (1996) that are dominated by eucalypts. In the Warragamba catchment, small areas of 'Burragorang River Flat Forest' (map unit 88b) and 'Oakdale Alluvial Rough-barked Apple Forest' (map unit 88c) of NPWS (2002) are included within this community. On the south coast of NSW, this community includes those parts of 'Ecotonal Coastal Swamp Forest' (forest ecosystem 27) of Thomas *et al.* (2000) dominated by eucalypts, those parts of 'Coastal Lowlands Riparian Herb/Grass Forest' (forest ecosystem 48) and 'Southern Hinterland Shrub/Herb/Grass Riparian Forest' (forest ecosystem 49) of Thomas *et al*. (2000) mapped on alluvial soils, and those parts of 'Cumberland River Flat Forest' (map unit 33) and 'Floodplain Swamp Forest' (map unit 105) of Tindall et al. (2004) that are dominated by eucalypts. In the Eden region, this community includes forested parts of 'Floodplain Wetlands' (map unit 60) that are dominated by eucalypts and parts of 'Bega Wet Shrub Forest' (map unit 19) that are mapped on floodplains (Keith and Bedward 1999). River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is included within the 'Coastal Floodplain Wetlands' vegetation class of Keith (2002, 2004). There may be additional or unmapped occurrences of River-Flat Eucalypt Forest on Coastal Floodplains within and beyond these surveyed areas.

9. The extent of the River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. However, one estimate based on a compilation of regional vegetation maps suggests that Coastal Floodplain Wetlands, which include Temperate Eucalypt Forest on Coastal Floodplains, currently cover 800-1400 km2, representing less than 30% of the original extent of this broadly defined vegetation class (Keith 2004). Compared to this combined estimate, the remaining area of River-Flat Eucalypt Forest on Coastal Floodplains is likely to be considerably smaller and is likely to represent much less than 30% of its original range. Major occurrences include: about 2000 ha in the lower Hunter region in 1990s (NPWS 2000); less than 10 000 ha on the NSW south coast from Sydney to Moruya in the mid 1990s (Tindall et al. 2004), of which up to about three-quarters occurred on the Cumberland Plain in 1998 (Tozer 2003); and less than 1000 ha in the Eden region in 1990 (Keith and Bedward 1999).

10. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens and other cropping enterprises (e.g. turf). In the lower Hunter region, about one-quarter of the original extent was estimated to have remained during the 1990s (NPWS 2000), while less than one-quarter remained on the Cumberland Plain in 1998 (Tozer 2003). In the Sydney - South Coast region, less than one-fifth was estimated to remain in the late 1990s (Tindall et al. 2004), in the Eden region about 30% was estimated to remain during the 1990s (Keith and Bedward 1999).

11. Land clearing continues to threaten River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Benson and Howell 1990), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and are further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping (e.g. Benson and Howell 1990, Boulton and Brock 1999, Johnston *et al*. 2003). Anthropogenic climate change may also threaten River-Flat Eucalypt Forest on Coastal Floodplains if this affects future flooding regimes (IPCC 2001, Hughes 2003). Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species. Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change; High frequency fire; and Removal of dead wood and dead trees are listed as Key Threatening Processes under the Threatened Species Conservation Act (1995).

12. Very few examples of River-Flat Eucalypt Forest on Coastal Floodplains remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community, dumping of landfill rubbish and garden refuse, polluted runoff from urban and agricultural areas, construction of roads and other utilities, and grazing by domestic livestock. The principal weed species affecting River-Flat Eucalypt Forest on Coastal Floodplains include *Anredera cordifolia* (madeira vine), *Araujia sericiflora* (moth plant), *Asparagus asparagoides* (bridal creeper), *Axonopus fissifolius* (narrow-leaved carpet grass), *Bidens pilosa* (cobbler's peg), *Cardiospermum grandiflorum* (balloon vine), *Cirsium vulgare* (spear thistle), *Conyza bonariensis* (flaxleaf fleabane), *C. sumatrensis* (tall fleabane), *Gleditsea triacanthos* (honey locust), *Hypochaeris radicata* (catsear), *Ipomoea* spp. (morning glories), *Lantana camara* (lantana), *Ligustrum lucidum* (large-leaved privet), *L. sinense* (small-leaved privet), *Lonicera japonica* (Japanese honeysuckle), *Macfaydyena unguis-cati* (cat's claw creeper), *Olea europea* subsp. *cuspidata* (African olive), *Plantago lanceolata* (plantain), *Rubus* fruticosis agg. (blackberries), *Senecio madagascariensis* (fireweed), *Senna pendula* var. *glabrata, Setaria parviflora* (slender pigeon grass), *Sida rhombifolia* (paddy's lucerne), *Sonchus oleraceus* (common sowthistle), *Tradescantia fluminensis* (wandering jew), *Verbena bonariensis* (purpletop), *Paspalum dilatatum* (paspalum), *P. urvillei* and *Pennisetum clandestinum* (kikuyu) (Tozer 2003, Keith and Scott 2005, J. R. Hosking, pers. comm.).

13. Small areas of River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Blue Mountains, Cattai, Dharug, Georges River, Marramarra, Morton, Deua and Wadbilliga National Parks, and Gulguer and Mulgoa Nature Reserves, and these are

unevenly distributed throughout the range and unlikely to represent the full diversity of the community. The reserved examples are on localised, sheltered river flats between hills, rather than the large open floodplains that comprised the majority of the original habitat (Keith 2004).

14. In view of the above the Scientific Committee is of the opinion that River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam

Chairperson

Scientific Committee

Proposed Gazettal date: 17/12/04

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About the NSW Scientific Committee

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JMD design

Catherine McAuley & Parramatta Marist High Schools

APPENDIX C

Landscape Drawings & Technical Specification

December 2009

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Client: Catholic Education Office
Date: 21st December 2009
Location: Westmead Campus
Works: Bush Regeneration & Maintenance

TECHNICAL SPECIFICATION

A PRELIMINARIES

A 1 Generally

The work to be performed under this Contract includes, but is not limited to, weed removal, bush regeneration works, soil works, revegetation works, seed/propagule sourcing, propagation, growing of plant material, planting, plant establishment and maintenance of the planting works and generally all other works described in the Documents for a 2 year period.

The work as covered by this Contract includes the planning and supervision, the supply of all materials and the cost of all labour, equipment, machinery, all applications, certificates, profits and overheads necessary to complete the works as detailed in the Contract Documents.

A water supply is not available on site. The Contractor shall allow to provide water as required for planting & Maintenance works.

The Contractor will ensure that erosion & sediment control measures are in place at all times, to prevent erosion of bare earth areas and siltation of Basin 1.

A 2 Scope of Work

The Contractor shall be responsible for construction, supply, installation and maintenance of all works specified herein and as shown on the Drawings.

Briefly the works include:

- Weed removal and control
- Bush Regeneration & recurrent maintenance works for 2 years
- Seed/propagule sourcing, growing on of planting material
- Cultivation and preparation of planting areas
- Supply and installation of plant material
- Supply and installation of rural style fence (Provisional)
- Supply and installation of erosion control measures (Provisional)
- Supply and installation of erosion control mat (Provisional)
- Supply and installation mulch
- Plant Establishment of each discrete section of new planting works for 26 weeks

A 3 Inspections

Give not less than 24 hours notice so that inspections may be made of the following:

- weed removal and control complete
- setting out of all planting works complete
- plant material at source of supply
- setting out of planting works completed
- plant material delivered to site
- cultivation of existing site topsoil prior to planting
- planting completed
- achievement of Practical Completion
- at various stages throughout Plant Establishment
- at 6 month intervals throughout Bush Regeneration Contract
- upon Final Completion

A 4 Public Utilities Services

The Contractor shall be responsible for ascertaining the location of all existing public utility services, mains, valves, hydrants etc. in and adjacent to the works area.

Location of services and liaison with the Service Authorities as well as undertaking any protection requested by the Service Authorities remains the Contractor's responsibility.

A 5 Workmanship & Certification

Generally work shall be executed by appropriately qualified trades people. Subcontractors shall be licensed for their respective trades and have current licenses, permits and insurances as required by law.

A 6 Setout & Discrepancies

The Contractor shall be responsible for the setting out of the work and checking the work for discrepancies and ambiguities prior to undertaking the works. The Contractor shall immediately refer any discrepancies or ambiguities to the Client's Representative for resolution. No claims for delays to the works shall be accepted due to discrepancies found after the works have commenced.

B SITE PREPARATION

B 1 SAA Code Requirements

The whole of the site works and soilworks shall be carried out in accordance with AS 1289 Methods of Testing Soils for Engineering Purposes. Soil testing for horticultural purposes to AS 4419.

Tree Protection shall be to AS 49XXX 2009

B 2 Protection of Existing Vegetation

Existing endemic vegetation is to remain undisturbed and shall be adequately protected for the duration of the contract. Storage of materials, mixing of materials, vehicle parking, location of site office or sheds, stockpiling of soil, rubble or any debris shall not occur in this area.

Do not remove topsoil or fill ground within the dripline of trees to be retained. Do not disturb tree roots during cultivation or any other Contract Works.

B 4 Bush Regeneration Strategy (Performance Specification)

The Bush Regeneration Contractor shall apply for DEC (NPWS) 132C scientific licence from local remnant Shale Sandstone Transition Forest (SSTF) / Sydney Coastal River Flat Forest (SCRFF) to procure seed/propagule material for fabrication treatments within the site.

The Bush Regeneration Contractor shall apply for DEC (NPWS) 132C scientific licence to undertake bush regeneration works.

The Bush Regeneration Contractor (BRC) shall inspect the site and determine the exact extent of weed infestation and areas of treatment types.

Remove all rubbish and debris from remnant vegetation areas. Care must be taken prior to removal of rubbish and debris to ensure that it is not providing habitat for native animals.

Remove all noxious weeds from Parramatta City Council's Noxious Weed List. Weed species to be removed include but are not limited to: Acer, Blackberry, Privet, Kikuyu, Paddy's Lucerne, Paspalum, Firethorn, Purpletop, Fireweed, African Olive, Weeping Willow and various annual, perennial weeds and introduced grasses.

The BRC is to provide an Action Plan being the proposed detailed statement of approach to be applied to the works including

1. **Programming of activities, timing and duration of tasks for the three year Contract period. (Refer G1 for indicative program)**
2. **Personnel allocated to each activity/task and qualifications and relevant experience of personnel**
3. **Plant & equipment to be used**
4. **Techniques of weed eradication to be used**
5. **Monitoring & Report**

Carry out Bush Regeneration generally to guidelines set out in DEC Publication Recovering Bushland on the Cumberland Plain 200.

Refer Plan for indicative locations of suggested Bush Regeneration treatment types.

1. Generally Assisted Natural Regeneration shall be used in any remnant SSTF or SCRFF areas, where seed bank may be present in the soil and a high degree of natural resilience exists. Assisted

Natural Regeneration works generally occur in three stages: Primary Treatment, Secondary Treatment and Maintenance.

2. Reconstruction shall be carried out where native community has been largely lost, but original native soils still dominate. Reconstruction shall occur in disturbed areas

Bush regeneration shall be a combination of reconstruction and assisted natural regeneration

Weed removal method will vary according to type of weed being controlled. (Refer DEC recommendations for weed control for common weeds of the Cumberland Plain – Appendix C) Weed control should not encourage soil erosion or removal of native fauna habitat. Glyphosate herbicide is to be used only by people trained in its use and must not be applied near waterways or in drainage lines.

1. Primary Treatment

Bulk weed removal shall be carried out as the first operation in the contract period. Where appropriate primary treatment may be limited to removal of existing impacts/threatening processes which would prevent regeneration from occurring.

The BRC shall determine the most appropriate method of controlling large areas of Kikuyu. Should Kikuyu be removed from drainage line, erosion control measures will be required. Alternatively, Kikuyu may be slashed, sprayed with herbicide, left in-situ to act as mulch and planted into.

2. Secondary Treatment (or Follow-up)

Following primary treatment, follow-up treatment shall be executed to carefully remove weed species which are re-establishing on site following disturbance.

Follow up weeding programs shall occur during the maintenance period.

Large woody weeds shall be cut off at ground level and removed from site. The stumps shall be drilled and poisoned. Submit proposed treatment for approval by the Client's Representative. Smaller weeds shall be removed by hand or, on approval of the Client's Representative , when occurring in large concentrations may be sprayed with an approved herbicide. Small succulent weeds, bulbs, corms, thickened rhizomes and plants which may regenerate from fragments shall be removed from site at the end of each working day.

No heavy machinery shall be allowed on to the bush regeneration site to clear weed growth. All machinery to be used in the weed removal/ decompaction process must be approved by the Client's Representative prior to arrival on site.

B 5 Sediment Control Barrier (Provisional)

The Contractor shall maintain sediment control provided by the building contractor .

Requirements

Particular care is to be taken to ensure that no erosion takes place and that no sediment escapes from the site or is deposited anywhere on site except in any properly designed and maintained sedimentation traps constructed by the Contractor to ensure compliance with this clause.

Silt Fence

If required silt fences shall consist of a geotextile membrane, Bidim A24 or equivalent stretched and supported by stakes, and wire strings to a height of 600mm minimum.

Stakes shall be 50 x 25 x 1000 star pickets, placed at 2 metre centres, Wire 16 gauge shall be strung tautly along the top of the stake. Membrane shall be fixed to stakes with 3 x gal clouts and turned down 50mm over top strand. Fix with continuous tie wire looped at 100mm centres.
Approximately 400mm of membrane is to be buried to a depth of 150mm to secure the base of the membrane. Tamp backfill to restore prior natural surface level.

B 6 Disposal of Spoil & Rubbish

All excess spoil and rubbish is to be disposed of off site at an Authorised Waste Management Centre.

C SOILWORKS

C 1 Cultivation

Remove existing weed growth, that is all non-endemic plant material, as specified. **All endemic plant material is to be retained.**

For bulk planting areas, cultivate by ripping to the depths specified below to loosen the ground. Do not disturb existing services or tree roots. Remove unwanted matter including stones exceeding 50mm in diameter, sticks and weeds brought to the surface during cultivation. Finely cultivate the surface and rake free of clods. Trim surfaces to specified levels after cultivation so that the minimum specified depth of topsoil and finish remains on completion of preparation.

Mass Planted Areas (Cleared Areas): Remove existing weed growth, rip ground to 300mm depth,

Tubestock Planting in bush regeneration :
Remove all weed growth and break up compacted soil, excavate planting hole twice the width of the container and 100mm deeper than the container, backfill with site topsoil.

C 2 Topsoil

Site topsoil shall be used for all planting works.

C 3 Mulch

Mulch shall be chipped native site material or Forest Blend, graded to 20 - 40mm as supplied by ANL, or similar

Spread mulch evenly to 75mm depth to all mass planted areas, to 75mm depth in Basin 1 and to bare weeded areas in bush regeneration areas. Taper mulch at edges to finish level with adjacent surfaces.

Mulch shall be free from soil, weed growth, and other green material or deleterious matter.

Provide 1kg sample of each mulch type for approval. No mulch shall be delivered to the site prior to approval of the sample provided.

C 4 Erosion Control Mat (Provisional)

If required install erosion control mat in locations as instructed by Client's Representative and as specified.

Erosion Control Mat shall be equivalent to Jute Thick Mat min. mass 800gms/m², min. density 125 kg/cub. M 100% organic 100% biodegradable product as supplied by Treemax Ph: (03) 9429 6000. Install Erosion Control Mat to the manufacturers recommendations including:

- Dig trench at top and bottom of slope minimum 300mm depth, lay blanket in trench prior to back filling with excavated material. Blanket edge at top shall be pinned using 500mm long pins at minimum 150mm centres or as directed.

- **Latitudinal joints - Bury upper end of lower blanket in trench 300mm depth. Overlap top blanket a minimum of 300mm and pin at 150mm centres. Longitudinal joints shall be overlapped at a minimum of 150mm.**

- Pins shall be 300mm deep min. and anchored firmly into compacted ground. A minimum of two pins per square metre shall be places internally or as directed. For slopes steeper than 1:3 extra pins (& longer if required) shall be placed internally at the direction of the Client's Representative. Extremities

of blanket shall be pinned at a minimum of 300mm intervals with 500mm long pins or as directed. All edges shall be turned under, pegged and finished in a neat manner.

Where flows are considered to be stronger, sandstone pieces shall be placed in appropriate locations over the mat to hold it down.

D PLANT MATERIAL AND PLANTING

D 1 Generally

This section includes the supply, delivery and planting of all plant material including labour and incidentals necessary to complete the work.

D 2 Seed Collection, Propagation and Plant Supply for Bush Regeneration & Reconstruction Areas

The contractor shall arrange for seed/propagule collection from site and from remnant SSTF &/or SCRFF within 5 km of site. Plant material shall be collected in accordance with the guidelines developed in "*Model Code of Practice for Community-Based Collectors and Suppliers of Native Plant Seed*" as prepared by *FloraBank* (www.florabank.org.au).

The contractor is responsible for gaining all necessary approvals.

The contractor will arrange for seeds to be propagated into appropriate pot size. The contractor shall determine quantities and staging of planting required, for bush regeneration areas, to meet stated goals over two year period.

If plant material is sourced for a commercial nursery the contractor shall provide written proof from the nursery as to details of the plants supplied and their provenance. Proof of ordering & provenance shall be furnished on request by the Client's Representative.

Sufficient quantities shall be ordered to allow for plant failures.

Any plants which fail or are damaged at any stage shall be replaced with an equivalent standard of plant.

If, in the opinion of the Client's Representative the plant material has been damaged as a result of lack of care by the Contractor, the Contractor shall be responsible for replacement of such stock.

D 3 Plant Materials

Plants shall be vigorous, well established, of good form, not soft or forced, hardened off, free from disease and pests with large healthy root systems, with no evidence of root spiralling or being pot bound. The root system shall be well balanced in relation to the size of the plant.

Trees shall have a single leading trunk and shoot.

Plant containers shall be of an appropriate size for the size of the plant and free from weeds. Plants shall not exhibit signs of being stressed at any stage during their development due to inadequate watering, excessive sunlight, physical damage or have restricted growth due to nursery rows. No substitutions shall be made unless approved in writing by the Client's Representative.

Give notice, of at least 24 hours, of plants availability for inspection at the source of supply and again on delivery to the site. No plant is to be delivered on to the site prior to approval by the Client's Representative.

At least one plant of each species in a batch shall be clearly labelled.

Keep plants in good condition during storage. Prevent drying out or damage from any cause including frost, wind, sun, theft, vermin, animals and the like. Provide an on site nursery for holding plant stock if plants to be on site for more than 48 hours prior to planting.

D 6 Planting

Do not vary plant locations from those shown on the Contract Drawings unless otherwise directed. If it appears necessary to vary the locations and spacings to avoid service lines, or for similar reasons, apply for directions.

The reinstatement of plants should reflect the natural community assemblage as far as possible but without extensive bare area, which may be the subject of soil erosion.

Do not plant in unsuitable weather conditions such as extremes of heat or cold, wind or rain.

Before plants are installed all pot sizes shall have their roots pruned with a appropriate, clean, sharp instrument to eliminate any root confusion occurring at the edge of pot zone.

Before planting begins, thoroughly water the plants and the planting area. Keep the area and plants moist during planting. Water the plants immediately after planting, and thereafter as required to maintain growth rates free of stress.

Revegetation Areas & Bushland Areas: Excavate a hole for planting each plant large enough to provide not less than 150mm all around the root system of the plant and backfill with site topsoil mixture

When the hole appears to be the correct size, and not before, remove the plant from the container with minimum disturbance to the root system and place in its final position.

When plant is in its final position in its hole the topsoil level of the plant root ball for tube stock plants shall be flush with the finished surface of the soil surrounding the hole.

The Contractor shall give notice, of not less than 24 hours, that plants are placed and ready for backfilling for an inspection by the Client's Representative.

E LANDSCAPE CONSTRUCTION

E 1 Generally

The Contractor shall be responsible for the setting out of the work and checking the work for discrepancies and ambiguities prior to undertaking the works. The Contractor shall immediately refer any discrepancies or ambiguities to the Client's Representative for resolution. No claims for delays to the works shall be accepted due to discrepancies found after the works have commenced.

The Contractor shall be responsible for the setting out of the works and ongoing checking for services while the works are in progress. The Client's Representative is to approve all setouts prior to construction proceeding. Any conflicts and / or discrepancies found shall be immediately reported to the Client's Representative.

E 2 Protective Fencing

Install Protective fencing around bush regeneration areas where shown on Plans to prevent vehicular access into bushland.

Protective fencing will be 900mm high consisting of 1800mm long 150 x 150mm square corner posts driven 900 into ground and 100 x 100mm square posts at 3.0m centres hardwood timber sourced from certified managed forests or Copper Azole or Tanalith E treated pine posts driven 600mm into the ground. Bracing posts are to be used at corner post and in straight runs of fencing at 15.0m centres.

Provide three (3) strands of 2.8mm high tensile galvanised wire threaded through posts and tensioned by turn buckle. Provide 25 x 50mm timber strainer at equal spacing between posts.

E 3 Service Access Gates

Provide gates in locations as shown and as as agreed with Client's Representative.

Gates shall be standard heavy duty field gates 1.17 m high with diagonal brace as supplied by ARC or approved equivalent to fit opening 3.0m wide as required. Fit gate to protection fence posts with manufacturer supplied hinges, gudgeons and field gate catch fitting as well as self closing mechanism.

F PLANT ESTABLISHMENT

F 1 Generally

The work contained in this section comprises maintenance of all works executed under this contract.

The Plant Establishment period for newly mass planted areas and Basin 1 is 26 weeks.

The Contractor shall maintain the bush regeneration areas and creekline for a period of 2 years. (Refer Sections G & H).

Throughout the maintenance period continue to carry out recurrent works of a maintenance nature specified elsewhere in this specification, including but not limited to watering, weeding, fertilising, pest and disease control, plant replacement and the like. Maintenance shall include the following items as a minimum requirement.

F 2 Plant Establishment Reports

The Contractor shall provide written maintenance reports, monthly, outlining what dates the site was inspected and what works were undertaken as follows:

- number and species of plant replacements,
- number and species of plants stolen or vandalised,
- extent of watering,
- extent of fertilising,
- extent of herbicide or insecticide spraying,
- extent of weeding,
- extent of rubbish removal,

Maintenance payments will be made only on receipt of Maintenance reports.

F 3 Watering

Planted areas shall be watered regularly to ensure continuous healthy growth and plant establishment. There is no water on site and the Contractor shall allow for supply of water.

F 4 Weeding and Rubbish Removal

During the contract period remove by hand, rubbish and weed growth that occurs throughout all contract areas. This shall be executed regularly so that at weekly intervals, at least, the contract area may be observed in a completely clean and tidy condition.

F 5 Replacements

Immediately replace plants which die or fail to thrive or are damaged or stolen, with plants of same size and quality unless otherwise directed.

In the case of stolen or vandalised plants the Contractor will be required to replace the plants a maximum of once.

F 6 Pruning

Pruning work shall be implemented to maintain dense foliage growth and encourage suitable growth habits.

F 7 Mulch

Maintain mulched surfaces in a clean and tidy condition. Reinstate mulch to specified depths and extents as specified.

F 8 Spraying

Report any incidence of pest or disease attack on plants to the Client's Representative. Insecticide and fungicide spraying, if considered necessary and approved by the Client's Representative, shall be carried out in accordance with the manufacturer's instructions. The Contractor shall treat all occurrences of insect attack or disease in plant material.

F 9 Completion

Notwithstanding anything to the contrary in the Contract, the Client's Representative may instruct the Contractor to perform urgent maintenance works. Should the Contractor fail to carry out these works within seven (7) days of such a notice, the Client's Representative reserves the right to employ others to carry out such works and charge costs of these works to the Contractor.

G Program Implementation

G 1 Maintenance & Management Regimes (INDICATIVE ONLY)

The following table provides a summary of the staging of revegetation and bush regeneration works as outlined on Plan and in **B 4 Bush Regeneration. The Contractor shall use this as s guide only. Contractor to provide a strategy of approach Action Plan and a program of works as part of their Tender**. The table provided will be used as the basis for gauging the performance of implementation.

Indicative Program- Stage 1

Tasks	Pre Construction	Construct	Year 1	Year 2
Species procurement for reconstruction treatments				
Develop species list and quantities for Bush Regeneration works. Species and quantities for works nominated on Plan.				
Apply for NPWS collection permit (Section 91) for nearby remnants to procure seed/propagule material required for reconstruction treatments/ source plant material				
Engage contract for propagation of plant material in conjunction with timing for works/ order stock from approved nursery				
Construction				
Establishment of sediment control barrier				
Implement Primary weed control				
Commence reconstruction of exotic dominated areas. Replanting, mulching/mat and maintenance of plantings				
Application of assisted natural regeneration treatment in better quality areas				
Monitoring & reporting				
Annual monitoring of works and reporting to Client's/Council / DEC (restoration progress & impact mitigation)				

G 2 VEGETATION MONITORING & REVIEW PROCESS

Maintenance & Management Regimes

Plant Establishment & Maintenance will be carried out by the landscape &/or bush regeneration contractor for a two year period.
The contractor is to establish 4 minimum photo points (locate with GPS co-ordinates) for the purpose of ongoing monitoring

VEGETATION MANAGEMENT TASK	MONTHLY MONITORING/ *ACTIVITIES*	BIMONTHLY MONITORING/ ACTIVITIES	6 MONTHLY ACTIVITIES	YEARLY ACTIVITIES
Plant Replacements	As required for two year establishment period		As required years 1 – 2	Recurrent if required
Weeding	As required for two year establishment period	As required for Years 1 - 2		Recurrent if required
Watering	As required for two year establishment period			
Mulching			Supplement mulch in years 1 – 2	
Pest & Disease Monitoring	For 6 month establishment period	Monitor and record occurrence- recommend treatments as relevant.		Recurrent
Erosion & Sediment Control		Monitor and record occurrence- see instructions as to action required		
Water Quality			Test water in years 1 -2- report any deviations from required results - see instructions as to action required	
Attack of vegetation by rabbits/hares, birds etc		Monitor and record occurrence- seek instructions as to action required		
Vandalism		Monitor and record occurrence- seek instructions as to action required		
Storm events	Additional inspection on occurrence- record occurrence and any damage, make good any damage on instruction			

Reports submitted are to address above items.

G 3 Monitoring And Review Of Terrestrial Vegetation

A monitoring program will be carried out by a suitably trained organisation to provide data for maintenance and establishment program including plant replacement, weed control and pest & disease control. Vegetation establishment to be monitored and reviewed over a period of 2 years initially. Annually review of performance and procedures and amend as necessary.

AREA	PERFORMANCE MEASURES	METHOD AND PARAMETERS	FREQUENCY OF MONITORING	RESPONSIBILITY
Planting of trees, shrubs & grasses	Establishment of vigorous growth of trees, shrubs and grasses	Establishment of 1 tree per 16m² and shrub per 2m² or 4 grasses per m²	Initial recording at time of planting 2 monthly assessment and reporting immediately after each storm event	Bushland Supervisor
Weed control	Control weed infestation to satisfactory levels	Nil Noxious Weeds 20% Visible Perennial Weeds 20% Visible Annual Weeds	Initial treatment at time of planting 6 monthly assessment and reporting.	Bushland Supervisor
Pest and disease control	Control pests and diseases to satisfactory levels utilising integrated pest management strategies	20 – 30% Visible Damage	2 monthly assessment and reporting.	Bushland Supervisor
Erosion & Sediment Control	No visual evidence of erosion or sediment transfer.	Visual Inspect Temporary sediment control structures (eg sediment control fences, straw bales, geofabric barriers) in place and operating	2 monthly assessment and reporting immediately after each storm event	Bushland Supervisor
Water Quality	Maintain the water quality recorded by the Upper Parramatta River Catchment Trust (UPRCT) for the two test sites within the study area described as 'wetland' and 'downstream school wetland' (see *www.**waterwatch.nsw**.gov.au)*	Inspect and sample water quality using the senior waterwatch methodology as outlined by the UPRCT	6 monthly assessment and reporting.	School

WORKS DECRIPTION

DESCRIPTION OF LANDSCAPE REVEGETATION WORKS IN ZONE 1 - 3

Works to be undertaken in this area include but are not limited to:

1. collection of locally indigenous plant propagation material;
2. propagation of locally Indigenous plant material;
3. weed and rubbish removal
4. installation of vegetation protection fencing
5. bush regeneration works to areas of supplementary planting
6. delivery of locally indigenous plant material to site;
7. soil cultivation of mass planting areas;
8. installation of erosion control measures;
9. planting of locally indigenous plant materials
10. Supply and installation of mulches
11. prevention of damage to revegetation works by local fauna;
12. establishment of locally indigenous plant material;
13. maintenance of works zone for 2 years.

DESCRIPTION OF LANDSCAPE REVEGETATION WORKS IN ZONE 4

Works to be undertaken in this area include but are not limited to:

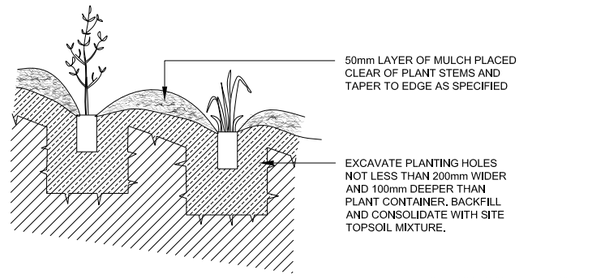
1. collection of locally indigenous plant propagation material;
2. propagation of locally indigenous plant material;
3. weed and rubbish removal
4. Installation of vegetation protection fencing
5. bush regeneration works to areas of supplementary planting
6. delivery of locally indigenous plant material to site;
7. soil cultivation of mass planting areas;
8. installation of erosion control measures;
9. planting of locally indigenous plant materials
10. Supply and installation of mulches
11. thinning of littoral plants in wetland by 50% of total planted area
12. prevention of damage to revegetation works by local fauna;
13. establishment of locally indigenous plant material;
14. maintenance of works zone for 2 years.

DESCRIPTION OF LANDSCAPE REVEGETATION WORKS IN ZONE 5

Works to be undertaken in this area include but are not limited to:

1. collection of locally indigenous plant propagation material;
2. propagation of locally indigenous plant material;
3. weed and rubbish removal
4. installation of vegetation protection fencing
5. delivery of locally Indigenous plant material to site;
6. soil cultivation of mass planting areas;
7. installation of erosion control measures;
8. planting of locally indigenous plant materials
9. Supply and installation of mulches
10. prevention of damage to revegetation works by local fauna;
11. establishment of locally indigenous plant material;
12. maintenance of works zone for 2 years.

LOCALITY

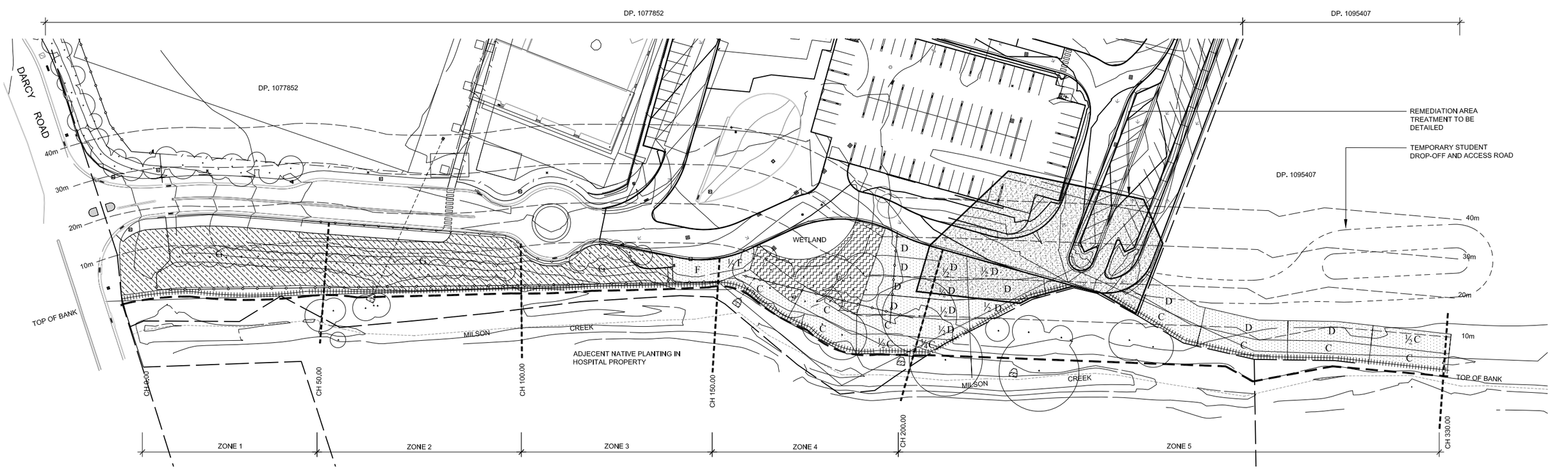


1 TUBESTOCK PLANTING TYPE A
Scale 1:10

0 100 200 500mm

LEGEND

- RETAIN AND PROTECT EXISTING TREE
- PROPERTY BOUNDARY
- CREEK LINE
- TOP OF BANK OF EXISTING CREEK
- OFFSET TOP OF BANK LINE
- CHAINAGE LINE
- EXISTING FENCE LINE TO BE RETAINED
- REMEDIATION AREA
- A — PROPOSED PLANTING BLOCKS AS DETAILED
- EXTENT OF PLANTING TYPE E
- EXTENT OF PLANTING TYPE G
- SEDIMENT FENCE TO ENGINEERS DETAIL
- EXISTING STORM WATER OUTLET, LOCATIONS SHOWN ARE INDICATIVE
- STRAW BALES OR SIMILAR TO ANY OUTLET IN RIPARIAN CORRIDOR



PLANTING PLAN

Scale 1:500

0 5 10 20m

Issue	Comments	Date
ADV	80% ADVANCED ISSUE	05.03.09
ADV	Discussion Plan	20.05.09
A	For 3A Permit Approval	22.12.09

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Project
WESTMEAD CATHOLIC EDUCATION PRECINCT
Drawing Title
REHABILITATION WORK SHEET 1

Date
JUNE 07

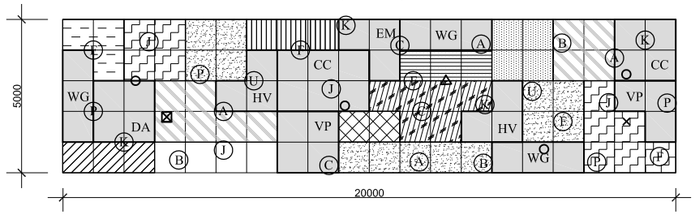
Scale
1:500 @ A1

Drawing Number
L01

Issue
A

PLANTING BLOCK C

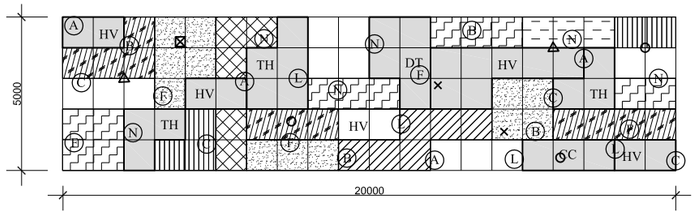
NOMINALLY 100m² - 5m x 20m
ZONE 4 REPEAT 4,5 TIMES, ZONE 5 REPEAT 4,75 TIMES (TOTAL 9,25)



SPECIES	SYM	ZONE 4 QTY	ZONE 5 QTY	TOTAL
TREES				
Casuarina glauca	○	18	14	32
Eucalyptus ampliflora	△	5	4	9
Eucalyptus elata	×	5	4	9
Melaleuca decora	⊠	5	4	9
Melaleuca stypheliodes	□	14	11	25
SHRUBS				
Acacia floribunda	F	23	18	41
Acacia linifolia	A	18	14	32
Banksia spinulosa	B	14	11	25
Bursaria spinosa	U	9	7	16
Callistemon citrinus	C	14	11	25
Kunzea ambigua	K	18	14	32
Leucopogon juniperinus	J	18	14	32
Pimelea linifolia	P	18	14	32
GRASSES & GROUND COVERS				
Commelina cyanea	CC	180	140	320
Dianella caerulea s. lat		54	42	96
Dianella revoluta		36	28	64
Dichondra repens		72	56	128
Doodia aspera	DA	72	56	128
Entolasia marginata	EM	54	42	96
Gahnia aspera		54	42	96
Geranium solanderi		234	182	416
Hardenbergia violacea	HV	108	84	192
Imperata cylindrica var. *major*		180	140	320
Lomandra filiformis		54	42	96
Lomandra multiflora subsp. *multiflora*		180	140	320
Pratia purpurascens		54	42	96
Persicaria decipiens		108	84	192
Veronica plebeian	VP	126	98	224
Wahlenbergia gracilis	WG	162	126	288

PLANTING BLOCK D

NOMINALLY 100m² - 5m x 20m
ZONE 4 REPEAT 4 TIMES, ZONE 5 REPEAT 4 TIMES, ZONE 5 REPEAT 3 TIMES (TOTAL 11)



SPECIES	SYM	ZONE 4 QTY	ZONE 5 QTY	TOTAL
TREES				
Casuarina glauca	○	12	21	33
Eucalyptus ampliflora	△	8	14	22
Eucalyptus elata	×	8	14	22
Melaleuca decora	⊠	4	7	11
Melaleuca stypheliodes	□	8	14	22
SHRUBS				
Acacia floribunda	F	20	34	54
Acacia linifolia	A	16	27	43
Banksia spinulosa	B	16	27	43
Callistemon citrinus	C	16	27	43
Callistemon linearifolius	N	24	41	65
Leptospermum polygalifolium	L	16	27	43
GRASSES & GROUND COVERS				
Commelina cyanea	CC	48	81	129
Danthonia tenuior	DT	80	135	215
Dianella caerulea s. lat		80	135	215
Dianella revoluta		80	135	215
Geranium solanderi		176	297	473
Hardenbergia violacea	HV	240	405	645
Lomandra filiformis		96	162	258
Lomandra multiflora subsp. *multiflora*		192	324	516
Pratia purpurascens		48	81	129
Persicaria decipiens		176	297	473
Themada australius	TH	176	297	473

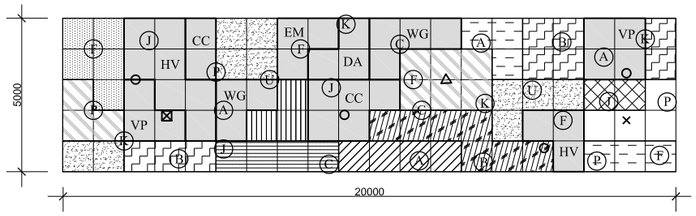
PLANTING AREA E

ZONE 4: 384m² (TOTAL 384m²)

SPECIES	ZONE 4 QTY	TOTAL
SHRUBS		
Acacia floribunda	10	10
Banksia spinulosa	10	10
Leptospermum polygalifolium	10	10
GRASSES & GROUND COVERS		
Commelina cyanea	20	20
Danthonia tenuior	50	50
Dianella caerulea s. lat	50	50
Dianella revoluta	150	150
Geranium solanderi	100	100
Hardenbergia violacea	150	150
Lomandra filiformis	70	70
Lomandra multiflora subsp. *multiflora*	150	150
Pratia purpurascens	20	20
Persicaria decipiens	100	100
Themada australius	100	100

PLANTING BLOCK F

NOMINALLY 100m² - 5m x 20m
ZONE 3 REPEAT 1TIMES, ZONE 4 REPEAT 0,5 TIMES (TOTAL 1,5)



SPECIES	SYM	ZONE 1 QTY	ZONE 2 QTY	ZONE 3 QTY	ZONE 4 QTY	TOTAL
TREES						
Casuarina glauca	○	10	10	8	2	30
Eucalyptus ampliflora	△	3	3	2	1	9
Eucalyptus elata	×	3	3	2	1	9
Melaleuca decora	⊠	3	3	2	1	9
Melaleuca stypheliodes	□	8	8	6	2	24
SHRUBS						
Acacia floribunda	F	13	13	10	3	39
Acacia linifolia	A	10	10	8	2	30
Banksia spinulosa	B	8	8	6	2	24
Bursaria spinosa	U	5	5	4	1	15
Callistemon citrinus	C	8	8	6	2	24
Kunzea ambigua	K	10	10	8	2	30
Leucopogon juniperinus	J	10	10	8	2	30
Pimelia linifolia	P	10	10	8	2	30
GRASSES & GROUND COVERS						
Commelina cyanea	CC	70	70	56	14	210
Dianella caerulea s. lat		30	30	24	6	90
Dianella revoluta		20	20	16	4	60
Dichondra repens		50	50	40	10	150
Doodia aspera	DA	30	30	24	6	90
Entolasia marginata	EM	30	30	24	6	90
Gahnia aspera		40	40	32	8	120
Geranium solanderi		100	100	80	20	300
Hardenbergia violacea	HV	100	100	80	20	300
Imperata cylindrica var. *major*		90	90	72	18	270
Lomandra filiformis		40	40	32	8	120
Lomandra multiflora subsp. *multiflora*		90	90	72	18	270
Pratia purpurascens		60	60	48	12	180
Persicaria decipiens		70	70	56	14	210
Veronica plebeian	VP	70	70	56	14	210
Wahlenbergia gracilis	WG	70	70	56	14	210

PLANTING AREA G

ZONE 1: 877m², ZONE 2: 739m², ZONE 3: 336 m² (TOTAL 1952m²)

SPECIES	ZONE 1 QTY	ZONE 2 QTY	ZONE 3 QTY	TOTAL
SHRUBS				
Acacia floribunda	25	25	10	60
Acacia linifolia	20	15	7	42
Banksia spinulosa	30	20	7	47
Callistemon citrinus	15	10	8	33
Kunzea ambigua	20	20	10	50
GRASSES & GROUND COVERS				
Commelina cyanea	90	70	20	180
Danthonia tenuior	150	140	40	330
Dianella caerulea s. lat	150	170	40	360
Dianella revoluta	350	300	150	800
Geranium solanderi	200	150	80	430
Hardenbergia violacea	300	250	130	680
Lomandra filiformis	140	120	80	340
Lomandra multiflora subsp. *multiflora*	300	250	130	680
Pratia purpurascens	120	100	20	240
Persicaria decipiens	200	150	80	430
Themada australius	200	150	80	430

Issue	Comments	Date
ADV	80% ADVANCED ISSUE	05.03.09
ADV	Discussion Plan	20.05.09
A	For 3A Permit Approval	22.12.09

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Project
WESTMEAD CATHOLIC EDUCATION PRECINCT
Drawing Title
REHABILITATION WORK SHEET 2

Date
JUNE 07

Scale
1:500 @ A1

Drawing Number
L02

Issue
A