



North Ryde Station Precinct, M2 Site, State Significant Development, Vegetation Management Plan

Prepared for
NPC on behalf of Urban Growth NSW

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Abbreviations

ABBREVIATION	DESCRIPTION
AABR	Australian Association of Bush Regenerators
APVMA	Australian Pesticides and Veterinary Medicines Authority
BGHF	Blue Gum High Forest in the Sydney Basin Bioregion
CEEC	Critically Endangered Ecological Community
CPI	Consumer Price Index
DPI	Department of Planning and Infrastructure
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GST	Goods and Service Tax
ILP	Indicative Layout Plan
LGA	Local Government Area
MPC	Macquarie Park Corridor
NW Act	<i>Noxious Weeds Act 1993</i>
OEH	Office of Environment and Heritage
OH&S	Occupational Health and Safety
OSL	Office of Strategic Lands
RCMS	Riparian Corridor Management Study
RMS	NSW Roads and Maritime Authority
SGF	Sydney Gully Forest
SRW	Sydney Sandstone Ridgetop Woodland
SSDA	State Significant Development Application
TEC	Threatened Ecological Community
The Precinct	North Ryde Station Precinct Project
TSC Act	<i>Threatened Species Conservation Act 1995</i>
VMP	Vegetation Management Plan
WONS	Weeds of National Significance

1 Introduction

1.1 Background

This Vegetation Management Plan (VMP) has been prepared by Eco Logical Australia Pty Ltd (ELA) for NPC on behalf of UrbanGrowth NSW. This plan provides recommendations for the restoration and revegetation of a bushland area to be retained on the M2 Site in the North Ryde Station Precinct.

1.2 Planning Context

The North Ryde Station Precinct (NRSP) is located northwest of Sydney CBD and was rezoned in July 2013 to facilitate high density residential development and mixed uses. The site is located within the North Ryde Station Urban Activation Precinct which was initiated by the NSW Planning & Infrastructure (P&I) and Transport for NSW (TfNSW).

Based on the Indicative Layout Plan for the NRSP, a State Significant Development Application (SSDA) was prepared on behalf of Transport for NSW in 2012 / 2013 for superlot subdivision and early enabling works on the NRSP lands including the M2 Site and the following sites:

- Station Site North (owned by TfNSW)
- Station Site South (owned by Goodman)
- OSL Site (owned by Office of Strategic Lands)
- RMS Site (owned by Roads and Maritime Services (RMS)).

As part of this SSDA, Eco Logical Australia (ELA) prepared an Ecological Impact Assessment (EIA) and Vegetation management Plan (VMP) for the whole NRSP (ELA, 2012), however the SSDA was not lodged by TfNSW. The North Ryde Station Precinct Development Control Plan (NRSP DCP) was adopted in December 2013.

The majority of the NRSP is now under the ownership of UrbanGrowth NSW (UGNSW). UGNSW now intends to lodge an SSDA for the M2 Site only. This will reflect a modified M2 Site Masterplan and requires associated amendments to the NRSP DCP.

The SSDA will focus on the M2 site only rather than the wider NRSP. A separate application has previously been submitted for enabling works on the Station Site North and is not the subject of these proposed works on the M2 Site. ELA have reviewed their 2013 VMP to address the management of vegetation that relate to the M2 site, herein the VMP area.

1.3 Study Area

The study area, also referred to as the 'M2 site' is located within the NRSP, being land bound by Wicks Road, Epping Road, Delhi Road and the M2 Motorway at North Ryde (**Figure 1**). The study area is legally described as Lot 101 DP 113 1776 and an area of approximately 528 m² on Lot 2 DP 528 488 has been added to the study area. This land is located in the southwest corner of the study area, and has been considered in this assessment as it is proposed to adjust the boundary site for a deceleration lane off Epping Road. The area in which this VMP applies to (referred to as the VMP area), is approximately 4,323 m² (**Figure 2**). A proposed elevated boardwalk and viewing platform will also feature within the study area and as yet the final design has not been provided to be included in this VMP. The boardwalk and platform have potential to reduce the extent of revegetation works required in this VMP (**Appendix A**).

The study area is situated within the City of Ryde (Council) Local Government Area (LGA), and is located at the southern end of the Macquarie Park Corridor (MPC). There is an underground train line passing below the study area between Macquarie Park Station and Delhi Road Station.

Porters Creek is located in the north of the study area in the area marked 'VMP area' in **Figure 2** (. Porters Creek drains east along Wicks Road toward the Porters Creek catchment area and Lane Cover River to the north. This area is referred to as the 'Northern Bushland Park' within the NRSP DCP and as the 'Public Reserve' in the Masterplan.

Bundara Reserve is located to the south of the study area on the opposite side of Epping Road.

1.4 Scope and objectives of VMP

The precinct will improve or maintain 0.43 ha of bushland of which a small proportion will include the elevated boardwalk and viewing platform. This VMP will direct the management of this bushland through the establishment phase (two years) and the maintenance phase (three years). Works adjacent to the VMP area includes areas of grassed open space, native and exotic vegetation plantings, footpaths, retaining walls, drainage works and roads (see **Appendix A** for more details). None of these features are included in the VMP. The management aims of this VMP are detailed below:

- protect remnant bushland within the VMP area, undertake bush regeneration works to improve the condition of the bushland within the VMP area, including revegetation and weed control noxious and environmental weeds within the VMP area; and
- identify the costs associated with the implementation of this VMP.

1.5 Implementation of Works

All vegetation management works will be undertaken by suitably qualified and experienced bush regeneration contractors who are members of the Australian Association of Bush Regenerators (AABR) or fulfil the membership criteria and all weed control techniques will utilise techniques recognised by the AABR. Suitable minimum qualifications are considered to be a TAFE Certificate III in Conservation & Land Management or equivalent.

A project specific, comprehensive environmental and Occupational Health and Safety (OH&S) plan is to be prepared by the contractors prior to undertaking works and all staff are to be inducted to the site by the lead supervisor.

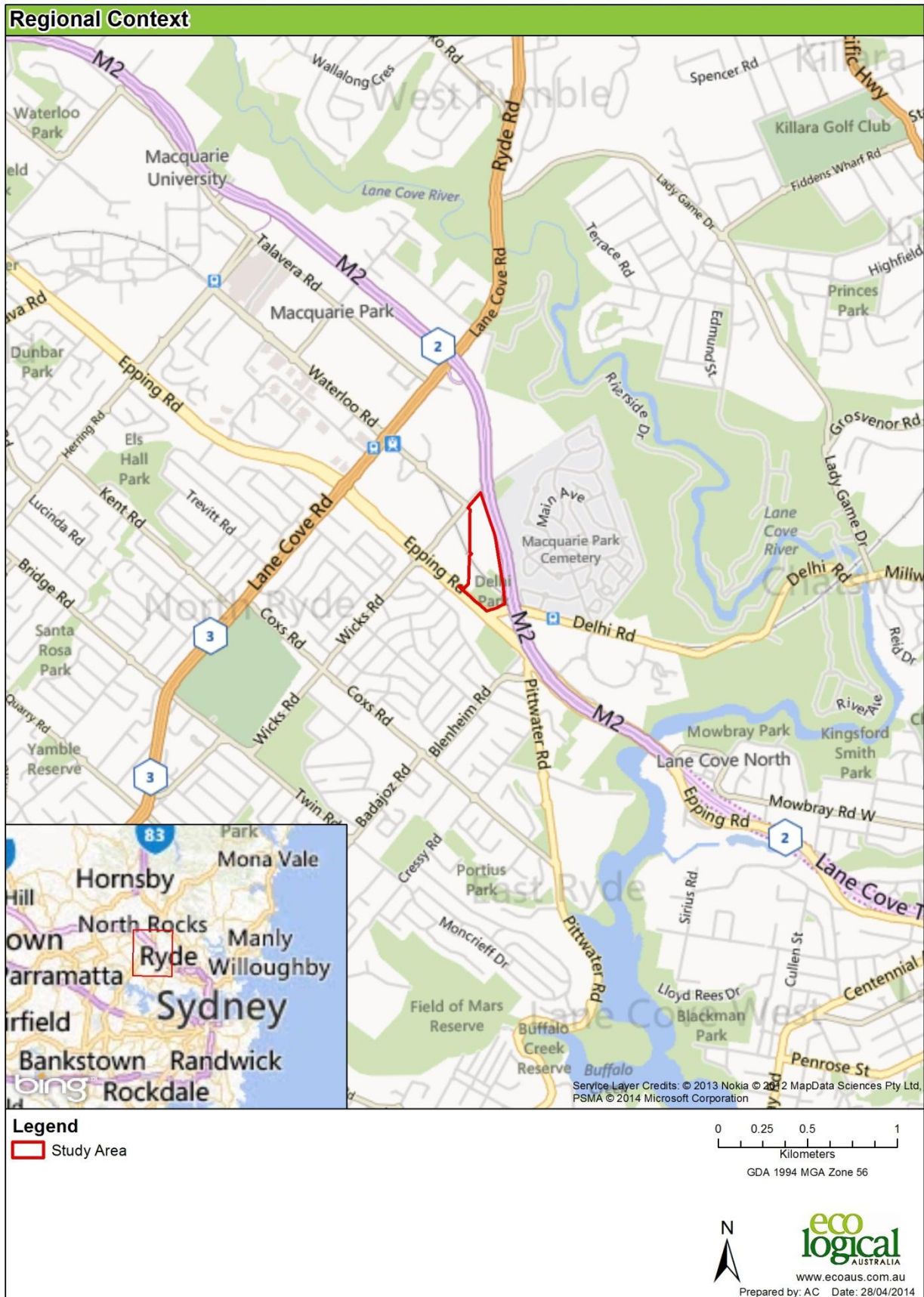


Figure 1: Regional context of the North Ryde Station Precinct, M2 Site (Study area)



Figure 2: Location of the VMP area within the North Ryde Station Precinct

2 Description of environment

2.1 Existing environment

The VMP area is on a drainage line. The VMP area slopes to the north with the drainage line flowing into Porters Creek and ultimately draining in to Lane Cove River to the north east. Details for the VMP area are provided in **Table 1**.

Table 1: Existing environment in the VMP area

SITE	ELEVATION	TOPOGRAPHY	SOILS
M2	~35m	Drainage line	Lucas Heights (lh)

The climate of the area is typical of the Sydney region, which can generally be described as temperate (BOM 2014).

The VMP area is located on the 'Lucas Heights' (lh) residual soil landscape which extends south and west to the Lane Cove River (Chapman and Murphy 1989). Soil depth for the 'Lucas Heights' soil landscape at higher elevations is <100cm, with up to 30cm of loose, yellowish-brown sandy loam overlaid on 10-30cm of bleached, stony, hard setting sandy clay loam and up to 100cm yellowish-brown, pedal clay. The soils within the A1 horizon of the 'Lucas Heights' soil landscape have a moderate erosion potential, which increases to highly erodible within the A2 horizon (Chapman and Murphy 1989).

2.2 Vegetation communities

Field surveys (ELA 2012) identified two vegetation communities on the M2 site:

- Sandstone Ridgetop Woodland (SRW), as shown in **Figure 3**.
- Weeds and Exotics.

The SRW recorded on the M2 site is in poor condition as shown in **Figure 4**. This area contained *Eucalyptus resinifera*, *Melaleuca* spp., and *Pittosporum undulatum* in the canopy, with BioBanking plot data indicating that only 14% of over-story was native. This area had a very dense shrub layer of exotics interspersed with some native species *Microlaena stipoides*, *Adiantum* spp., *Pteridium esculentum* (Bracken), *Dianella caerulea*, and *Entolasia stricta* (Wiry Panic) occurred in the ground layer. Whilst it could be argued that the extent of weeds and exotics in this patch are enough to include it in the weeds and exotics category, this report includes it as part of the SRW due to the presence of similar over-story species.

The watercourse through this area essentially receives only urban run-off. The watercourse is not mapped on the 1:25 000 topographic map and is therefore not classified as a Strahler stream order under the NSW Office of Water *Guidelines for riparian corridors on waterfront land*. It does however have the characteristics of a first order stream as there is a defined bed and bank. For the purposes of this VMP this stream will be classified as a first order stream.

SRW is not consistent with any threatened ecological communities (TECs) listed under the TSC or EPBC Acts. See **Appendix B** for full floristic data.



Figure 3: Sandstone Ridgetop Woodland in the M2 Site

2.3 Flora

A total of 57 flora species were recorded within the VMP area by ELA during the flora and fauna assessment (ELA 2012) and the survey for this report. This includes 11 native species and 46 exotic species. None of these flora species recorded are listed as threatened under the TSC Act or EPBC Act. See **Appendix B** for full floristic data.

Forty-seven threatened flora species have been recorded within a 10 kilometre radius of the precinct that are listed under either the TSC or EPBC Acts (ELA 2012). However, none of these species were considered to have potential to occur in the VMP area.

A total of 46 exotic flora species were recorded in the VMP area (**Appendix B**). Of these, 10 are listed as noxious within the Ryde LGA (DI&I 2012) under the *Noxious Weeds Act 1993* (**Table 2**). Two of these species, *Asparagus aethiopicus* (Asparagus Fern) and *Lantana camara* (Lantana), in addition to one species not listed as noxious within Ryde LGA, *Senecio madagascariensis* (Fireweed) are also classified as Weeds of National Significance (WoNS) (AWC 2012).

Some other significant environmental weeds found in the VMP area include *Ageratina adenophora* (Crofton Weed), *Bidens pilosa* (Cobber's Pegs), *Cinnamomum camphora* (Camphor Laurel), *Verbena bonariensis* (Purpletop), *Foeniculum vulgare* (Fennel), *Cortaderia selloana* (Pampas Grass), *Cirsium vulgare* (Spear Thistle), *Solanum nigrum* (Blackberry Nightshade) and *Ehrharta erecta* (Panic Veldtgrass).

Table 2: Noxious weeds and WoNS found in the VMP area

SCIENTIFIC NAME	COMMON NAME	NOXIOUS	WONS	M2 SITE
<i>Anredera cordifolia</i>	Madeira Vine	Class 4	Yes	X
<i>Asparagus aethiopicus</i>	Asparagus Fern	Class 4	Yes	X
<i>Cortaderia selloana</i>	Pampas Grass	Class 3	-	X
<i>Lantana camara</i>	Lantana	Class 4	Yes	X
<i>Ligustrum lucidum</i>	Large Leaved Privet	Class 4	-	X
<i>Ligustrum sinense</i>	Small Leaved Privet	Class 4	-	X
<i>Ochna serrulata</i>	Ochna	Class 4	-	X
<i>Ricinus communis</i>	Castor Oil Plant	Class 4	-	X
<i>Senecio madagascariensis</i>	Fireweed	-	Yes	X
<i>Toxicodendron succedaneum</i>	Rhus Tree	Class 4	-	X
<i>Tradescantia fluminensis</i>	Trad	Class 4	-	X

2.4 Habitat

The primary habitat type of the VMP area is associated with the SRW along with the weeds and exotics. Within this habitat type specific habitat features including deep leaf litter, dense shrub layers and large woody debris are present. These habitat features provide potential foraging, roosting, breeding and nesting resources for fauna species. **Table 3** outlines the habitat features present for fauna groups and indicates where these were located in relation to the areas comprising the study area.

Table 3: Habitat features present in the VMP area for fauna groups

HABITAT FEATURE	VEGETATION TYPE	FAUNA GROUP USING FEATURE
Stag	SRW	Birds, including birds of prey
Flowering Myrtaceous trees and shrubs	SRW	Foraging resources for birds, mammals and GHFF
Fallen timber	SRW	Small mammals, reptiles, and insects
Leaf litter	SRW, Weeds and exotics	Amphibians, reptiles, ground-dwelling mammals
Decorticating bark	SRW	Microchiropteran bats, reptiles
Sandstone Watercourse	SRW	Amphibians, birds, reptiles, microchiropteran bats
Dense shrubs	SRW	Small birds and birds common to urban environments, ground-dwelling mammals.
Dense exotic shrub and vine layers	Weeds and Exotics	Small birds and birds common to urban environments.
Aquatic Habitat	SRW, Weeds and Exotics	Amphibians

Note: SRW: Sandstone Ridgetop Woodland.

2.5 Fauna

A total of 19 fauna species have been recorded on or adjacent to the VMP area; of which there were nine bird species, two amphibians, three non-flying mammals, three bats and two reptiles (See **Appendix C** for full species inventory). The bird species recorded are considered common in urban

areas, including *Manorina melanocephala* (Noisy Miner) and *Cacatua galerita* (Sulphur-crested Cockatoo). Other native fauna recorded included *Trichosurus vulpecula* (Brush-tailed Possum), *Pseudocheirus peregrinus* (Ring-tailed Possum), *Physignathus lesueurii* (Eastern Water Dragon), *Litoria peronii* (Peron's Tree Frog) and *Crinia signifera* (Common Eastern Froglet). The introduced *Oryctolagus cuniculus* (European Rabbit) was also sighted during survey work.

Two threatened species, *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat) and *Mormopterus norfolkensis* (East Coast Freetail Bat), were recorded during previous field survey (ELA 2012). Eastern Bentwing-bat and East Coast Freetail Bat are listed as vulnerable species under the TSC Act.

54 fauna species listed as either threatened or migratory under either the TSC or EPBC Acts have been recorded within a 10 kilometre radius of the VMP area (ELA 2012). Of these two threatened diurnal bird species, one nocturnal bird species, one migratory bird species and six bat species were considered to have potential to occur onsite (**Table 4**). Three of the bat species were recorded in the VMP area during surveys. *Pseudophryne australis* (Red-crowned Toadlet) was previously recorded adjacent to the M2 Site, but given the poor habitat quality for this species it was not considered to have potential to occur in the VMP area.

Table 4: Threatened fauna with potential to occur in the VMP area

SCIENTIFIC NAME	COMMON NAME	STATUS		LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT	
DIURNAL BIRDS				
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	Potential
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Potential – foraging habitat
NOCTURNAL BIRDS				
<i>Ninox strenua</i>	Powerful Owl	V	-	Likely – foraging habitat
MIGRATORY BIRDS				
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	Potential – foraging
MAMMALS (BATS)				
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Potential
<i>Miniopterus australis</i>	Little Bent-wing Bat	V	-	Potential
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V	-	Yes
<i>Mormopterus norfolkensis</i>	East Coast Freetail-bat	V	-	Yes
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Potential



Figure 4: Vegetation found on the North Ryde Station Precinct, M2 Site (ELA 2011)

Note: GPS marking of hollow-bearing trees was subject to errors of +/-20 m during field surveys.

3 Vegetation management works

The VMP area is shown in **Figure 2**. Specific treatment zones for the site are described in **Section 3.2**. The site for the VMP works represents a low resilience given the disturbed existing condition and the ongoing impacts of the modified creekline. Given these existing conditions, there are issues with relying on natural resilience alone. As such vegetation management works for this VMP are focused on revegetation and weed removal. The VMP area is divided into three zones based on landform type, resilience levels and the subsequent works required (**Figure 5**). Specifically, these treatment zones are:

- Zone 1: Riparian management.
- Zone 2: Understorey revegetation and bush regeneration
- Zone 3: Gas pipeline.

It should be noted that the entire vegetated buffer to the creekline is 30 m in width. The management zones within that vegetated buffer vary according to the site characteristics.

This VMP covers both the establishment phase and the maintenance phase. The establishment phase will last for approximately two years following substantial completion of construction works. These works are outlined for each portion of the VMP area below, including specific management techniques. In addition, the current condition of much of the VMP area is moderate to poor.

Management works will need to extend beyond the initial two years in order to allow the revegetation works to sufficiently establish. It is recommended that management works extend for at least three years beyond the establishment phase. Details on maintenance works has been provided in **Section 3.3**.

Recommendations for specific weed control techniques are found in **Appendix D**.

3.1 Preliminary Works

3.1.1 Fencing

Temporary fencing to prevent construction impacts must be in place prior to construction works commencing. Fencing should be undertaken according to the specifications in **Appendix D**.

3.1.2 Site preparation

The creekline has been subject to rubbish dumping and erosion from channelization and the urbanisation of the surrounding catchment area. This riparian area, within the top of bank of the creek, will require remediation to prevent further damage. As such, the natural resilience of this area has been severely minimised. Site preparation works will take place in the creekbed and banks area, as encompassed by Zone 2. To ensure a reduction in erosion and adequate establishment of plants the following works are required:

1. Removal of any dumped rubbish that may be present.
2. Mechanical removal of any exotic vegetation that may be present (note: this material must be disposed of as outlined in **Appendix D**). If the removal of exotic vegetation is likely to jeopardize the stability of the creek, it is recommended that the roots and stumps are not disturbed and only the vegetative (i.e. above ground) material is removed. This will require

weed management works as identified in **Appendix D** to ensure these individuals do not regrow.

3. Undertake the shaping of banks if required to allow for the installation of erosion control structures and materials. This may involve some excavation. Note that under the dripline of trees to be retained this should be undertaken very carefully so as to avoid damage to roots. If shaping works cannot be undertaken without significant damage to roots of native species, this step should be skipped and works proceed to Step 4.
4. Installation of topsoil where required.
5. Installation of erosion control structures such as jute matting, coir logs, hay bales, sediment fencing as outlined below.

These soil preparation works should not remove vegetation or impact upon the roots of any native canopy species or significant understorey species (e.g. *Asplenium* sp., etc.). Some trimming of native vegetation may be required for machinery access. A suitably qualified and experienced bush regenerator or ecologist should supervise the works to ensure any impact is limited. In addition, any top soil used should be 'clean' (i.e. free of weed propagules or contaminants) and of a complementary soil type to the soil profile of the area.

Examples of best practice specifications for straw bales are provided in **Appendix D**, however the use of hay bales is preferential to straw bales as these can carry seed material which has potential spread on to the site and create a new weed issue on site. The hay bales carry a lower risk of spreading seed propagules. In addition, sediment fences should be installed around the perimeter. Best practice specifications for sediment fencing are also provided in **Appendix D**.

Riparian restoration works should adhere to best practice guidelines, such as *A rehabilitation manual for Australian streams: Volume 2* (Rutherford, Jerie and Marsh 2000), to ensure no impact on aquatic or terrestrial ecosystems. Some recommendations on structures and techniques are provided in **Appendix D**.

3.1.3 Seed collection

Seed collection should take place during the construction phase to ensure the supply of sufficient local provenance tubestock for revegetation during the establishment phase. Seed collection should be as per the specifications found in **Appendix D**.

3.2 Treatments

3.2.1 Zone 1: Riparian management

This zone encompasses the top of bank of the creekline. This zone is subject to continuing impacts from the creekline and dense weed infestations. Some native species are present in the canopy overhanging this zone, but a number of exotic species are present as well. This zone also has dense weed infestations in the midstorey and understorey. As such it is considered to have little chance of regenerating a diverse native community on its own. The primary management action in this zone will be soil preparation, revegetation and maintenance of that revegetation. Soil preparation should take place as per the treatment outlined in **Section 3.1.2**.

This zone is located within the existing top of bank and so over-storey species are largely confined to the banks. In these areas there are dense stands of *Ligustrum sinense* (Small Leaved Privet) regrowth

along the banks. Vegetation removal within this zone should be mechanical or via cut and paint with non-specific herbicide formulated for use around water (e.g. RoundUp[®] Biactive[™]).

Once the site is prepared, this zone will require planting using the riparian species shown in **Table 5**. Over-storey species will be planted at a density of one plant per 100 square metres, tall midstorey species at a density of one plant per 50 square metres, short midstorey species at a density of one plant per five square metres and understorey species at a density of two plants per square metre. Densities have been determined based on the entire area between banks, however revegetation works should be undertaken at a higher density along the creek bank. Revegetation should be undertaken as per the specifications in **Appendix D**.

A total of 1,080 plants will be required to revegetate this area. An attrition rate of 10% has been estimated for all revegetation species.

After revegetation works are undertaken this zone will require further monitoring and maintenance for ongoing issues such as weed removal and erosion control. These issues are addressed in **Section 3.3**.

The total area of riparian management (Zone 2) required on the M2 Site is approximately 0.05 ha.

3.2.2 Zone 2: Understorey revegetation and bush regeneration

This encompasses the area within the M2 Site outside of the top of bank of the creekline. This zone is also subject to ongoing impacts from the creekline, including increased nutrients and sediment from stormwater and erosion impacts. This zone is also subject to higher levels of waste dumping, as it is located closer to the road. Some native species are present in the canopy but a number of exotic species are present as well. This zone also has dense weed infestations in the midstorey and understorey. As such it is considered to have little chance of regenerating a diverse native community on its own. The primary management action in this zone will be soil preparation, revegetation and maintenance of that revegetation. It is important that native overstorey species are not removed or damaged during construction works as they will maintain a visual barrier and increase aesthetic appeal during bush regeneration works. Soil preparation should take place as per the treatment outlined in **Section 3.1.2**

The overstorey contains native species but also large exotic trees such as Camphor Laurel. The midstorey is dominated by woody weeds such as African Olive and Large and Small Leaved Privet. The understorey is dominated by the exotic grass Panic Veldtgrass. A number of herbaceous weeds and climbers, including *Acetosa sagittata* (Turkey Rhubarb), Crofton Weed, *Anredera cordifolia* (Madeira Vine), *Conyza* sp. (Fleabane), *Hedera helix* (English Ivy) and Trad are also present, and dominant in patches. In general, woody weeds will be removed by hand using cut and paint. Seedlings will be hand pulled. Grass weeds may be sprayed using a monocot specific herbicide, though care must be taken to avoid any regeneration of native grass species. Herbaceous weeds, including Spear Thistle and Fireweed will be hand pulled as required. Herbaceous vines will be controlled by skirting or by scrape and paint. Given the proximity to water, only non-specific herbicide formulated for use around water (e.g. RoundUp[®] Biactive[™]) may be used.

Due to the relatively small nature of the site, there will be increased “edge effects”, which may include weed incursion, bushrock/firewood removal, illegal dumping of garden/building waste, general littering and track proliferation. In an effort to minimise some of these effects, it is recommended that fencing be erected, primarily along the southern boundary adjoining the residential area, which will aim to encourage visitors to frequent formal footpaths and discourage illegal dumping within the site. This edge effect” will need to be taken into account during the weed control works at the site.

At least six nest boxes will be installed in mature trees in this zone as recommended by ELA (2012), though the exact type required was not specified. Additional nest boxes are required if hollow-bearing trees are to be removed for the gas pipeline. Given the potential for threatened bats on the site it is recommended that the nest boxes be designed specifically for bats and include nest boxes with side entrance for possums. The exact location of these nest boxes will be determined by the bush regeneration contractor at the start of works. Specifications for nest box design are outlined in **Appendix D**.

Once the site is prepared, this zone will require planting using the riparian species shown in **Table 5**. Species have been selected based on their occurrence in SRW or, given the riparian nature of the site, Sandstone Gully Forest (SGF). SGF is a transitional community from SRW found in moister areas such as gullies. Overstorey species will be planted at a density of one plant per 100 square metres, tall midstorey species at a density of one plant per 50 square metres, short midstorey species at a density of one plant per five square metre and understorey species at a density of four plants per one square metre. Revegetation should be undertaken as per the specifications in **Appendix D**.

A total of 8,918 plants will be required to revegetate this area. An attrition rate of 10% has been estimated for all revegetation species.

After revegetation works are undertaken this zone will require ongoing monitoring and maintenance for ongoing issues such as weed removal and erosion control. These issues are addressed in **Section 3.3**.

The total area of understorey regeneration and bush regeneration (Zone 2) required on the M2 Site is approximately 0.27 ha.

3.2.3 Zone 3: Gas pipeline

Management zone 3 has low potential to regenerate naturally following disturbance to the soil profile. The main objective of this management zone is to rehabilitate the zone following construction works. This includes revegetation and bank stabilisation works. Bank stabilisation is required at two locations (**Figure 5**) following removal of exotic weeds. The first location is a steep embankment off Wicks Road and the second is where the gas pipeline will traverse the creek. Jute matting or coir logs are required to prevent erosion of soil along the bank and within the creek line. Planting of native shrubs and ground cover species will assist in the stabilisation of soil. Riparian restoration works should adhere to best practice guidelines, such as *A rehabilitation manual for Australian streams: Volume 2* (Rutherford *et al* 2000), to ensure no impact on aquatic or terrestrial ecosystems.

It is understood that Jemena may at times slash the vegetation along the pipeline as part of routine maintenance. Therefore, the management actions have taken this into consideration and will utilise low growing herbaceous species along the new pipeline alignment. Shrubs and other herbaceous native species will be used to stabilise areas of steeper gradient and along the outer edge of the slashing zone. Revegetation of a canopy layer may occur along the western extent of zone 3 following the removal of the existing pipe. A list of recommended species, densities and costings are provided in **Table 5**.

It is assumed that soil will be retained during the construction works and will be used to infill the trench following the completion of works. Addition of top soil has not been costed for these works. If additional top soil is required the soil should be free of weed propagules.

Site preparation is required following the installation/removal of the gas pipeline. This is particularly relevant in areas of steep terrain.

Site preparation should include the following:

- removal of any remaining noxious weeds (using cut and paint)
- tilling of soil surface is required if the soil has been compacted during construction works
- installation of erosion control structure such as jute matting, coir logs etc.

Planting of local provenance species should be conducted following site preparation. Recommended species include species identified within the VMP area and according to species consistent with SGF and SRW vegetation communities. Establishment of overstorey, shrub and ground cover species may occur along the existing pipeline (the western boundary). This area also contains moist depressions and should include suitable species such as *Melaleuca decora* and ferns (see **Table 5**).

Ongoing treatment for weed control is required within zone 3 as the soil profile contains low native resilience. The vegetation will be subject to edge effects including the threat of new weed invasions. Weed control treatment should include the cut and paint (or drill and paint) for large woody weeds and application of a non-specific herbicide. Smaller individuals may be hand removed if soil disturbance is kept to a minimum.

A total of 3,386 plants will be required to revegetate this zone. An attrition rate of 10% has been estimated for all revegetation species.

Table 5: Revegetation species and densities for M2 Site

SCIENTIFIC NAME	COMMON NAME	ZONE 1 (0.05 HA)	ZONE 2 (0.27 HA)	ZONE 3 (0.11 HA)
Overstorey		1 per 200 m²	1 per 50 m²	1 per 200 m²
<i>Angophora costata</i>	Smooth-barked Apple	-	15	2
<i>Angophora floribunda</i>	Rough-barked Apple	-	-	2
<i>Ceratopetalum apetalum</i>	Coachwood	3	8	-
<i>Eucalyptus punctata</i>	Grey Gum	-	15	-
<i>Eucalyptus resinifera</i>	Red Mahogany	-	-	2
<i>Syncarpia glomulifera</i>	Turpentine	-	15	2
Midstorey - Tall		1 per 50 m²	1 per 20 m²	1 per 50 m²
<i>Allocasuarina littoralis</i>	Black She-oak	4	29	5
<i>Banksia serrata</i>	Old Man Banksia	4	29	-
<i>Elaeocarpus reticulatus</i>	Blueberry Ash	4	29	2
<i>Exocarpos cupressiformis</i>	Cherry Ballart	4	-	2
<i>Glochidion ferdinandi</i>	Cheese Tree	4	29	5
<i>Notelaea longifolia</i>	Large Mock Olive	8	-	5
<i>Melaleuca decora</i>		-	-	5
<i>Stenocarpus salignus</i>	Scrub Beefwood	4	19	
Midstorey - Short		1 per 10 m²	1 per 5 m²	1 per 5 m²
<i>Acacia myrtifolia</i>	Red-stemmed Wattle	-	58	5
<i>Acacia terminalis</i>	Sunshine Wattle	-	68	5
<i>Breynia oblongifolia</i>	Coffee Bush	-	-	5
<i>Ceratopetalum gummiferum</i>	NSW Christmas Bush	17	48	5

SCIENTIFIC NAME	COMMON NAME	ZONE 1 (0.05 HA)	ZONE 2 (0.27 HA)	ZONE 3 (0.11 HA)
<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum	-	48	-
<i>Homalanthus populifolius</i>	Bleeding Heart	4	48	5
<i>Leucopogon juniperinum</i>	Prickly Bearded-heath	-	68	5
<i>Notelaea longifolia</i>	Large Mock Olive	8	48	-
<i>Ozothamnus diosmifolius</i>	Rice Flower	-	-	5
<i>Pittosporum revolutum</i>	Yellow Pittosporum	17	58	
<i>Polyscias sambucifolia</i> subsp. A	Elderberry Panax	4	48	5
<i>Zieria smith</i>	Sandfly Zieria	-	48	5
Understorey		2 per 1 m²	3 per 1 m²	3 per 1 m²
<i>Adiantum aethiopicum</i>	Common Maidenhair	-	480	27
<i>Asplenium australasicum</i>	Bird's Nest Fern	-	100	11
<i>Baumea juncea</i>	Bare Twig-rush	167	-	-
<i>Chorizandra cymbaria</i>	Bristle-rush	167	-	-
<i>Cyathochaeta diandra</i>		42	390	55
<i>Dianella caerulea</i>	Blue Flax Lily	-	960	545
<i>Entolasia marginata</i>	Bordered Panic	21	960	545
<i>Entolasia stricta</i>	Wiry Panic	21	960	545
<i>Ficinia nodosa</i>	Knobby Club-rush	167	190	-
<i>Goodenia hederacea</i>	Forest Goodenia	-	-	55
<i>Hibbertia dentata</i>	Guinea Flower	-	770	27
<i>Kennedia rubicunda</i>	Dusky Coral Pea	-	480	27
<i>Lepidosperma gunnii</i>		42	480	-
<i>Lepidosperma laterale</i>		167	-	109
<i>Lepyrodia scariosa</i>		42	290	-
<i>Lomandra glauca</i>	Pale Mat-rush	-	680	-
<i>Lomandra longifolia</i>	Spiny-headed Matrush	-	1,450	545
<i>Microlaena stipoides</i>	Weeping Grass	-	-	545
<i>Oplismenus aemulus</i>	Australian Basket Grass	-	-	273
<i>Schoenus melanostachys</i>	Black Bog-rush	167	-	-
Subtotal		1,080	8,918	3,386
10% replacement rate		108	891	338
Total		1,188	9,810	3,725



Figure 5: Management zones within the VMP area (subject site)

3.3 Maintenance

The VMP area will require ongoing maintenance to prevent regrowth of weed species. Species of particular concern include Lantana, African Olive, Large and Small Leaved Privet, Ochna and Madeira Vine. However, all weed species recorded on the site are likely to regenerate at some time in the future, especially after removal of the dominant groundcovers such as Privet, Trad or Panic Veldtgrass.

Maintenance work will need to be undertaken to ensure that no new weed species invade the site and this will involve regular surveys and monitoring of the entire area subject to the VMP to determine if new weed species are becoming established through time. Any new infestations will be referred to the landowner and an appropriately qualified bush regenerator or ecologist will provide further information on the best practice control techniques for these new weed species.

Maintenance works will be undertaken by a qualified bush regeneration contractor for a total of five years including three years of maintenance work after the initial two year establishment phase. All maintenance work is to meet the performance criteria stated in **Section 5.3**. Works will be undertaken in all management zones during the maintenance phase. Priorities will be the treatment of any regrowth of primary treated weed species and control of subsequent growth of other weed species (secondary weed control).

Maintenance will be required on a regular basis especially in the peak growing seasons and less frequently in the cooler periods. The frequency of maintenance required will depend on the rate of native regeneration and persistence of exotic species. It is expected that maintenance works will be required bi-monthly during the peak growing seasons (August – February) and quarterly in the cooler periods (March – July). The number of person days estimated to be required at each site is shown in **Table 6**. However, variation as to when these days are used on the site during the year may be necessary based on annual and seasonal variations. In addition to the scheduled maintenance activities undertaken at the site, additional hours should be allocated to monitoring and treating weed growth which is likely to result from the disturbance caused during the construction of the raised footpath and meeting space which will be constructed within Zone 2.

After the completion of the first five years of establishment and maintenance works, the maintenance program will be reassessed to determine its effectiveness and on-going management requirements.

Table 6: Number of bush regeneration maintenance days per year across the VMP area

Site	AREA (HA)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
M2	0.43	20	56	48	36	28

4 Environmental safeguards

4.1 Limitations

It has been assumed that bushland to be retained in the VMP area will not have excavation works, fencing (whether permanent or temporary), drainage, spoil, machinery storage, lighting, services, or other matters impacting on the bushland areas. Some trees adjacent to the bushland areas are currently identified for removal. It is assumed that all works have been designed to avoid impacts to tree root zones for trees within the bushland areas to be retained. The techniques outlined in **Section 4.2** should also be applied to all areas of the precinct, especially those areas adjacent to the bushland areas to be retained in the VMP area. It is assumed that controls outside of the bushland areas will deal with any erosion leaving the bushland areas.

The management actions proscribed in this document are based on the current level of disturbance. While the current level of disturbance is high over much of the VMP area, if construction works have a further impact then management actions may need to be updated.

4.2 Techniques

Given the proximity of the VMP area to the precinct construction works, construction impacts need to be managed. As such, the following details will be addressed:

- Protection of flora and fauna.
- Soil and water management.

The following tables (**Table 7** and **Table 8**) highlight the requirements for the protection of existing bushland on site during construction. The safeguard and mitigation measures will be used to limit impacts to the environment during construction.

Table 7: Flora & Fauna Impacts & Safeguards

POTENTIAL IMPACT	SAFEGUARD/ MITIGATION	RESPONSIBILITY
Damage to roots & trunks can be detrimental to the health of trees	Exclusion fencing will be placed at the bushland area boundaries as per AS 4970. Any works within tree drip lines of vegetation to be retained is to be performed so as to prevent damage to their root systems.	Site Supervisor
	Any excavation under the drip line of trees will be done by hand (where possible). If project timelines and safety are concerns, machinery may be used.	Site Supervisor
	No equipment or stockpiles will be placed against the trunk or under the canopy of any vegetation.	Site Supervisor
Unnecessary damage to vegetation can occur if plants are not clearly identified	Trees that are to be trimmed or removed if necessary will be clearly marked. Any vegetation to be protected adjacent to the VMP area will be protected within exclusion fencing.	Site Supervisor

POTENTIAL IMPACT	SAFEGUARD/ MITIGATION	RESPONSIBILITY
Work activities can potentially increase the extent of weeds	Any noxious weed within the work area will be removed and stored in sealed containers and disposed of appropriately. See Appendix D	Site Supervisor / Bush Regeneration Contractor
	Any weeds and or noxious weeds will be disposed of appropriately.	Site Supervisor / Bush Regeneration Contractor
	Lay down areas and set up sites are to be located on flat, cleared ground within the construction footprint in a manner that minimises impacts on surrounding vegetation.	Site Supervisor
	If any damage occurs to vegetation within the bushland areas, mitigation of impacts and site restoration works will be performed as required.	Site Supervisor
	Construction machinery should be washed prior to entering and leaving site to ensure weed propagules are not transported.	Site Supervisor
	At the completion of the works, all areas will be revegetated as per this VMP.	Site Supervisor

Table 8: Erosion & Sediment Control Impacts & Safeguards

POTENTIAL IMPACT	SAFEGUARD	RESPONSIBILITY
Erosion of VMP area and increased nitrification from water entering site.	If works take place upslope of the VMP area overburden will be placed in the form of a bund upslope of the site where necessary to reduce surface water entering the site (only where safe to do so).	Site Supervisor
	Sandbags, hay bales wrapped in geotextile fabric, etc. will be used to slow water flow and trap sediment using best practice specifications for straw bales (e.g. Appendix E). However, hay bales should be used in preference to straw bales.	Site Supervisor
	Linear silt stop fencing to be installed down slope of all affected areas and stockpiles using best practice specifications for sediment fencing(e.g. Appendix E). Silt fencing will be installed before excavation begins.	Site Supervisor
	Site management will incorporate best management erosion and sediment control practices such as those found in the Department of Housing's "Blue Book (4 th Edition) on erosion and sediment control (Landcom 2004).	Site Supervisor

POTENTIAL IMPACT	SAFEGUARD	RESPONSIBILITY
	All erosion and silt control devices will be visually inspected weekly as well as after each rainfall event to ensure effectiveness.	Site Supervisor
To remain effective, erosion controls need to be regularly maintained	Any sediment that accumulates behind the silt fences or hay bales will be cleaned out and used during rehabilitation where possible, otherwise disposed of offsite.	Site Supervisor
	The work area adjacent to the VMP area will be kept to the smallest possible size. The work area will be rehabilitated as soon as work is finished in an area as required in the contract.	Site Supervisor
Surface disturbance makes the site more susceptible to erosion	All sediment control measures will be left in place until the site has been stabilised.	Site Supervisor
	Any excess soil or excavated material that cannot be used in site rehabilitation will be disposed of at an appropriate EPA licensed facility.	Site Supervisor
	If excavated material or redundant equipment is left on site overnight it will be covered and adequately contained with silt stop fencing.	Site Supervisor
	The tyres of work vehicles and machinery will be checked and cleaned as necessary before leaving the work site to ensure that soil or other erodible materials are not transferred from work sites to sealed access routes or roadways.	Site Supervisor
	Where possible works will not take place during or immediately after heavy rain, or if the onset of rain is likely.	Site Supervisor
	In the event of heavy rainfall conditions developing during works execution, all construction materials and equipment in the vicinity of disturbed surfaces are to be removed and the site made secure against erosion. Work will only recommence after rainfall has stopped and the ground surfaces have sufficiently dried out. Any areas that are disturbed or damaged by the works will be restored to the pre-works condition or better.	Site Supervisor

5 Monitoring and reporting

The bush regeneration contractor and the landowner will monitor the vegetation for changes over time. The objective of the monitoring and reporting program is to record changes to the vegetation as a result of vegetation management works. Monitoring works will require liaison with the landowner, the bush regeneration contractor and OEH.

The bush regeneration contractor will establish photo monitoring points and prepare the initial reports template to record the progress of their work and demonstrate compliance with the VMP. This will be undertaken during the establishment phase. During the maintenance phase negotiations should be undertaken between the land manager and OEH as to what reports are required, using the recommendations below as a guide. Reports will include a brief work report and an annual audit and assessment of compliance with the performance criteria in **Section 5.3**. The requirements of monitoring and reporting are described in detail in the sections below.

5.1 Photo monitoring points

Three photo monitoring points will be established across the site to provide a visual reference of changes in the vegetation through time. This will be undertaken prior to the commencement of works and at the beginning of each summer season. The bush regeneration contractor will:

- Set up three photo monitoring points spread across the site to include all management zones and differences in resilience within them.
- Mark the point using a star picket, recording the location with a GPS.
- Take digital photos should at each photo monitoring point with the star picket in frame. A photo should be taken in the four cardinal directions (i.e. north, south, east, and west), each with the star picket in frame.
- Organise the digital photos logically with each image labelled with a unique reference number indicating the location of the photo monitoring point, direction and the date the photo is taken (i.e. "01_2012_12_08_N" for photo point 1 taken on the 8 December 2012 facing north).

5.2 Bush regeneration reporting

A brief report outlining work undertaken by the bush regeneration contractor will be prepared every six months during the establishment phase. These reports will be submitted to the landowner. During the maintenance phase, a schedule for the preparation of reports will be negotiated by the landowner with OEH based on the success of the establishment phase. Reports will include:

- A summary of works carried out within the period.
- An approximation of the time spent on each task.
- A description of any problems encountered in implementing the works recommended in the VMP and how they were overcome.
- Any observations made, including new plant species recorded (native and weed species), comments on rates of regeneration and any problems which impact on the implementation of the VMP.

5.3 Performance criteria

The progress and compliance with the VMP will be monitored and reviewed annually. This process will involve the bush regeneration contractor, the landowner and OEH. A report will be prepared commenting on each performance criteria, followed by a site visit to discuss each performance criteria. The performance criteria are:

- Commencement of all tasks outlined in the VMP or evidence of planning for their implementation.
- Demonstrated control works undertaken on noxious and environmental weeds across the VMP area.
- No adult seeding woody weeds present by the end of the establishment phase.
- No more than 5% total cover of exotic grasses over all zones by end of maintenance phase.
- No more than 10% total weed cover over all zones by end of maintenance phase.
- Evidence that noxious and significant weeds have been removed from site by the end of the establishment phase.
- Greater than 50% native groundcover in all management zones by end of establishment phase.
- Greater than 75% native groundcover in all management zones by end of maintenance phase.
- Suitable evidence (e.g. site locations and date collected, record of provenance from nursery) of the location of all seed collected in any revegetation programmes.
- Minimum of 80% survival rate of all revegetation.
- Areas of revegetation that failed to establish are not larger than 2 square metres.
- Monitoring and reporting undertaken in accordance with **Section 5.1** and **Section 5.2**.

Based on the success of the establishment phase, further performance criteria should be developed for the maintenance phase.

6 Implementation schedule & cost

The cost to implement all works identified in this VMP is shown in **Section 6.4**. These costs are indicative estimates based on market rates over the lifetime of this VMP (five years) and exclusive of GST and CPI.

6.1 Preliminary Works

6.1.1 Fencing

The expense of machinery and staff time for the installation of any fencing is understood to be incurred by landowner. However, budget has been included for the supervision of the works by an ecologist.

6.1.2 Site Preparation

The expense of machinery and staff time for the implementation of the site preparation works is understood to be incurred by the landowner. However, budget has been included for the supervision of the works by an ecologist.

Likewise, costs for implementation of erosion control works and supplies such as jute matting or coir logs have not been included in this budget. These are estimated to cost approximately \$4 per square metre for jute matting and \$23 per metre for coir logs with a 200mm diameter.

6.1.3 Seed Collection

Budget for the collection of seed from the site and surrounding area has been included for the first two years. These costs do not include the propagation of these seeds, which is addressed in **Section 6.34** below.

6.2 Habitat augmentation

Prior to removal of vegetation for the construction process, installation of nest boxes are to be installed in Zone 2. As a minimum six nest boxes are required within the Northern Bushland Park. If hollow-bearing are removed for the installation of the pipeline additional nest boxes are required to mitigate the loss. Nest boxes should include a side entrance box for possums and where possible several hanging-boxes for microbats. More details on the installation of nest boxes are provided in **Appendix D**.

Larger privet along the edge of the zone 3 should be drilled and left *in-situ* to provide roosting habitat for fauna until recruitment or planted vegetation has established. Woody weeds, free of propagules, may be cut and stacked in piles during the bush regeneration process to provide temporary habitat for small birds, reptiles and other ground dwelling fauna species. Recommended planting species should include suitable foraging vegetation for native fauna.

6.3 Weed Control Treatments

Bush regeneration contractors will implement this VMP, including the weed management treatments. These works have been calculated at \$2,000 for a team of four bush regenerators per day. The cost of bush regeneration works includes the costs of herbicide, vehicles and equipment which are required to implement the VMP.

6.4 Revegetation Treatments

Bush regeneration contractors will implement this VMP, including the planting treatments.

Indicative costs of tubestock (based on pricing in 2014)

- Trees – \$4 / plant includes plant, installation and biodegradable bag
- Shrubs - \$4 / plant includes plant, installation and biodegradable bag
- Groundcover species - \$3 / plant includes plant, installation and biodegradable bag.

Cost for jute matting estimated at \$4 per square meter and coir logs at \$23 with a 200 mm diameter.

Estimated cost for weed removal will vary according to the treatment.

- Primary weed control - \$2 per metre square
- Secondary weed control - \$1.50 per metre square
- Maintenance weed control - \$1 per meter square.

These costs include planting, fertiliser, water crystals and initial watering for midstorey and understorey species. The number of plants required in across the VMP area is 13,384 and replacement of 1338. Therefore the total number of plants was calculated as 14,722 assuming 10% replacement rate for revegetation.

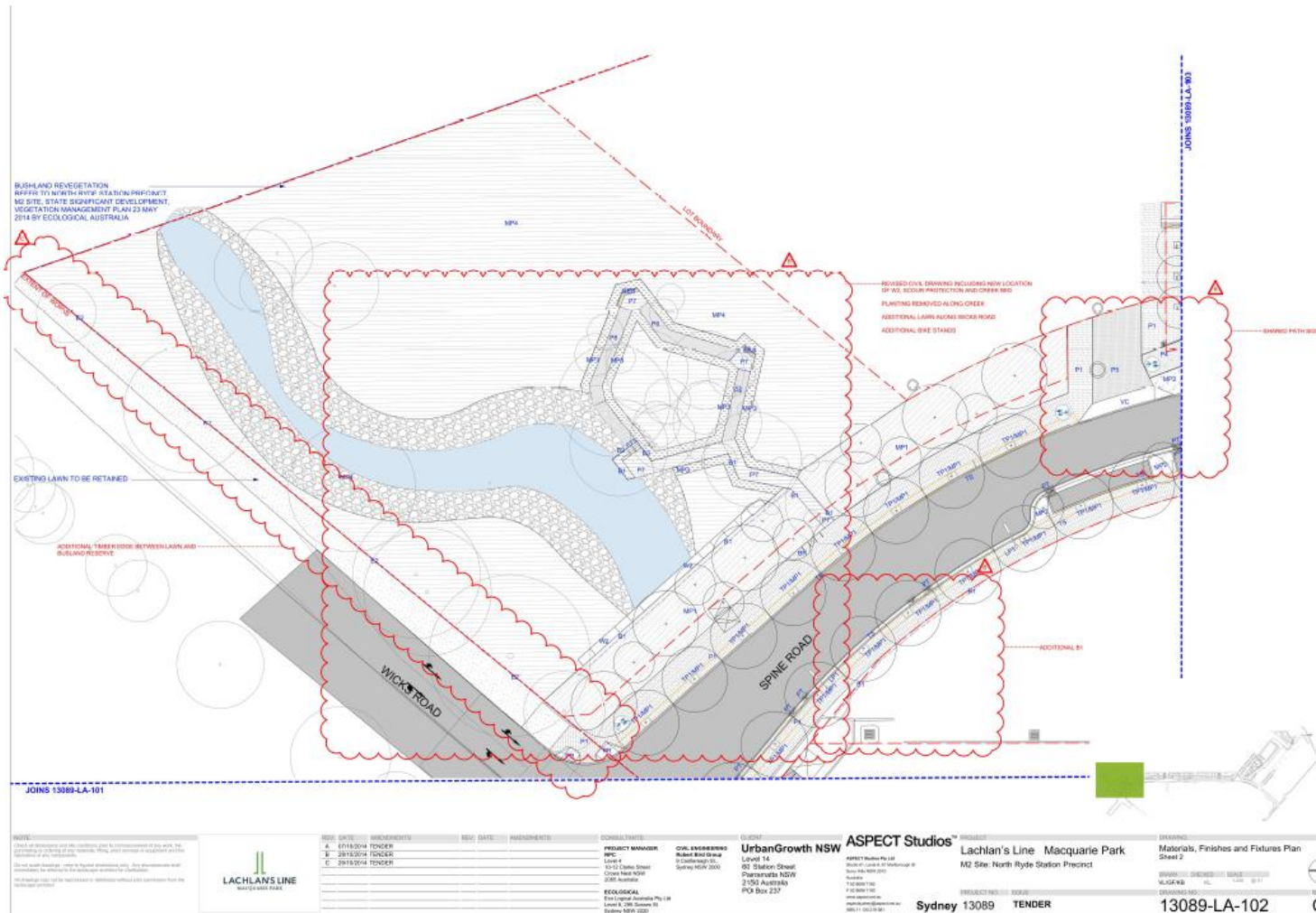
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Appendix A: Landscape Drawings (supplied by Aspect Studios)



Appendix B: Flora on-site

Native flora species found on-site

SCIENTIFIC NAME	COMMON NAME
<i>Acacia longifolia</i>	
<i>Acacia parramattensis</i>	Parramatta Wattle
<i>Adiantum aethiopicum</i>	Common Maidenhair
<i>Cyperus</i> sp.	
<i>Dianella caerulea</i>	Blue Flax-lily
<i>Eucalyptus resinifera</i>	Red Mahogany
<i>Eucalyptus sideroxylon</i>	Mugga Ironbark
<i>Microlaena stipoides</i>	
<i>Pittosporum undulatum</i>	Native Daphne
<i>Pteridium esculentum</i>	Common Bracken
<i>Trifolium</i> sp.	

Exotic flora species found on-site

SCIENTIFIC NAME	COMMON NAME	NOXIOUS	WONS
<i>Acetosa sagittata</i>	Turkey Rhubarb		
<i>Ageratina adenophora</i>	Crofton Weed		
<i>Anredera cordifolia</i>	Madeira Vine	Class 4	
<i>Araujia sericifera</i>	Moth Vine		
<i>Asparagus aethiopicus</i>	Asparagus Fern	Class 4	Yes
<i>Bidens pilosa</i>	Cobbler's Pegs		
<i>Brassica</i> sp.			
<i>Bromus catharticus</i>	Prarie Grass		
<i>Bryophyllum delagoense</i>	Mother-of-millions		
<i>Cestrum parqui</i>	Green Cestrum		
<i>Chloris gayana</i>	Rhodes Grass		
<i>Cinnamomum camphora</i>	Camphor Laurel		
<i>Cirsium vulgare</i>	Spear Thistle		
<i>Conyza</i> sp.	Fleabane		
<i>Cordyline</i> sp.	Cordyline		
<i>Cortaderia selloana</i>	Pampas Grass	Class 3	
<i>Cyperus</i> sp.			
<i>Echium plantagineum</i>	Paterson's Curse		
<i>Ehrharta erecta</i>	Panic Veldtgrass		
<i>Eragrostis curvula</i>	African Lovegrass		
<i>Foeniculum vulgare</i>	Fennel		
<i>Gamochaeta</i> sp.	Cudweed		

SCIENTIFIC NAME	COMMON NAME	NOXIOUS	WONS
<i>Gomphocarpus physocarpus</i>	Balloon Cotton Bush		
<i>Hedera helix</i>	English Ivy		
<i>Ipomoea sp.</i>			
<i>Lantana camara</i>	Lantana	Class 4	Yes
<i>Ligustrum lucidum</i>	Large Leaved Privet	Class 4	
<i>Ligustrum sinense</i>	Small Leaved Privet	Class 4	
<i>Macadamia sp.</i>	Macadamia		
<i>Medicago sp.</i>			
<i>Modiola caroliniana</i>	Red-flowered Mallow		
<i>Ochna serrulata</i>	Ochna	Class 4	
<i>Passiflora sp.</i>			
<i>Phyllostachys sp.</i>	Bamboo		
<i>Plantago lanceolata</i>	Plantain		
<i>Prunus sp.</i>			
<i>Ricinus communis</i>	Castor Oil Plant	Class 4	
<i>Senecio madagascariensis</i>	Fireweed		Yes
<i>Senna pendula var. glabrata</i>	Winter Senna		
<i>Setaria sp.</i>	Pigeon Grass		
<i>Solanum nigrum</i>	Black-berry Nightshade		
<i>Taraxacum officinale</i>	Dandelion		
<i>Toxicodendron succedaneum</i>	Rhus Tree	Class 4	
<i>Tradescantia fluminensis</i>	Trad	Class 4	
<i>Verbena bonariensis</i>	Purpletop		
<i>Zingiber sp.</i>	Ginger		

Appendix C: Fauna on-site

Fauna species found on-site

SCIENTIFIC NAME	COMMON NAME
AVES	
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo
<i>Cacatua roseicapillus</i>	Galah
<i>Corvus coronoides</i>	Australian Raven
<i>Grallina cyanoleuca</i>	Magpie-lark
<i>Gymnorhina tibicen</i>	Magpie
<i>Manorina melanocephala</i>	Noisy minor
<i>Strepera graculina</i>	Pied Currawong
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet
<i>Vanellus miles</i>	Masked Lapwing
AMPHIBIANS	
<i>Crinia signifera</i>	Eastern Common Froglet
<i>Litoria peronii</i>	Peron's Tree Frog
NON-FLYING MAMMALS	
<i>Trichosurus vulpecula</i>	Brush-tailed possum
<i>Oryctolagus cuniculus</i> *	Rabbit
<i>Pseudocheirus peregrinus</i>	Ring-tailed Possum
BATS	
<i>Miniopterus schreibersii oceanensis</i> ^	Eastern Bentwing-bat
<i>Mormopterus norfolkensis</i> ^	East Coast Freetail-bat
<i>Mormopterus sp.2</i>	
REPTILES	
<i>Physignathus lesueurii</i>	Eastern Water Dragon
<i>Eulamprus quoyii</i>	Eastern Water Skink

^ denotes threatened species. * denotes introduced species

Appendix D: Specifications / standards

Bradley method

All works will employ the principles of bush regeneration and will follow the Bradley Method and use other techniques to promote natural regeneration described in Buchanan (2000), summarised below:

- Where available, refer to best practice guidelines for individual weed species and apply these to the site bearing in mind that a) these guidelines are usually written from an agricultural perspective and so may need to be adapted to a natural setting and ecological outcome b) the potential for off-target damage.
- Ensure correct plant identification – many weed species are difficult to identify because they resemble native species or typically occur in a vegetative (i.e. non-flowering) form.
- Limit the creation of bare patches of soil and soil disturbance in general, since this will encourage weeds to establish and grow – do not create unnecessary tracks with vehicles or other machinery.
- As a first option for weed control, consider methods that don't use herbicide (e.g. hand pulling and crowning) and which create very little soil disturbance.
- When using herbicides, use the least toxic chemical whenever possible and always follow the instructions.
- When working on or near water, use an approved herbicide for this environment (e.g. RoundUp® Biactive™); Refer to Australian Pesticides and Veterinary Medicines Authority (APVMA) website (www.apvma.gov.au) for information on off-label permits.
- Apply herbicides when the plants are actively growing and prior to seed set to achieve the best results.
- Regularly monitor for new infestations and report on the outcomes of the Landscaping and Weed Management Program.
- If safety permits, where woody weeds are providing habitat for native birds and animals, use the drill and fill technique to enable the structure to remain in situ while the tree or shrub dies – this will enable the plant to provide shelter for a period of time, while giving the birds and animals a chance to move on of their own accord.

Integrated weed management

Integrated weed management techniques have been considered the most effective method to control weeds. Integrated weed management may use a combination of any of the following techniques; mechanical, chemical, manual handling and biological methods. According to the Department of Primary Industries' *Noxious and environmental weed control handbook* the best management practices considers a long-term perspective and does not rely solely on herbicide application (DPI 2010).

Weed control can be broken down into three main categories:

Primary Weed Control:	the first weeding of the site.
Secondary Weed Control:	the second weeding of the site which may be very intensive as all regrowing/germinating weeds should be removed before they seed and out-compete native plants.
Maintenance/Follow-up Weed Control:	every re-weeding of the site after the secondary phase.

Primary weed control refers to the first time an area is weeded; it can be labour intensive and time consuming and depending on the target species and site conditions, it may take over several months to complete for one species (Buchanan 2009). In areas of high weed infestation and with no native resilience and/or native plants present, primary weeding may be accelerated as preparatory works for revegetation. However, in areas where native plants may occur, primary weeding should be undertaken at a pace that assists with the natural regeneration of the site.

Secondary weed control is the second weeding of an area and it may take longer than primary treatment (Buchanan 2009). Secondary weed control needs to be carefully timed to:

- Prevent weeds from setting seed.
- Suppress vegetative regrowth while plants are still small.
- Allow native plants to recruit without being smothered or out-competed by weeds.

However, secondary weed control should allow enough time for the soil profile to recover following primary weed control and the establishment of weed growth from the soil seed bank.

Maintenance weed control refers to weed control that is carried out after the secondary treatment (Buchanan 2009). The goal of follow-up control is to remove weedy recruits so that native species can re-colonise the area; frequent visits are likely to be needed at first, although the amount of time and resources used should gradually decrease through time.

Weed control techniques

Detail of specific weed control techniques to be used such as cut and paint, scrape and paint, herbicide spraying and hand weeding are given in Brodie (1999). The principles of bush regeneration and techniques to trigger natural regeneration are to be in accordance with the Bradley Method and other techniques described in Buchanan (2000). Management techniques for different types of weeds are provided below, with specific recommendations for significant weeds, including noxious species and/or WoNS. Regeneration will consist of the removal of weeds as specified in **Section 3**, and the promotion of native species as per the Best Practice Guidelines for restoring BGHF (DECC 2008a) and STIF (DECC 2008b).

Woody weeds

Woody weeds will be controlled by the cut and paint, scrape and paint or drill and fill method using a non-selective herbicide unless otherwise specified. The most appropriate method to be used depends on the size of the individual to be removed and will be determined by the bush regeneration contractor. Primary weed control should use techniques that will not encourage flushes of secondary weed growth. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-selective herbicide.

Lantana, a Class 4 noxious weed and WoNS, should be controlled by the cut and paint method. Larger individuals may need to be treated by progressively cutting back stems until the main trunk and crown is exposed. The crown should be left with at least 1m of trunk attached until woody debris has been cleared. The trunk should then be cut as low to the crown as possible and the non-selective herbicide applied. Cut stumps should be low to the ground (e.g. not higher than 5cm) and level to allow the poison to penetrate.

Large-leaved and Small-leaved Privet, Class 4 noxious weeds, should be controlled by the cut and paint method. The effectiveness of herbicide application, especially for larger plants, will be enhanced by

peeling back the bark below the cut stump to increase surface area. For larger individuals the drill and frill method can be used, taking care to remove any dirt from the stump and drilling directly into the crown. Larger individuals are likely to resprout, so follow up treatments will be needed. Smaller individuals and seedlings can be hand removed, taking care to remove all root material.

Ricinus communis (Castor Oil), a Class 4 noxious weed, can be treated using the cut and paint method. This should be undertaken in spring-early summer when plants are actively growing but fruit has not developed. Smaller plants and seedlings can be hand removed.

Toxicodendron succedaneum (Rhus Tree), a Class 4 noxious weed, should be controlled via cut and paint. Seedlings should be hand pulled. Care should be taken to avoid contact with plant materials, including sap as these can cause severe allergic reactions. Precautions must be taken, including gloves, enclosed shoes, a dust mask and eye protection.

Ochna serrulata (Ochna), a Class 4 noxious weed, will be controlled by scrape and paint. Cut and paint should not be used as the species has a very deep taproot which will resprout if cut.

Cinnamomum camphora (Camphor Laurel), a locally significant weed, should be controlled by stem scraping of smaller individuals and drilling and frilling of large individuals (over 5 cm diameter).

Creepers and climbers

The control of creepers, including Moth Vine, varies depending on the species. For the most part, seedlings will be hand pulled, while mature plants can be controlled by the stem-scrape method or spot spraying using a non-selective herbicide. The precise method to be used will be determined by the bush regeneration contractor depending on the species, size and reproductive status of the individual.

Asparagus Fern, a Class 4 noxious weed and WoNS, has the potential to establish in great numbers in any areas disturbed during construction and vegetation removal works. This species has the potential to spread vegetatively, by water or via bird-dispersed seed. Any large infestations of Asparagus Fern will be controlled by spot spraying using a selective herbicide while it is flowering in spring. Individual plants should be hand removed by gently levering out the rhizome during the moister months (autumn-winter). Tuberous and fibrous roots can be left in the ground, but ensure that the entire rhizome mass is removed as any remaining pieces can resprout vegetatively. Alternately, the rhizome can be treated using the drill and frill technique using selective herbicide. Ensure that stems are severed and dirt is cleared away from the rhizome. All vegetative material removed should be bagged, removed from site and disposed of appropriately.

Rubus fruticosus (Blackberry), a class 4 Noxious weed, will be controlled by spot spraying using a dicot specific herbicide (i.e. Grazon®) when it is actively growing, prior to fruits being developed (December). If the plant is in among native species then it should be scraped along the stem and with non-specific herbicide. Alternately, the roots can be hand removed and elevated to dry the plant out. If this technique is used all seeds need to be removed, bagged, and properly disposed of. Seedlings will either be dug out or controlled by spot spraying.

Anredera cordifolia (Madeira Vine), a WoNS, is a persistent weed due to its ability to reproduce vegetatively and, increasingly, by seed. This species should be treated with the scrape and paint method with a selective herbicide to ensure treatment of aerial tubers that would fall off and resprout if the vine was skirted. Alternately, small infestations may be sprayed with a selective herbicide from spring to autumn. Follow up spraying will likely be required in the future. All vegetative material removed should be bagged, removed from site and disposed of appropriately.

Acetosa sagittata (Turkey Rhubarb), a significant local weed, is a prolifically seeding weed. Where Turkey Rhubarb is in close proximity to natives, tubers should be dug out as spraying with non-specific herbicide is ineffective. In the case of large plants with multiple tubers scraping the stem and applying non-specific herbicide is effective, though follow up will be required. Seeds should be removed while green to prevent their spread.

Annual grasses

Annual grasses, including *Bromus catharticus* (Prairie Grass), should be hand removed where isolated or in low concentrations. Larger patches of annual grasses may be slashed/brush cut in late spring to early summer, after flowering, but prior to seed set. Slashing/brush cutting prior to late spring through to early summer will promote vigorous growth and should not occur. Monitoring of these species will occur and if new growth occurs, the same treatment will be applied to the new growth to prevent seed production. Individual plants should be hand removed, bagged and disposed of appropriately offsite.

Some annual grasses can grow and produce seed at any time of the year dependent on climatic conditions such as high rainfall and warm temperatures. Therefore, monitoring of these species is crucial and plants need to be treated if flowering is observed.

Perennial grasses

Perennial grasses, including African Love Grass and Kikuyu, will be slashed prior to seed production in spring or summer (depending on the growth cycle of the species) and the regrowth will be spot sprayed 2-3 weeks later when it is actively growing and approximately 10 cm in length.

A grass specific herbicide (e.g. Fusilade®: active ingredient Fluazifop-P) will be used to control grass weeds such as African Lovegrass and across the VMP area. This will allow for broad scale application of herbicide to control African Lovegrass, without impacting upon native broad leaf species. Care will be required when spot spraying is being undertaken to prevent native grasses from being killed by the spot spraying process. If grass weeds are found in the vicinity of native grasses they will be hand pulled to prevent off target damage to native species from occurring.

Pampas Grass, a Class 3 noxious weed, has been observed in the VMP area. Pampas Grass should be dealt with swiftly, as each flower head can produce up to 100,000 seeds and disperse up to 25km (Sutherland Shire Council 2008). If flowers are present, each flower head will be deseeded and disposed off-site. Plants can be brush-cut or sawed, and undiluted non-specific herbicide applied to the stump.

It is recommended that *Cynodon dactylon* (Couch) should only be managed if it begins to smother native vegetation or dominates large areas. If necessary to control it should be sprayed with a monocot specific herbicide (e.g. Fusilade®) between September and March.

Herbaceous weeds

Where individual plants of other herbaceous weeds, including Cobbler's Pegs, *Hypochaeris radicata* (Catsear), *Verbena bonariensis* (Purpletop), and Fleabane, are found, they will be hand pulled prior to flowering. Where large swaths of these species occur they will be sprayed using a non-selective herbicide. If high densities of mature stands occur, weeds may be slashed first using a brush cutter and any subsequent regrowth sprayed. Regular monitoring of these species will be required to prevent seed production. Spear Thistle will not be hand-pulled due to its thorns and instead will be spot sprayed using a non-selective herbicide. All vegetative material that is pulled out and has the potential to regrow if deposited on ground will be bagged and removed from site.

Trad, a locally significant weed, has the potential to smother native regeneration and invade the works area. Management of this weed will involve raking of large patches and composting on site. This will involve the establishment of temporary composting sites consisting of four star-pickets in a square with sediment control fencing between them and black plastic placed over the top of the pile. Approximately nine months after the addition of new material to this compost pile this construction can be taken apart and the compost distributed in a thin layer around the site. Care should be taken to avoid harming fauna, particularly amphibians and reptiles, when raking Trad. Alternately, spray works can be undertaken. Spot spraying of infestations should be undertaken in early spring with repeat applications once a month until the end of summer or it is controlled. Small infestations can be spot sprayed using a non-specific herbicide on a monthly basis or hand removed.

Mother-of-Millions, a significant local weed, will be controlled by spot spraying all infestations in autumn before flowering with either a specific (e.g. Gazon®) or non-specific herbicide. A surfactant may need to be added to penetrate the waxy exterior. This species should not be removed mechanically as it spreads vegetatively very easily. Instead, this species should be sprayed until all propagules are dead before mechanical removal takes place.

Bamboo

Bamboo and bamboo-like species, such as *Phyllostachys* sp. (Bamboo) should be controlled by cut-and-paint with a non-specific herbicide formulated for use around water. Stems should be cut as low to the ground as possible. Vegetative material can be left on site if it able to be 'rafted' above the ground as outlined previously.

Management of weed waste

All exotic vegetation material should be removed from site and composted at a registered green waste disposal facility. Fruiting parts and tubers should be bagged before being removed from site. On-site composting or the laying of exotic 'brush matting' is not appropriate at this site.

Herbicide use

The use of herbicide to control weeds should be carefully considered. Herbicide use should assess potential long-term impacts of the technique including whether the proposed works actually address the source of the weed infestation. However, herbicide application forms an important and useful component of an integrated weed management approach and can be the most appropriate method to control some weed species.

Herbicide use should occur during the active growing season for plants to encourage the chemical uptake into the plant. The selection of herbicides should also consider the type of weed and the location. Where non-selective herbicides are required for use, glyphosate is the most suitable. If herbicides are required to be used near waterways, a glyphosate-based herbicide formulated for use near waterways will be used (e.g. RoundUp® Biactive™).

Broad-leaf selective herbicide may be used as per the NSW Department of Primary Industries (DPI) *Noxious and environmental weed control handbook* (2010). However, this type of herbicide is extremely toxic to aquatic life and must not be used in, or adjacent to, waterways (e.g. the M2 Site). Registration and records must be kept in accordance with the NSW *Pesticide Regulation 2009*.

Revegetation

Revegetation will be required during the establishment phase to supplement natural regeneration. Any revegetation should consist of local provenance stock. Revegetation should be conducted in the shoulder months (early spring or early autumn) to prevent shock to young saplings and reduce exposure to frost or drought conditions. Prior to planting, each sapling should be soaked in a plant tonic (e.g. Seasol™) for at least 1-2 hours to reduce transplant shock. Water crystals or wetting agents should be added to each plant hole. This will increase the water holding capacity of the soil and reduce watering schedules especially in difficult to access locations. All plants will be irrigated when installed to increase survival rates of revegetation. Herbaceous species will be planted in clumps rather than scattered individuals. In addition, no trees are to be planted within 2m of any existing native trees to be retained.

Tree guards may need to be installed on each plant to protect seedlings from extreme weather (frosts and heat), herbivorous grazing and herbicide drift during maintenance. The requirement for tree guards will be determined by the bush regeneration contractor at the end of the establishment phase. If used, bio-degradable tree guards are recommended to protect the seedlings, especially those in the more exposed Buffer zone. Depending on the weather, irrigation needs to be undertaken for at least 4-6 weeks following planting to aid establishment of the plants.

Planting of tube-stock for trees and shrubs species and *Hiko* or *Viro* cells for grasses and other groundcover species is the preferred method in all zones.

Seed collection

It is essential that only local provenance species are used for plantings. Provenance refers to where the plants, or seeds, come from. In accordance with best practice standards, all plants (or the seed used to grow them) need to be sourced from nearby areas that have the same vegetation community, landforms, soil landscapes, soil types and weather conditions (Buchanan 2009). Groundcovers, shrubs and trees should be collected from within 3km of the site. Should seed not be available within 3km, this radius can be extended to a maximum of 10km. Native grasses typically have much larger dispersal ranges and are to be collected from within a 10km radius of the site. Should seed not be available within the specified radius, OEH may provide written approval for seed supply from other areas of western Sydney.

Where the species identified in this VMP cannot be sourced, they may be substituted for other local species as identified in *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009). Trees must be substituted with trees, shrubs with shrubs etc. Only wild native species are to be used. Plants are not to be substituted with horticultural varieties under any circumstances.

Record keeping of seed collection and planting locations is to be as per the Flora Bank guidelines (Mortlock 2000). The bush regeneration contractor is responsible for recording this information and providing it to OEH. A Section 132C licence under the NSW *National Parks and Wildlife Act 1974* (NPWS Act) will not be required to undertake seed collection works from vegetation within the precinct to be removed as it will be approved through the planning process. Section 132C licence(s) under the NPWS Act will be required for seed collection from areas of STIF or BGHF vegetation outside the approved areas of vegetation removal, including the VMP area.

Nest boxes

Nest boxes are not uniform in shape and size and are tailored for particular species. In order for nest boxes to last and function as fauna refuge in the long term they need to be made from quality wood products and the growth of the tree on which the nest box is attached needs to be considered.

ELA recommends that nest boxes are sourced from a reputable supplier, such as Hollow Log Homes. Hollow Log Homes build nest boxes using external grade plywood and cypress (from ethical sources), natural wood preservative, and stainless steel hinges on lids. Furthermore, installation of boxes will be conducted using the 'Habisure system'. This system is based on the way buckets are placed in rubber trees, where it is essential not to impede the sap flow. By using this system it can be assured that no damage is done to the host tree and the risk of the acidic tree sap eating through the bolts over short amount of time is avoided. Habisure wires allow for tree growth, unlike other wires that can constrict the tree. Attaching the nest boxes with screws should be avoided as inserting metal into the tree and wounding the protective out layers may cause fungal infections within the tree.

In order to further protect the tree from damage nest boxes should be installed at a height of approximately 3 – 4 m to prevent the need to use spikes which may damage the tree.

Erosion control devices

Erosion control materials such as coir logs or jute matting should be used as part of revegetation in areas of high erosion risk. The use of erosion control material is very important because it provides organic matter to the top soil, improves soil structure and aeration, water infiltration, nutrient availability, and is also useful in the suppression of weed growth (Buchanan 2009). Erosion control material is especially important in the riparian management zone (Zone 2) and depending on the weed removal works, the remediation zone (Zone 1) due to the lack of significant native vegetation to assist in holding soil together. If mulch is used it should be sourced from within the local area and be free of weed propagules and invasive woody species such as *Erythrina x sykesii* (Coral Tree). Further, specifications for sediment fencing and straw bale installation are shown in **Appendix D**.

Riparian restoration

It is recommended that riparian restoration works focus on the following outcomes:

- Reducing erosion.
- Increasing habitat.
- Assisting revegetation.

There are a number of techniques that can be used to achieve the following outcomes, however given the size, condition and structures of the existing riparian areas on the VMP area, a few techniques will be most effective. The recommendations below are taken from '*A rehabilitation manual for Australian streams: Volume 2*' (Rutherford, Jerie and Marsh 2000). This resource provides more detail on the techniques listed below.

Bank protection

Bank protection can be achieved by 'armouring' the bank where water is likely to scour. This can be achieved by rocks, logs, or brushmatting. Bank protection generally only needs to extend at maximum over two-thirds of the way to bankfull height and can be reduced to a third of the bank height, or less, by combining traditional rock protection for the toe, and stabilising the rest of the bank face with vegetation (Rutherford, Jerie and Marsh 2000). The revegetation works to be undertaken in the riparian areas of the VMP area are concentrated along the banks.

In addition, logs, root wads and rocks can be combined to form a bank protection. This increases habitat while providing scour protection. This may be undertaken by pushing whole tree trunk or other large woody debris (LWD), with roots facing out, into the bank, leaving the roots exposed in the stream (Rutherford, Jerie and Marsh 2000). It may be feasible to use this technique with exotic woody weeds removed from the site, provided that they have been given time to dry out ensure they will not resprout.

Bank protection can also be undertaken with brush matting. Brush provides less protection than solid logs, but provides greater habitat value, because of the complex hydraulic diversity where the brush extends into the flow, and because burrowing animals can easily access the bank (Rutherford, Jerie and Marsh 2000).

To ensure that LWD is located so as to reduce bank erosion the following techniques can be undertaken (Rutherford, Jerie and Marsh 2000):

- When placing LWD into a stream the projected area of the piece should be less than 10% of the cross-sectional area.
- Several pieces of LWD placed close together (as described above), with one end attached to the bank, will behave like partial-width bank protection. This means that they will tend to protect the banks from erosion.
- The amount of erosion will increase the more the log interferes with the flow. As a crude rule of thumb, the cross-sectional area of erosion around a snag will be $\pm 100\%$ of the 'projected-area' of the obstruction.

In general the total amount of erosion caused by snags tends to be small and localised.

Partial-width bank control structures

Partial-width bank control structures are used to move the energy of a stream away from the bank. These can be used to reduce sediment loads in the creekline, provide habitat to macro-invertebrates and create varied hydraulic condition.

Retards are permeable structures used for bank stabilisation and/or river training. Traditional retards are a series of piles which extend from the bank toward the centre of the channel (Rutherford, Jerie and Marsh 2000). Brush retards are similar, but use local vegetative material instead. The basic design technique is to attach brush (branches) between retard pins, either by drilling through larger pieces or by weaving smaller pieces. In general, retards are intended to reduce the erosion of the bank, maintain the stability of the artificial bench, create low velocity conditions behind the structure suitable for the establishment of vegetation and to encourage deposition of fine sediment on the bench to improve the moisture retention needed for revegetation of the bench (Rutherford, Jerie and Marsh 2000). Brush retards could be constructed on site using woody weed species removed as part of bush regeneration works, though vegetation would need to be dried out first to avoid regrowth.

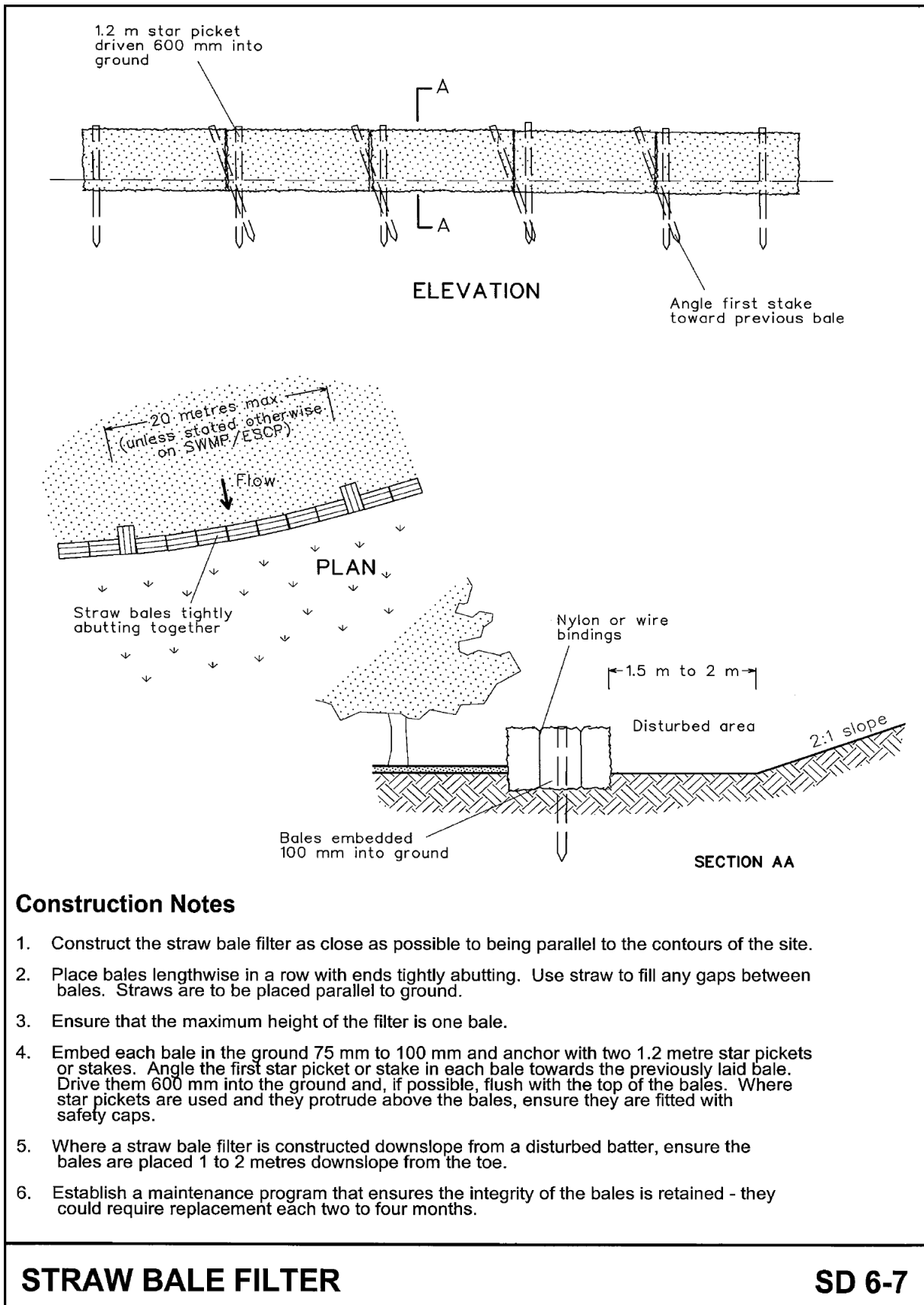
Fencing

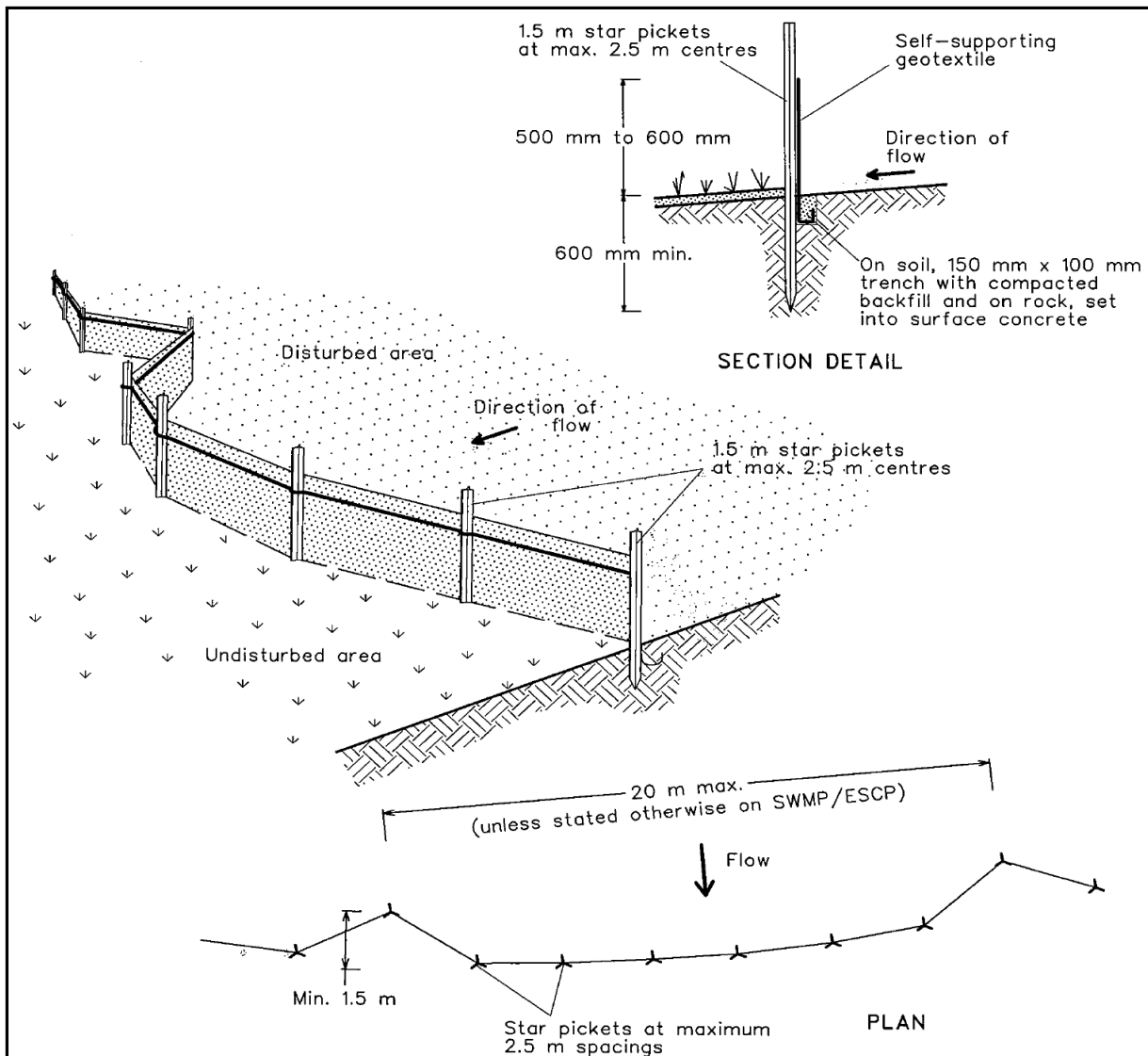
Temporary construction fencing is required to protect the areas of vegetation to be retained within the VMP area from impacts during the construction works in the precinct. Fencing must be placed within the area proposed to be cleared and not within the boundary of the VMP area. Trees or shrubs that are located within 1m of the fencing line may be pruned, though fencing should be placed so that it is not within 0.5m of trees or shrubs to be retained. The temporary fencing used during construction is to comply with section 4 of *AS 4970 – 2009 Protection of Trees*

After construction works are substantially completed fencing (or other demarcation) should be installed to delineate the bushland areas from the pathways, buildings, roads, landscaping and open space areas adjacent and prevent access. Fencing is not recommended where the VMP area borders bushland. It is suggested that fencing should be a 'chain and bollard' style fencing approximately 1m high.

Appendix E: Erosion Control Specifications

Source: *Managing Urban Stormwater: Soils and Construction* (Transport for NSW 2004).





Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE

SD 6-8



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