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Director Development  
Gregory Hills Development Company Pty Ltd  
PO Box 119  
Oatlands NSW 2117

**Ref: 4417**

24 May 2016

Dear Richard,

**RE: Addendum to Bushfire Protection Assessment – Gregory Hills Corporate Park**

Eco Logical Australia (ELA) was engaged to prepare an addendum to a Bushfire Protection Assessment (Ref 11WOLECO-0051 dated 24 April 2012) previously prepared for the Gregory Hills Corporate Park at 650 Camden Valley Way, Gregory Hills (hereafter referred to as the 'subject land').

Whilst the subject land is not currently mapped as bush fire prone on the Camden Bush Fire Prone Land Map, the Bushfire Protection Assessment (BPA) was undertaken to reflect the revegetation of riparian corridors within and adjacent to the subject land. These areas would then create bush fire prone vegetation within the subdivision that would later be subject to the requirements of relevant planning legislation including 'Planning for Bush Fire Protection 2006' (PBP) and Australian Standard (AS) 3959-2009 'Construction of buildings in bushfire prone areas'.

A wide forested corridor was proposed to be revegetated along South Creek to the north and this vegetation was classified as 'forest' in accordance with PBP, while a narrower corridor was to be revegetated from north to south joining South Creek and was classified as 'low hazard' vegetation in accordance with PBP.

Since the BPA was prepared, amendments have been made to the Vegetation Management Plan (VMP) applying to the area, with the narrower corridor to be revegetated in such a way that it will not constitute bush fire prone vegetation.

The VMP requires revegetation along the narrow corridor to be no wider than 10 m on either side of a 5 m wide creek bed. The indicative species will be low trees or shrubs with a grassy understorey, with revegetation to meet the following additional planting regimes to ensure a future bushfire hazard is not created:

- Trees will be planted to allow a crown separation of 2-5 m at maturity. Tree canopy cover will not exceed 15%; and
- Shrub and sedge plantings will be designed as clumps or islands and will not cover more than 20% of the total revegetation area.

It is proposed that the area will be managed for the first 5 years by the developers of the Corporate Park after which time responsibility for the ongoing management of this riparian corridor will be transferred to Camden Council.

As a result of this change to the management of the riparian corridor, an Asset Protection Zones (APZs) is no longer required for future development adjoining this area. An APZ will still be required for any development within 100 m of the South Creek riparian corridor.

Changes to the proposed uses have been considered recently by the landowner to include class 9A buildings which may be classed as Special Fire Protection Purpose (SFPP) development. SFPP development includes hospitals, schools, childcare centres and tourist accommodation as these developments cater for more vulnerable community members who may require assistance with evacuation in the event of a bushfire. Any SFPP development adjacent to the South Creek riparian corridor will require a 60m APZ to be provided based on 'forest' vegetation and a flat/upslope (as shown in **Figure 1**).

Consequently, the management actions outlined within the VMP and this report will result in a reduction in the extent of bush fire prone vegetation within the Gregory Hills Corporate Park.

If you have questions about any aspect of this letter, please contact me on (02) 8536 8600.

Yours sincerely,



Danielle Meggos

**Bushfire Consultant**

**FPAA BPAD Certified Practitioner No. BPD-L2-37742**





Figure 1: Asset protection zones



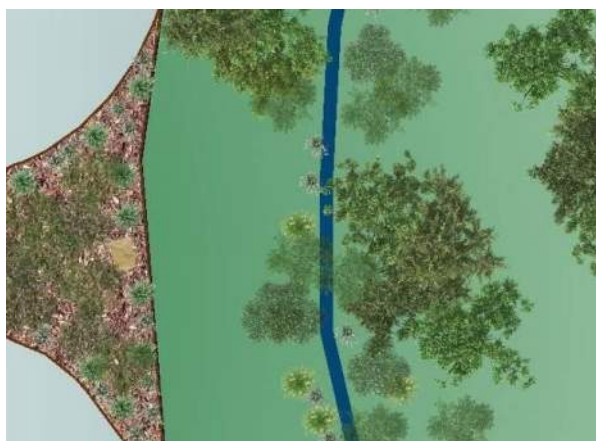
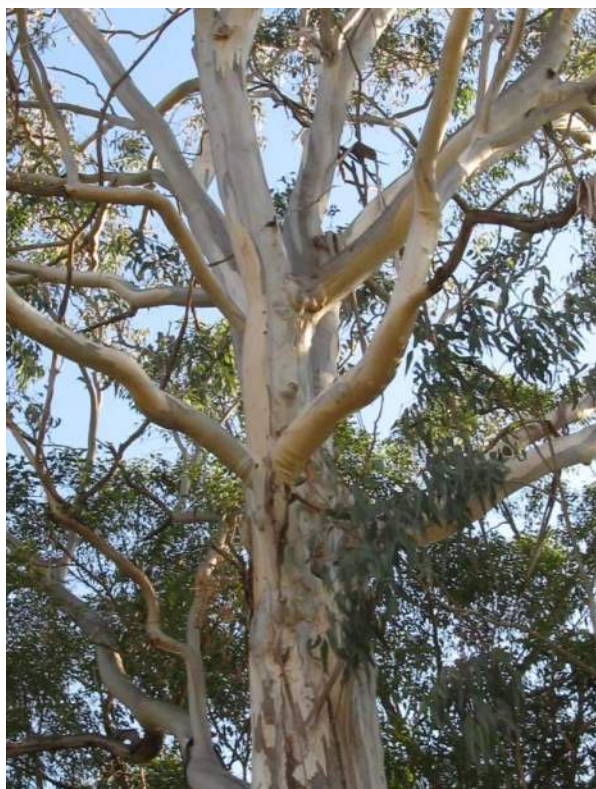
## VEGETATION MANAGEMENT PLAN

Gregory Hills Corporate Park

Prepared for

**Gregory Hills Development Company Pty Ltd**

6 November 2015





# Vegetation Management Plan

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## Vegetation Management Plan – Gregory Hills Corporate Park

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**PREPARED FOR** Gregory Hills Development Company Pty Ltd

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**PROJECT NO** 3040

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**DATE** 6 November 2015

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## Abbreviations

ABBREVIATION	DESCRIPTION
CRZ	Core Riparian Zone
DA	Development Application
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
LGA	Local Government Area
VB	Vegetated Buffer
VMP	Vegetation Management Plan
WLS	Waterfront Land Strategy

# 1 Introduction

This Vegetation Management Plan (VMP) has been prepared by Eco Logical Australia Pty Ltd (ELA) on behalf of Gregory Hills Development Company Pty Ltd for the Gregory Hills Corporate Park development at Narellan.

This VMP relates to the land parcel Lot 701 DP1154772 Gregory Hills Drive in the Camden Local Government Area (LGA), for the current Development Application for the subdivision of the Employment Lands within their landholdings at the Turner Road Precinct on Camden Valley Way. The DA will include, bulk earthworks, construction of lead in services, roads and bioswales, re-design and re-alignment of the South Creek Tributary and rehabilitation works within riparian corridors.

## 1.1 BACKGROUND

The DA comprises 49 industrial/retail lots, bulk earthworks, construction of roads and stormwater management facilities. Lot release will be carried out in three stages.

The subject of this VMP is a 10m strip of Vegetated Buffer (VB) along the northern boundary of the site which comprises the VB for South Creek. This VMP also covers and the riparian area between the southern boundary and the northern boundary in the eastern side of the site (**Figure 1**), which is identified as a Category 2 Watercourse under the Turner Road Waterfront Land Strategy (DoP 2009) (see **Section 1.3**).

Several precinct planning reports have previously been prepared for the site in conjunction with the rezoning of the Turner Road precinct, these include Waterfront Land Strategy (DoP 2009), a Flora and Fauna Assessment (ELA 2007), a Bushfire Protection Assessment (ELA 2007), Growth Centres Conservation Plan, Growth Centres Commission Development Code and the Turner Road Development Control Plan.

A separate soils and water management plan and works plan are being developed by Mott MacDonald and this report has been prepared to accompany them.

## 1.2 OBJECTIVES OF THE VMP

The objectives of this VMP are to provide a guide to bush regeneration contractors to:

- Protect remnant vegetation in the riparian area associated with these DAs;
- Control noxious and environmental weeds on the subject land;
- Revegetate the riparian area with native vegetation which emulates pre-European vegetation communities;
- Protect flora and fauna habitat; and,
- Provide for a stable bed and bank.

### 1.3 REQUIREMENTS OF THE TURNER ROAD WATERFRONT LAND STRATEGY, JULY 2009

The Turner Road Waterfront Land Strategy July 2009 (hereafter referred to as the 'Turner Road WLS', has categorised all watercourses within the Turner Road Precinct, and the riparian area addressed in this report is a Category 2 Watercourse – Terrestrial and Aquatic Habitat. The controls for this category are as follows:

- Provide and emulate a stable naturally functioning watercourse;
- Provide a Riparian Protection Area of a minimum of 60m width, including a Core Riparian Zone (CRZ) of an average of 40m... measured from Top of Bank (TOB)... and an additional 10 m wide Vegetation Buffer (VB) either side of the CRZ;
- Restore and rehabilitate the CRZ and VB with local provenance vegetation;
- Ensure vegetation in the CRZ is at a density that would occur naturally;
- Minimise the number of road crossings and ensure riparian connectivity is maintained;
- Provide later connectivity for in-stream function.

This section of Waterfront Land is an anomaly within the Turner Road precinct, in that although it is a Category 2 Watercourse subject to the controls for that category, the outcomes may be compliant with the outcomes for a Category 3 Watercourse. According to the Turner Road WLS (DoP 2009), these outcomes are listed as follows:

- **Outcome 1:** To retain, maintain and restore where possible the natural functions of the watercourse including bed and bank stability to protect local water quality;
- **Outcome 2:** Where the natural functions of a stream are proposed to be retained and restored, a continuous, viable CRZ which emulates the native vegetation communities in the area is to be provided to facilitate a stable watercourse; and
- **Outcome 3:** Where it is not possible to retain the natural functions of a stream, an engineered solution to the watercourse will be considered subject to the proposed development satisfactorily demonstrating minimal impacts on downstream riparian protection areas.

This VMP seeks to adhere to the controls outlined for Category 2 Watercourses, to achieve the outcomes outlined for Category 3 Watercourses.

## 2 Description of the Environment

### 2.1 LOCATION

The Gregory Hills Corporate Park development is located east of Camden Valley Way in the Camden LGA, approximately 50 kilometres south west of Sydney (**Figure 1**). The site of the development will provide 49 industrial lots.

The area of land subject to this VMP is a section of South Creek VB and the Core Riparian Zone (CRZ) and VB north of Gregory Hills Drive extending downstream through to South Creek. The area subject to this VMP totals 4.05 hectares.

A retaining wall will be constructed along the northern boundary of the site, located 4m in from the edge of the South Creek VB. Within the outer 4m of the VB, bioswales will be constructed to catch and treat stormwater from the adjacent roads (see **Appendix 5**).

Similarly, a masonry retaining wall and footpath is proposed within the VB along the South Creek Tributary on the eastern side.

The Turner Road Waterfront Land Strategy states that the VB may accommodate open space uses within the roadside edge of the VB, providing these uses do not exceed 40% of the area of the VB, and does not cause a reduction in the function of the VB.

### 2.2 REGIONAL CONTEXT

The precinct is located on a large grazing property with no existing native vegetation on the property. The closest areas of remnant vegetation can be found approximately two kilometres to the west on another housing development site at Harrington Grove.

### 2.3 EXISTING VEGETATION

A flora and fauna assessment of the Turner Road precinct has been undertaken by ELA (2007). The site (refer to **Figure 1**), is part of a previously large grazing property, substantial clearing and long term grazing across the site has resulted in vegetation remaining on site consisting of predominantly exotic grassy groundcover and no native vegetation associations.

#### 2.3.1 Vegetation Associations

No native vegetation associations are located within the development site, however two vegetation communities, Shale Plain Woodland and Alluvial Woodland, have been recorded within the wider Turner Road Precinct. The Shale Plain Woodland is a sub-community of the Cumberland Plain Woodland, while the Alluvial Woodland is a sub-community of the River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and south-east corner Bioregion. Both vegetation communities are listed as Endangered Ecological Communities (EEC) under the NSW *Threatened Species Act 1992* and the Cumberland Plain Woodland is also listed under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. These vegetation communities consist of some scattered trees and an understorey dominated by pasture grasses.

The vegetation associations in the area subject to the VMP are characterised by scattered trees and the understorey is dominated by exotic pasture grasses. The creek line is in poor geomorphologic condition which is dominated by exotic pasture grasses with occasional clumps of native sedges.

### 2.3.2 Native Flora

A total of 22 native species of flora have been recorded within the Turner Rd precinct (the greater development foot print). None of these species are listed under the NSW *TSC Act* or the Commonwealth *EPBC Act*.

### 2.3.3 Weed Species

A total of 18 weed species were recorded within the Turner Rd precinct. Two species are declared noxious weeds under the NSW *Noxious Weeds Act 1992* (**Table 1**). Ten weed species have been recorded on the site subject to this VMP, one of which is a noxious weed species.

**Table 1. Weed species observed within the VMP area, with noxious weeds indicated**

Scientific Name	Common Name	Observed in VMP Area	Noxious Weed Category
<i>Araujia sericifera</i>	Moth Vine		
<i>Bidens pilosa</i>	Cobblers Peg	✓	
<i>Chenopodium album</i>	Fat Hen	✓	
<i>Chloris gayana</i>	Rhodes Grass	✓	
<i>Cotoneaster glaucophyllus</i>	Cotoneaster		
<i>Cynodon dactylon</i>	Cooch	✓	
<i>Foeniculum vulgare</i>	Fennel		
<i>Jacaranda mimosifolia</i>	Jacaranda		
<i>Ligustrum sinense</i>	Small Leaf Privet		4
<i>Lycium ferocissimum</i>	African Boxthorn	✓	4
<i>Olea europaea</i>	Olive		
<i>Paspalum dilatatum</i>	Paspalum	✓	
<i>Pennisetum clandestinum</i>	Kikuyu	✓	
<i>Pinus sp.</i>	Pine		
<i>Plantago lanceolata</i>	Ribbed Plantain	✓	
<i>Senecio madagascariensis</i>	Fireweed	✓	
<i>Sida rhombifolia</i>	Paddy's Lucerne	✓	
<i>Verbena bonariensis</i>	Purpletop	✓	

Note - Noxious weed categories are shown in **Appendix 1**.

## 2.4 FAUNA

Twenty-two native fauna species have been recorded across the Turner Rd precinct, none of which are listed under the TSC or EPBC Acts. Three introduced species of fauna were also recorded, the Common Starling (*Sturnus vulgaris*), Indian Myna (*Acridotheres tristis*) and European Rabbit (*Oryctolagus cuniculus*).

## 2.5 SOILS

The Turner Rd precinct is dominated by Wianamatta Shale and characterised by floodplains, valley flats and drainage depressions of the Cumberland Plain.

## 2.6 EXISTING CREEKLINE

The existing creek line (**Figure 1**) was assessed as part of the previous ELA Assessment (2007) and has been considered suitable for realignment as part of the Turner WFL strategy. The existing streamline is of minimal aquatic value and has been highly modified. The upper reaches of the watercourse have been re-aligned and rehabilitated as part of the Badgally Road extension and surrounding Gregory Hills Residential Development. The new Badgally Road extension, now forms the southern boundary of this VMP, where flows are fed through a new culvert structure under Badgally Road.

This watercourse does flow directly into South Creek at present, and the plans for re—alignment will ensure that the confluence of this tributary and South Creek is appropriate for the integration with future rehabilitation plans for the South Creek Corridor by Sekisui House Developments who own the land to the north of the site.

The re-aligned channel will meander through Management Zone 1a and 1b (see **Figure 1** and **Appendix 5**), with a bed width suitable for holding 1:2 year events, however it will remain mostly dry and be vegetated with appropriate native species of rushes and sedges.

Refer to Mott Macdonald engineering drawings for further detail (**Appendix 5**).



Figure 1 Location of Management Zones within landscape

### 3 Vegetation Management Works

The area subject to the VMP is the riparian protection area (CRZ and VB) north of Gregory Hills Drive and a section of the South Creek VB (**Figure 2**). Works required include

- minor earth works to recreate the streamline,
- laying of geotextile fabric to stabilise the bed and banks as well as rock
- transverse rock armouring (or similar) placed at scour locations and in particular areas that may suffer damage during 1:5yr events.
- extensive weed control and revegetation works throughout the VB and CRZ
- revegetation of batters within the South Creek VB.

Management actions are discussed in this section for two Management Zones.

These tasks will be undertaken by a suitably qualified bush regeneration contractor (see **Appendix 2**). Weed control techniques are identified for each management zone and further details in **Appendix 3**.

An aerial layout of the site illustrating proposed works has been provided, along with an indicative cross section of the area subject to the VMP. These are provided in **Appendix 5**.

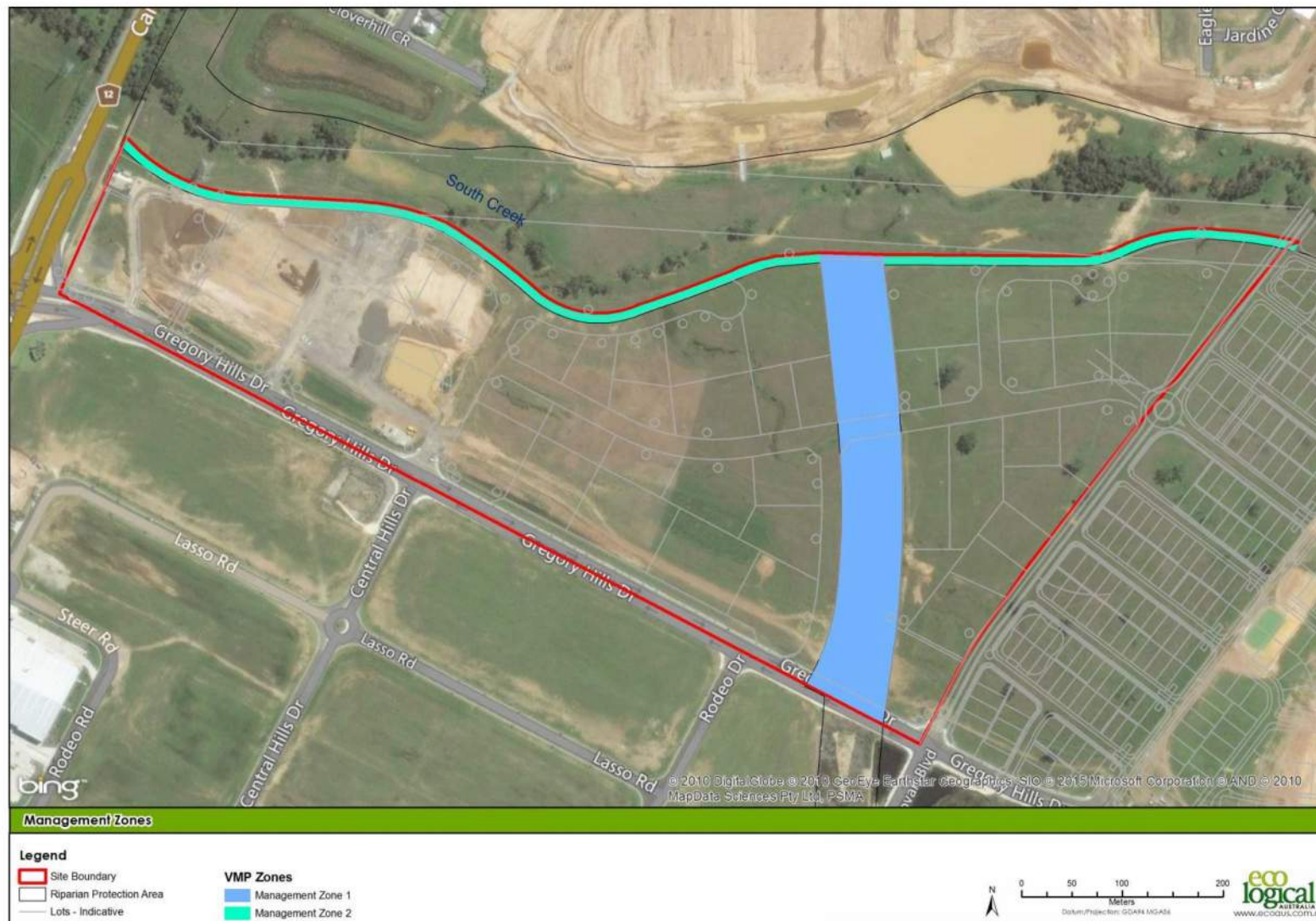


Figure 2 Area of works showing Management Zones, Gregory Hills.

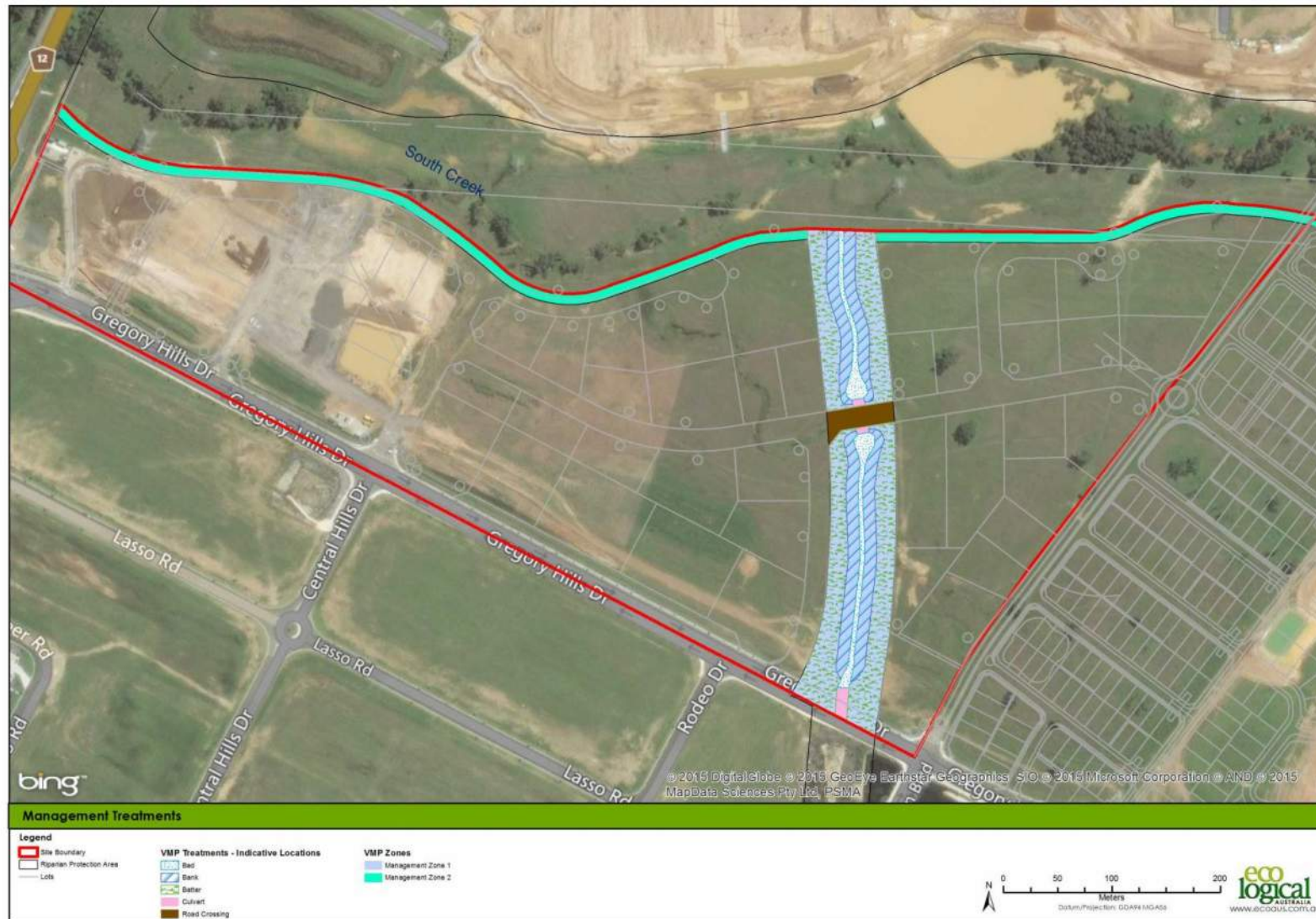


Figure 3 Management Treatments within each Zone

### 3.1 MANAGEMENT ZONES

#### 3.1.1 Management Zone 1

Management Zones 1 consists of Core Riparian Zone and VB of the South Creek Tributary. The area of this management zone is 2.9 hectares, being approximately 60 metres wide in accordance with the Turner Road WLS (DoP 2009). This Management zone is separated by a proposed road crossing and works within both zones will include realigning the watercourse, construction of a retaining wall along the eastern edge and a shared path with a line of landscaping at a maximum depth of 4m in the VB. The layout of the corridor and proposed bed structure is shown in **Appendix 5**.

Management zone 1 is proposed to be revegetated to a River Flat Eucalypt Forest vegetation community. However, the planting design and densities are to be modified so that the future riparian corridor does not pose a bushfire threat to the surrounding development.

This zone is further broken down into management treatment areas as shown in **Figure 3** and **Table 2**.

**Table 2 Management Zone 1 Treatment Areas**

Treatment type	Bed	Bank	Batter	Culvert/Road Crossing	Total (Ha)
Total (Ha)	0.241	0.809	1.661	0.177	<b>2.888</b>

#### *Pre-construction works*

The boundary between the VMP works and the South Creek CRZ will be delineated with construction fencing to prevent construction workers and machinery entering the corridor.

Rabbit control by way of identification and fumigation of warrens within a 200 metre radius of the site will be undertaken prior to any revegetation works. No other pre-construction works are required in Management Zone 1a or 1b.

#### *Construction Phase*

Earthworks will be required to realign the streamline, no existing native vegetation is currently existing within this zone. Once earthworks are complete, the area will be lined with geofabric or jute matting to prevent soil erosion and stabilise the stream bed (refer to separate Engineering Plans for full detail). Transverse rock armouring (or similar) will be placed at scour locations and in particular areas that may suffer damage during 1:5yr events.

Significant earthworks will also be required to construct the road crossing in this zone.

The area requiring jute matting has been calculated at 2.9 hectares however the amount of jute matting required is 32,000 m<sup>2</sup>, as individual layers need to overlap by a minimum of 10%. The removal of temporary construction fencing can occur once the Construction Phase is complete.

#### *Post Construction*

**Figure 3** shows the post construction treatment areas within each management zone. Bed, Banks and Batters as shown in **Figure 3** will require planting.

The creek bed will require revegetation with species tolerant to wet conditions, as found in **Table 3**.

10m either side of the bed, banks of 1% fall are proposed. These banks will require revegetation with grasses, herbs and isolated trees consisting of species found in **Table 4**. These species resemble species found in the River Flat Eucalypt Forest vegetation community.

The remainder of the riparian corridor (approximately 15m on from each outer edge) will form a batter with a fall of 1:6. Trees cannot be planted on these batters, therefore they are to be revegetated with grasses, herbs and shrubs only as listed in **Table 5**.

For the revegetation of the banks and batters, the following additional planting regimes are required in order to create a vegetation community which will not pose a future bushfire hazard;

- Trees should be planted to allow a crown separation of 2-5m at maturity. Tree canopy cover should not exceed 15%
- Shrub and sedge plantings should be designed as clumps or islands and should not covering more than 20% of the area.

Prior to revegetation occurring, the area will be sprayed using a boom spray to control weeds. Should the soils requiring cover, jute matting is to be used. Once the site has been mulched, revegetation will occur. Overstorey and mid storey species will be planted at a density of one plant per 100 square metres while understorey species will be planted at a density of four plants per square metre, except in the bed of the creek where densities of 6 plants per square meter are is required.

#### *Maintenance*

Any removal of weed species will be undertaken by hand pulling or spot spraying all pasture grasses following the revegetation programme. Weeds of most concern include Kikuyu (*Pennisetum clandestinum*), Paspalum (*Paspalum dilatatum*), Cobbler's Pegs (*Bidens pilosa*) and Paddy's Lucerne (*Sida rhombifolia*).

Where there is the chance of damage occurring due to herbicide drift all weed species will be hand pulled in this immediate area. If herbicides are to be used, extreme care will be required when spot spraying in areas near the creek and/or water, or areas of revegetation as the revegetation will be killed by herbicide drift.

The following additional maintenance activities are required in order to maintain a vegetation community which will not pose a future bushfire hazard;

- Mature trees should have lower limbs removed up to a height of 2m above the ground.
- Remove or thin understory plants and shrubs less than 3m in height in order to maintain the clumps of plantings and keep the cover at 20%.
- Prune mature trees where applicable to maintain crown separation.
- Grasses and herbs are to be kept short and where possible green.
- Ground fuels such as fallen leaves, twigs (less than 6 mm in diameter) and bark should be removed on a regular basis.

**Table 3: Species to be used in the revegetation of stream bed in Management Zone 1**

Species Name	Common Name	% of total	Number Required
<b>GRASSES &amp; HERBS (6 plants/m2)</b>			
<i>Juncus usitatus</i>	Juncus	34	9825
<i>Lomandra longifolia</i>	Mat Rush	33	9536
<i>Cyperus trinervis</i>	Cyperus	33	9536
<b>Total</b>			<b>28 897</b>
Estimated total cost at \$1.80 per plant			\$52,014

**Table 4 Species to be used in the revegetation of banks in Management Zone 1**

Species Name	Common Name	% of total	Number Required
<b>TREES &amp; SHRUBS (1 plant/50 m2)</b>			
<i>Angophora bakeri</i>	Narrow-leaved Apple	5	10
<i>Angophora subvelutina</i>	Broad Leaf Apple	5	10
<i>Bursaria spinosa</i>	Blackthorn	30	58
<i>Casuarina glauca</i>	She-Oak	20	39
<i>Eucalyptus tereticornis</i>	Forest Red Gum	20	39
<i>Indigofera australis</i>	Australian Indigo	15	29
<i>Pultenaea microphylla</i>	Bush Pea	5	10
<b>GRASSES &amp; HERBS (4 plants/m2)</b>			
<i>Austrostipa ramosissima</i>	Spear Grass	10	3853
<i>Commelina cyanea</i>	Native Wandering Jew	5	1926
<i>Cyperus trinervis</i>	Cyperus	5	1926
<i>Dichondra repens</i>	Kidney Weed	10	3853
<i>Echinopogon ovatus</i>	Hedgehog Grass	5	1926
<i>Entolasia stricta</i>	Wiry Panic	5	1926
<i>Glycine clandestina</i>	Glycine	5	1926
<i>Juncus usitatus</i>	Juncus	5	1926
<i>Lomandra longifolia</i>	Mat Rush	5	1926
<i>Microlaena stipoides</i>	Weeping Rye Grass	10	3853

Species Name	Common Name	% of total	Number Required
<i>Oplismenus aemulus</i>	Basket Grass	5	1926
<i>Persicaria subsessilis</i>	Knotweed	10	3853
<i>Pratia purpurascens</i>	White Root	5	1926
<i>Themeda australis</i>	Kangaroo Grass	15	5779
<b>Total</b>			<b>38 625</b>
Estimated total cost at \$1.80 per plant			\$69,526

Table 5 Species to be used in revegetation of batters in Management Zone 1

Species Name	Common Name	% of total	Number Required
<b>Shrubs 1 plants/5m2</b>			
<i>Indigofera australis</i>	Australian Indigo	50	1445
<i>Pultenaea microphylla</i>	Bush Pea	50	1445
<b>Herbs and Grasses 4 plants/m2</b>			
<i>Arthropodium milleflorum</i>	Chocolate Lily	5	2889
<i>Dianella longifolia</i>	Flax Lily	10	5778
<i>Goodenia hederacea</i>	Forest Goodenia	5	2889
<i>Linum marginale</i>	Native Flax	5	2889
<i>Themeda australis</i>	Kangaroo Grass	20	11556
<i>Brunoniella australis</i>	Blue Trumpet	5	2889
<i>Chrysocephalum apiculatum</i>	Everlasting daisy	5	2889
<i>Eremophila debilis</i>	Winter Apple	5	2889
<i>Atriplex semibaccata</i>	Berry Saltbush	5	2889
<i>Dichondra repens</i>	Kidney Weed	5	2889
<i>Einadia hastata</i>	Berry Saltbush	5	2889
<i>Glycine tabacina</i>	Glycine	5	2889
<i>Microlaena stipoides</i>	Weeping Rye Grass	20	11556
<b>Total</b>			<b>60 671</b>
Estimated total cost at \$1.80 per plant			\$109, 208

### 3.1.2 Management Zone 2

Management Zone 2 is the Southern VB of the South Creek Riparian Protection Area. The area of this Management Zone is 1.16ha, which will require revegetation works.

This management zone includes a batter with a 600m wide, a footing that runs along the length of the site at 4m in from the edge of the riparian protection area and 4m wide bioswales along the edges of the proposed roadways (refer to **Appendix 4** for indicative cross section). Some stormwater infrastructure associated with discharge points will encroach into the adjacent CRZ (refer to detailed engineering drawings).

#### *Pre-construction Works*

The boundary between the Vegetated Buffer and the CRZ will be delineated with construction fencing to prevent construction workers and machinery entering the CRZ.

Rabbit control by way of identification and fumigation of warrens within a 200 metre radius of the site will be undertaken prior to any revegetation works. No other pre-construction works are required in Management Zone 2.

#### *Construction Phase*

Significant earthworks will be required to create the batter and build the bioswales. All earth works will be contained to the VB and no machinery will enter the CRZ. Once earthworks are complete, the area to the north of the retaining wall will be stabilised with just matting. The area requiring jute matting has been calculated at 1.16 hectares however the amount of jute matting required is 13,000 m<sup>2</sup>, as individual layers need to overlap by a minimum of 10%. After the, jute matting has been laid and the area has been stabilised, the bioswales will be constructed prior to revegetation being undertaken. The removal of temporary construction fencing can occur once the Construction Phase is complete.

The 6m of VB on the north side of the retaining wall will be revegetated with species found in **Table 6**. These species are found in the River Flat Eucalypt Forest vegetation community. Prior to revegetation occurring, the area will be sprayed using a boom spray to control weeds and then mulched to a depth of 100 mm to prevent weed regeneration. If jute matting is used for stabilisation, then no mulching is required. Overstorey and mid storey species will be planted at a density of one plant per 50 square metres while understorey species will be planted at a density of four plants per square metre.

Regular maintenance work will be required to control emergent weed species, these are likely to be pasture grasses which will be controlled by spot spraying prior to flowering or by hand pulling. Weeds of most concern include Kikuyu (*Pennisetum clandestinum*), Paspalum (*Paspalum dilatatum*), Cobblers Peg (*Bidens pilosa*) and Paddy's Lucerne (*Sida rhombifolia*).

#### *Post Construction*

Post construction, the site will require extensive maintenance work to control pasture grasses and herbaceous weeds. This will be undertaken by hand pulling and spot spraying. Where there is the chance of herbicide drift occurring, all weed species will be hand pulled in this immediate area. If herbicides are to be used, extreme care will be required when spot spraying in areas of revegetation as the revegetation will be killed by herbicide drift. The regeneration of African Boxthorn may also occur. Any seedlings will be either hand pulled or spot sprayed. Larger plants will be controlled by the cut and paste method.

**Table 6: Species to be used in the revegetation of Management Zone 2**

Species Name	Common Name	% of total	Number Required
<b>TREES &amp; SHRUBS (1 plant/50 m2)</b>			
<i>Angophora bakeri</i>	Narrow-leaved Apple	5	12
<i>Angophora subvelutina</i>	Broad Leaf Apple	5	12
<i>Bursaria spinosa</i>	Blackthorn	30	70
<i>Casuarina glauca</i>	She-Oak	20	47
<i>Eucalyptus tereticornis</i>	Forest Red Gum	20	47
<i>Indigofera australis</i>	Australian Indigo	15	35
<i>Pultenaea microphylla</i>	Bush Pea	5	12
<b>GRASSES &amp; HERBS (4 plants/m2)</b>			
<i>Austrostipa ramosissima</i>	Spear Grass	10	4653
<i>Commelina cyanea</i>	Native Wandering Jew	5	2327
<i>Cyperus trinervis</i>	Cyperus	5	2327
<i>Dichondra repens</i>	Kidney Weed	10	4653
<i>Echinopogon ovatus</i>	Hedgehog Grass	5	2327
<i>Entolasia stricta</i>	Wiry Panic	5	2327
<i>Glycine clandestina</i>	Glycine	5	2327
<i>Juncus usitatus</i>	Juncus	5	2327
<i>Lomandra longifolia</i>	Mat Rush	5	2327
<i>Microlaena stipoides</i>	Weeping Rye Grass	10	4653
<i>Oplismenus aemulus</i>	Basket Grass	5	2327
<i>Persicaria subsessilis</i>	Knotweed	10	4653
<i>Pratia purpurascens</i>	White Root	5	2327
<i>Themeda australis</i>	Kangaroo Grass	15	6980
<b>Total</b>			<b>46 648</b>
Estimated total cost at \$1.80 per plant			\$83,967

### 3.2 WEED CONTROL AND BUSH REGENERATION

Details of specific weed control techniques to be used such as hand pulling, grass control and the use of herbicides are described in **Appendix 3** with further details in Muyt (2001). The principles of bush regeneration will be in accordance with the Bradley Method and other techniques described in Buchanan (2000). Maintenance weed control works required are described in more detail in **Section 4**. Only herbicides and other additives recommended for use near water will be used to control weeds throughout this area.

### 3.3 REVEGETATION

Extensive revegetation works are required across the site. The remnant vegetation of the area resembles Shale Plain Woodland and River-flat Eucalypt Forest. All species used in the revegetation of this site reflect either of these vegetation associations and have been identified above.

All revegetation will be tube stock or hiko cells. As rabbit control will be undertaken separately, tree guards will only be required if planting is undertaken at a time of year where frost exposure is likely. All plants will be irrigated when they are planted and further irrigation may be required depending on rainfall following planting. A staged approach to revegetation works maybe required, which will be decided by the bush regeneration contractor. A staged approach would involve planting understorey species in the first year, followed by overstorey and midstorey species the following year.

The cost of revegetation works has been budgeted at \$1.80 per plant. This includes the cost of growing the plant, the tree guard (for trees), water retaining crystals, planting and initial watering.

Seed for revegetation works will be collected from the surrounding landscape to insure it is of local provenance with seed collection undertaken in accordance with Florabank Guidelines (Mortlock 2000). A Section 132C licence under the NSW *National Parks and Wildlife Act 1974* will be required to undertake seed collection works.

### 3.4 MANAGEMENT OF WEED WASTE

It is unlikely that large amounts of weed waste will be generated on the site due to the site being dominated by pasture grasses. However, all woody weed material will either be mulched on site or disposed of at a facility licensed to receive green waste.

## 4 Stream Works

The existing stream on the site exhibits poor geomorphic characteristics and is of a low natural recovery potential.

Upstream dams have been removed, and a culvert structure under the new Gregory Hills Drive is now the key influence on the stream. The tributary also flows into South Creek, the intersection of these two streams and any stormwater outlets, with regards to locations and levels will be part of the DA drawings, these are being prepared separately by Mott MacDonald engineers along with realignment and works plans.

## 5 Maintenance

The entire site will require ongoing maintenance to prevent weed regrowth from the soil seed bank for many of the weed species. Maintenance works will be undertaken by a qualified bush regeneration contractor (see **Appendix 2** for more details) appointed by Gregory Hills Development Company for a period of five years. All maintenance work is to meet the performance criteria stated in **Section 9.3**.

Maintenance work will need to be undertaken to ensure that no new weed invasions occur, This will involve regular surveys of the entire area subject to the VMP to determine if new weed species are becoming established through time. Any new infestations will need to be referred to Gregory Hills Development Company and the Camden Council who will provide further information on the best practice control techniques for these new weed species.

Maintenance work will be undertaken on a regular basis with works undertaken weekly in the peak growing seasons and monthly during cooler periods. Maintenance works will be undertaken for at least five years after the completion of initial works.

The additional maintenance requirements for zone 1 as specified in **Section 3.1.1** will need to continue in perpetuity once the land is handed over to Camden Council in order to maintain a vegetation community which will not pose a future bushfire hazard.

## 6 Cost

The cost to implement the VMP has been estimated at \$832,333 over a five-year period. This is divided across the following management zones:

- Zone 1 - \$593,202
- Zone 2 - \$239,131

The greatest cost is in the first year through revegetation costs, with a significant reduction in year two and a slight decline in subsequent years. A complete breakdown of yearly cost for each management zone can be seen in **Appendix 4**. As mentioned above, maintenance work is to be undertaken by a bush regeneration contractor appointed by Gregory Hills Development Company for a period of five years.

## 7 Fencing and Sediment Control

### 7.1 SOIL AND WATER MANAGEMENT PLAN

A Soil and Water Management Plan will be required for the whole construction area, including the area subject to the VMP. Water and soil from the construction zone will not be directed into the area subject to the VMP, as this will impact on restoration works. A copy of the Soil and Water Management Plan will be provided to the bush regeneration contractor by the site engineer.

### 7.2 CONSTRUCTION FENCING

Construction fencing is required to identify the boundary between construction activities and vegetation management works and around trees to be retained in the construction area. The aim of this is to prevent unnecessary damage to native vegetation in the VMP Area from construction activities and excludes all construction machinery, activities, materials and staff from the VMP Area.

## 8 Threatened Species Considerations

No threatened flora or fauna species have been recorded across the Turner Rd precinct, therefore there are no specific considerations for threatened species across the site subject to the VMP.

### 8.1 ECOLOGICAL COMMUNITIES

The vegetation on the site is highly degraded and will require revegetation with species River-flat Eucalypt Forest. These vegetation communities are listed as EECs under the TSC Act. A section 132C license under the NSW *National Parks and Wildlife Act 1974* is required to work in an EEC.

## 9 Monitoring and Reporting

The bush regeneration contractor 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 a Camden Council and Gregory Hills Development Company representative.

The bush regeneration contractor will establish photo monitoring points and prepare regular reports to describe the progress of their work and demonstrate compliance with the VMP. Reports will include a brief quarterly work report and an annual audit and assessment of compliance with the performance criteria in **Section 9.3**. The requirements of monitoring and reporting are described in detail in the sections below.

### 9.1 PHOTO MONITORING POINTS

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 two photo monitoring points in each management zone
- place two six foot star pickets 10-metres apart
- the location of the first star picket will be recorded with a GPS
- take a digital photo of each photo monitoring point from the first star picket, towards the second star picket, with the whole length of the second star picket visible in the photo to act as a reference point; and
- organise the digital photos logically with each image labelled with a unique reference number indicating the location of the photo monitoring point and the date the photo is taken (i.e. "01\_2015\_09\_08" for photo point 1 taken on the 8 September 2015).

## 9.2 BUSH REGENERATION REPORTING

A brief report outlining work undertaken by the bush regeneration contractor will be prepared quarterly (i.e. every third month). The report will be submitted to a Gregory Hills Development Company representative. Reports will include:

- a summary of works carried out within the period
- an approximation of the time spent on each task
- mapping of areas worked presented in a GIS compatible format
- 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

In addition, a report assessing the success of the works in relation to the performance criteria specified in **Section 9.3** will be prepared annually and submitted to a Gregory Hills Development Company representative for provision to Council.

## 9.3 PERFORMANCE CRITERIA

The progress and compliance with the VMP will be monitored and reviewed annually. This process will involve the bush regeneration contractor, a Gregory Hills Development Company Representative and a Camden Council representative. 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;
- Control of noxious and larger woody weeds including privet, African olive and African Boxthorn;
  - Year 1 – All adult seeding individuals to be controlled
  - Years 2 to 4 – no plants allowed to set seed
  - Year 5 – complete eradication from the site
  - All years – no establishment of new noxious species
- Control of agricultural weeds (Paddys Lucerne, cobblers pegs, etc):
  - Year 1 – 100% treatment of dense clumps (>5 plants/m<sup>2</sup>)
  - Year 2 – 100% treatment of dense clumps (>5 plants/m<sup>2</sup>)
  - Year 3 – No more than 1 individual plant/4 m<sup>2</sup>
  - Year 4 – No more than 1 individual plant/25 m<sup>2</sup>
  - Year 5 – No more than 1 individual plant/100 m<sup>2</sup>
- Control of exotic pasture grasses
  - Year 1 – No greater than 30% cover
  - Year 2 – No greater than 20% cover
  - Year 3 – No greater than 10% cover

- Year 4 – No greater than 5% cover
  - Year 5 – No greater than 5% cover
- For bush regeneration and revegetation works, native ground cover is required to achieve the NSW biometric benchmark of 50% by the end of the maintenance period, with the following annual criteria:
  - Year 1 – Minimum coverage of 20%
  - Year 2 – Minimum coverage of 30%
  - Year 3 – Minimum coverage of 40%
  - Year 4 – Minimum coverage of 50%
  - Year 5 – Minimum coverage of 50%
- At the end of each year, a minimum of 85% survival rate of all revegetation and of all revegetation strata (e.g. groundcover, shrub and canopy layers) is required;
- Any localised plant failure within planting areas are addressed with no area larger than 2 m x 2 metres without surviving plants;
- Maintenance replating is to replace plants by the same species, or where that species is not available, with the same growth form (ie tree for tree etc) and must not decrease species diversity. Any new species must be from the community being emulated and of local provenance;
- Where non-performance occurs and is not immediately rectified a 'stop the clock' notice on the maintenance period will be issued by Camden Council until the non-performance is rectified; and
- Monitoring and reporting undertaken in accordance with **Section 9.2**.

## 10 References

Buchanan, R.A. (2000) Bush regeneration: recovering Australian landscapes. 2<sup>nd</sup> ed, TAFE NSW, Sydney

NSW Department of Planning (DoP) (2009). Oran Park and Turner Road Waterfront Land Strategy, July 2009. NSW Government Gazette No. 105.

Eco Logical Australia Pty. Ltd. (ELA) (2007) Flora and Fauna Impact Assessment Final Report. Prepared for Dart West Developments, Pty. Ltd.

Eco Logical Australia Pty. Ltd. (ELA) (2010) Bushfire Protection Assessment Draft Report. Prepared for Dart West Developments, Pty. Ltd.

Mortlock, W. (2000) The Hawkesbury-Nepean Catchment Management Authority: Florabank Guideline 10: Seed collection ranges for revegetation. <http://www.florabank.org.au/> Florabank, Yarralumla, ACT

Muyt, A. (2001) Bush Invaders of South-East Australia. R.G. & F.J. Richardson. Meredith, Victoria.

# Appendices

## APPENDIX 1: NOXIOUS WEED CATEGORIES

Control class	Weed type	Example control requirements
Class 1	Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant.  The weeds are also "notifiable" and a range of restrictions on their sale and movement exist.
Class 2	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant.  The weeds are also "notifiable" and a range of restrictions on their sale and movement exist.
Class 3	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.*
Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.*
Class 5	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.	There are no requirements to control existing plants of Class 5 weeds.  However, the weeds are "notifiable" and a range of restrictions on their sale and movement exists.

## **APPENDIX 2: BUSH REGENERATION CONTRACTORS SPECIFICATIONS AND STANDARDS**

A suitably qualified and experienced bush regeneration contractor who is a member of the Australian Association of Bush Regenerators or fulfils the membership criteria will undertake the implementation of this VMP. All weed control techniques will utilise techniques recognised by the Australian Association of Bush Regenerators.

## **APPENDIX 3: WEED CONTROL TECHNIQUES**

### **Hand Pulling**

Hand pulling weed control practices include:

- Selecting the most appropriate tool for the weed being removed (if required);
- Minimise soil disturbance by controlling weeds when the soil is moist;
- Control plants before fruits or other propagules develop;
- Remove excess soil from the root system when there is no risk of spreading vegetative material;
- Cover disturbed soil or gaps with leaf litter and twigs;
- Prevent seed fall if plants contain semi-ripe or ripe seed;
- Ensure bulbs, corms, tubers, rhizomes or stolons are carefully dug out; and
- Bag all propagules before removing them off-site (Muyt 2001).

### **Grass Control**

Annual grasses will be slashed prior to seeding and monitored to see if secondary growth occurs. If secondary growth occurs, they will be slashed prior to seeding, until their annual life cycle is over.

Large perennial tussock grasses will be slashed prior to flower heads forming. Approximately two to three weeks later, the regrowth will be spot sprayed with a non-specific herbicide (i.e. glyphosate).

Attention to the active growing period of perennial grass species is required. For example, Kikuyu actively grows in August – December, while the active growing period for Rhodes Grass is December – February.

### **Climbing Weeds**

Climbing weeds have not been recorded on the site subject to the VMP, but if they are observed they will be controlled by the stem scrape method. This will involve using a knife to scrape the bark from the main vine and a non-specific herbicide (i.e. glyphosate) will be painted on immediately.

## Woody and Climbing Weeds

All woody weeds will be controlled by the cut and paste or stem scrape method. The target plant will be cut as close to the base of the plant as possible and a non-specific herbicide (i.e. glyphosate) will be applied to the cut stump immediately. All woody weed material will be disposed of offsite.

## Herbicide Use

Herbicides are required for use for the spraying of herbaceous and grassy weeds. All staff using herbicide will have appropriate training and appropriate records will be kept in accordance with the *Pesticide Regulation 1995*.

Only non-specific herbicide will be used for this work. Herbicide use near waterways including ephemeral areas will be minimised and only herbicides and other additives formulated for use near waterways (e.g. Round-Up<sup>®</sup> Biactive™) will be used.

## APPENDIX 4: VMP COSTINGS

**Table 7. Summary of estimated costs to implement the VMP.**

Management Action	Cost (\$)					
	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
<b>Management Zone 1 - 2.889 ha</b>						
Jute Matting and installation	192,000					192,000
Revegetation (128,193 plants)	230,747					230,747
Maintenance Work	57,782	28,891	28,891	14,446	14,446	144,455
<b>Management Zone 2 - 1.163 ha</b>						
Jute Matting and installation	78,000					78,000
Revegetation (46,648 plants)	83,966					83,966
Maintenance Work	23,266	11,633	11,633	5,817	5,817	58,165
<b>All zones – 4.05 ha</b>						
Monitoring and reporting	15,000	10,000	10,000	5,000	5,000	45,000
<b>TOTAL</b>	<b>680,761</b>	<b>50,524</b>	<b>50,524</b>	<b>25,262</b>	<b>25,262</b>	<b>832,333</b>

APPENDIX 5: PLANS AND CROSS SECTIONS

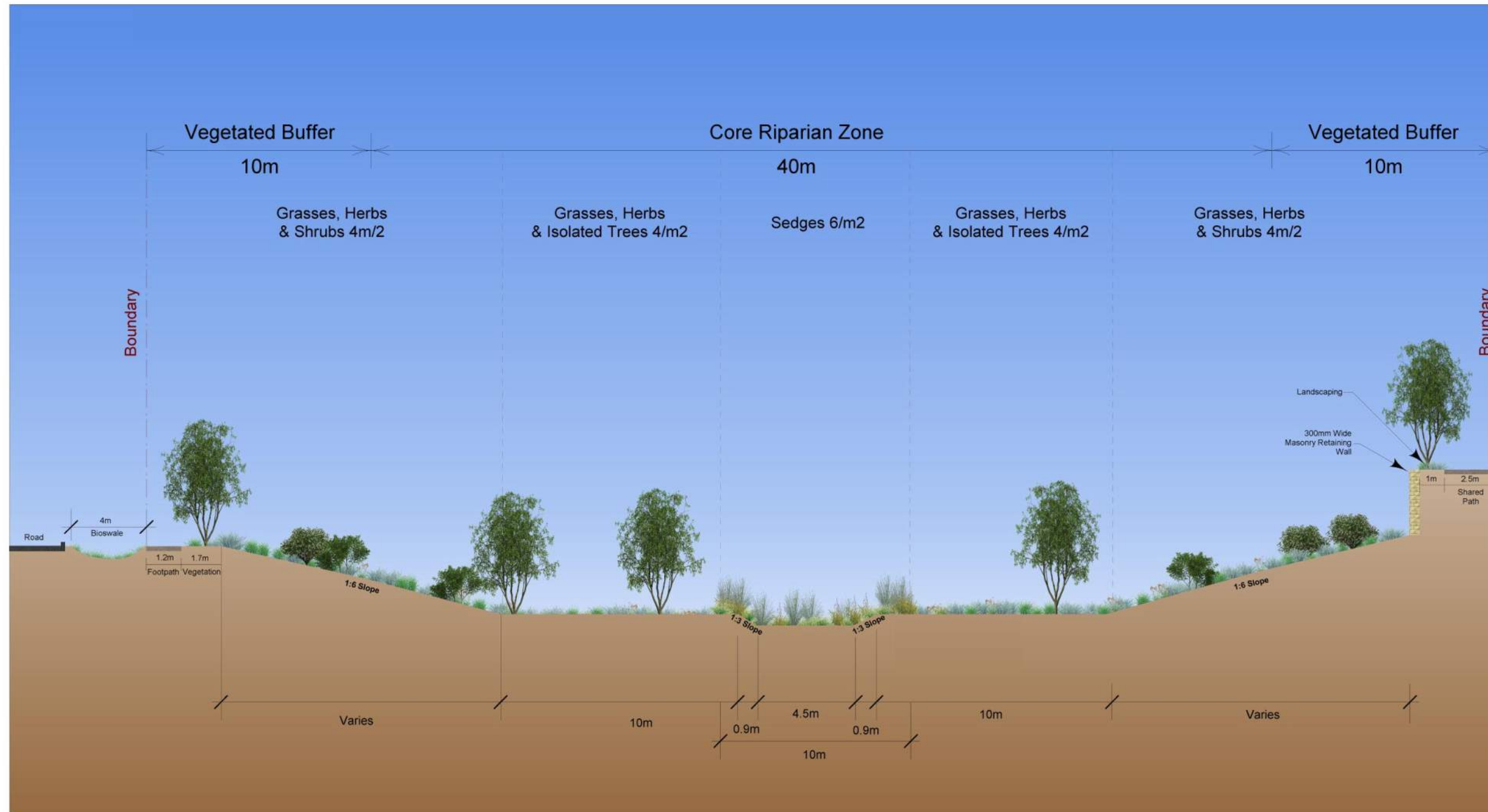
Indicative Plan View



PRELIMINARY - NOT FOR CONSTRUCTION

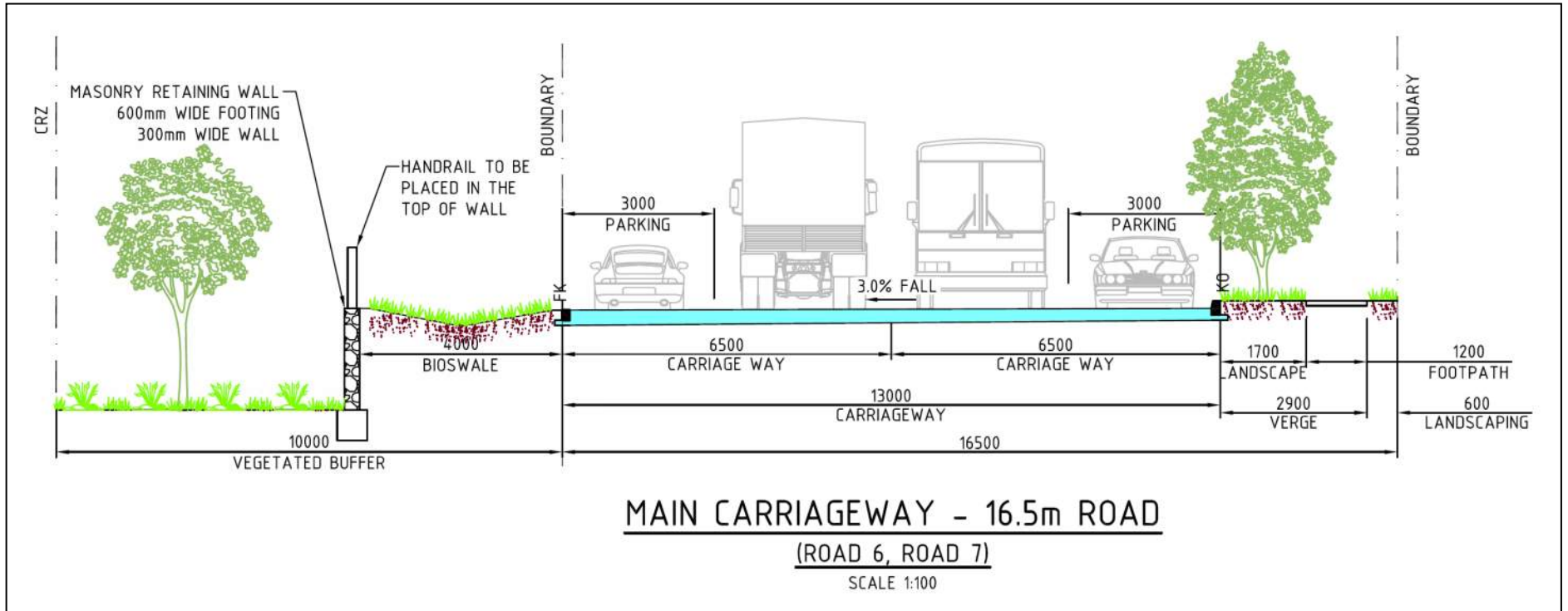
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<table border="1"> <thead> <tr> <th>Rev</th> <th>Amendment / Reason For Issue</th> <th>Date</th> <th>Drawn by</th> <th>Checked by</th> <th>Verified by</th> <th>Issue</th> </tr> </thead> <tbody> <tr> <td>E</td> <td>RE-ISSUED FOR D.A.</td> <td>07.06.12</td> <td>JD</td> <td>SR</td> <td>X</td> <td>PHCB</td> </tr> <tr> <td>D</td> <td>RE-ISSUED FOR D.A.</td> <td>06.06.12</td> <td>JD</td> <td>SR</td> <td>X</td> <td>PHCB</td> </tr> <tr> <td>C</td> <td>RE-ISSUED FOR D.A.</td> <td>12.04.12</td> <td>BY/JD</td> <td>SR</td> <td>X</td> <td>PHCB</td> </tr> <tr> <td>B</td> <td>ISSUED FOR D.A.</td> <td>14.02.12</td> <td>BY/JD</td> <td>SR</td> <td>X</td> <td>PHCB</td> </tr> <tr> <td>A</td> <td>ISSUED FOR CLIENT REVIEW</td> <td>30.02.12</td> <td>BY/JD</td> <td>SR</td> <td>X</td> <td>PHCB</td> </tr> </tbody> </table>					Rev	Amendment / Reason For Issue	Date	Drawn by	Checked by	Verified by	Issue	E	RE-ISSUED FOR D.A.	07.06.12	JD	SR	X	PHCB	D	RE-ISSUED FOR D.A.	06.06.12	JD	SR	X	PHCB	C	RE-ISSUED FOR D.A.	12.04.12	BY/JD	SR	X	PHCB	B	ISSUED FOR D.A.	14.02.12	BY/JD	SR	X	PHCB	A	ISSUED FOR CLIENT REVIEW	30.02.12	BY/JD	SR	X	PHCB	<p>Client GREGORY HILLS CORPORATE PARK Project Manager GREGORY HILLS CORPORATE PARK</p>		<p>Drawing No. 301222C-DA614</p>		<p>Sheet 58 of 72</p>		<p>Rev E</p>	
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Indicative Cross Section for MG1



Note: measurements are indicative only. Refer to final engineering drawings for specific design detail.

Indicative Cross Section for MGZ2



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