total earth care

Vegetation Management Plan

Warriewood Sector 3

Proposed Rezoning and Residential Land Release

Total Earth Care Pty Ltd

August 2005

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Vegetation Management Plan
Warriewood Sector 3
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Vegetation Management Plan
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1 INTRODUCTION

1.1 Background

1.1.1 Proposed Works

The Warriewood Valley Urban Release Area consists of a total of 13 sectors. Mirvac Homes (NSW) Pty Ltd (Mirvac) proposes to develop Sector 3 (the 'study area') within the Warriewood Valley Urban Release Area. The study area is approximately 6.1 hectares in area and covers three existing Lots (16, 18 and 20). This report has been prepared to accompany a Masterplan rezoning development application for Sector 3 (Scheme 10). The proposed Masterplan for Sector 3 (Scheme 10) will involve the construction of 130 new residential dwellings, access roads and landscaping. Additionally Pittwater Councils Development Control Plan 29 (Pittwater Council 2001), Warriewood Valley Land Release, states that Sector 3 is to be Medium Density Housing with a pedestrian pathway and creekline corridor planned along Narrabeen Creek. The creekline corridor will generally be 100m in width, comprising a 50m wide multiuse corridor (25m either side of the creek) with an additional 25m buffer strip on either side. Additional works along Narrabeen Creek will include rock armouring and regrading of the southern bank to improve stability and reduce the potential for scouring and erosion.

The site, Sector 3 Warriewood Valley Urban Release Area, is located near the junction of McPherson and Garden Streets Warriewood in the Pittwater Local Government Area (LGA). The site is bounded to the south by Macpherson Street and Brands Land to the east. Narrabeen Creek forms the northern boundary and Lot 20 ('Flower Power') the western. The current land uses across the site include plant nurseries and market gardening, including both wholesale and retail plant nurseries, several large glass houses and residential premises.

A *Terrestrial Flora and Fauna Assessment, Warriewood Sector 3,* describing the proposed works, the potential impacts of the development on the terrestrial environment and recommended mitigation measures, was prepared by Biosis (2004) for the proposal.

The *Vegetation Management Plan* (VMP) in accordance with 'Part 5 – Required Documentation', rezoning application requirements for the 'Natural Environment', of Pittwater Councils DCP 29 (2001)

2 Scope

The VMP applies to Sector 3, Warriewood Valley Urban Land Release, including the three existing Lots:

- Lot 16, DP 553816
- Lot 18, DP 604035
- Lot 20, DP 592091

The VMP has been prepared by qualified bushland and vegetation management consultants (TEC) and the VMP Management Actions are to be implemented by a qualified bushland regeneration contractor ('BR Contractor').

1.3 Aims & Objectives

The general aim of the VMP is to provide a working document for the protection and rehabilitation of the remaining native plant communities and associated habitat within the above mentioned study area. More specifically, the objectives of the VMP are to:

- assess the current and likely future threats to the viability of the vegetation within the study area;
- assess the current status of the vegetation to be retained within the study area, including weed levels, physical disturbance, native plant diversity;
- develop an appropriate management regime for the retained vegetation and habitats, based on their natural resilience;
- determine appropriate vegetation management measures to ensure the longevity and success of all rehabilitation works within the study area; and
- identify the appropriate timing of vegetation management measures, provide a schedule of works and assign responsibilities for work tasks.

2 METHODS

A field investigation and vegetation survey was carried out to assess the condition and resilience of vegetative cover within the study area. Visual and aural records were also taken of any fauna observed during the course of the flora survey. Reference was also made to a previous survey conducted within the study area by Biosis (2004).

The *Terrestrial Flora and Fauna Assessment* (Biosis 2004) was undertaken in August 2004, which identified plant species, plant communities, fauna species and habitats. The site assessment presented herein is based in part on the *Terrestrial Flora and Fauna Assessment* and on site inspections conducted as part of the VMP. In preparing the VMP the following documents, prepared for the current development application, were also reviewed:

- Development Control Plan No. 29, Warriewood Valley Urban Land Release (Pittwater Council 2001)
- Warriewood Valley Urban Release Area, Landscape Masterplan and Design Guidelines (Pittwater Council 2004)

A general diurnal (daytime) botanical survey was conducted over the study area on July 14, 2005, involving:

- the identification of plant species and the compilation of an inventory of native and exotic species;
- the identification and mapping of plant communities (where present) according to the structural definitions of Specht & Specht (1999);
- weed density mapping and bushland resilience assessment; and
- targeted searches for plant species of conservation significance using the “random meander” method of Cropper (1993).

Plants were identified in the field using Robinson (2003) and Auld and Medd (1992), and according to the latest published scientific names in Harden (1992, 1993, 2000 and 2002).

3 SITE DESCRIPTION

3.1 General

The site, Sector 3 Warriewood Valley Urban Release Area, is located near the junction of McPherson and Garden Streets Warriewood in the Pittwater LGA. The site is bounded to the south by

Macpherson Street and Brands Land to the east. Narrabeen Creek forms the northern boundary and Lot 20 ('Flower Power') the western (see Figure 1). The current land uses across the site include plant nurseries and market gardening, including both wholesale and retail plant nurseries, several large glass houses and residential premises.

The site is zoned the *1993* and 'Identified Urban Land Release' under *Pittwater 21*, the *Pittwater Local Environment Plan* (LEP – Pittwater Council, 2004)

3.2 Topography, Geology and Soils

The topography of the site is generally flat with little undulation, lying in the lower parts of Warriewood Valley. Local relief is 5m, with a gradual slope (< 3%) occurring from the south-west (10m ASL) to the east (5m ASL) side of the site. Surface drainage on the site would mostly flow directly into Narrabeen Creek, which in turn drains to the Warriewood Wetlands approximately 500m downstream.

The dominant geology of the region, as mapped on the Sydney 1:250,000 geological series (NSW Department of Mines 1965), consists of "alluvium, gravel, sand, silt and clay" and "sandstone, shale and tuff".

The site lies within land mapped on the Sydney 1:100,000 soil landscape sheet as "disturbed terrain" (Chapman and Murphy 1989), which is described as "level to plain hummocky terrain, extensively disturbed by human activity" (Chapman and Murphy 1989). The original soils are likely to have been subject to complete burial or removal. This description is consistent with the surface conditions observed during field surveys, which indicate that major levelling and filling has occurring over the majority of the site, with near complete removal of vegetation, and changes to surface and subsurface drainage.

The surrounding land throughout the Warriewood Valley is mapped as the Warriewood Soil Landscape Group (Chapman and Murphy 1989) which occurs on "level to gently undulating swales, depressions and infilled lagoons on Quaternary sands" and contain soils described as "deep, well sorted, sandy humus podzols and dark, mottled siliceous sands, overlying acid peats in depressions, and deep podzols and pale siliceous sands on sandy rises". Soils within the Warriewood landscape are highly permeable and subject to localised flooding, waterlogging, and high water tables. These soils are possibly still present at the surface on some parts of the site, and most likely occur at subsoil levels beneath fill and exotic vegetation.

3.2 Flora

3.2.1 Plant Species

A total of 84 plant species, including 23 native species and 61 introduced species, were recorded on the study area during the field survey (Appendix A). The introduced species are a combination of exotic species that are not indigenous to Australia, non-indigenous natives that do not occur naturally at this location, and noxious weeds (see Section 3.4.3). The diversity of introduced species is relatively high in comparison to the number of native species recorded.

Several mature Swamp Mahoganies *Eucalyptus robusta* occur on the site, including one along the north-eastern boundary adjacent to Narrabeen Creek and several others (8 in total) near the intersection of Brands Lane and Macpherson Street.

A more detailed assessment of the flora on the site can be found in the Flora and Fauna Assessment conducted by Biosis (2004).

3.2.2 Plant Communities

No native plant communities were identified on the site, with the vast majority of site being previously cleared and levelled to allow for development. The site is dominated by sporadic infestations of herbaceous groundcovers including Cobblers Peg *Bidens pilosa*, Crofton Weed *Ageratina*

adenophora, Flaxleaf Fleabane *Conyza bonariensis*, Wandering Jew *Tradescantia fluminensis*, Morning Glory *Ipomoea indica* and Common Couch *Cynodon dactylon*.

3.3 Fauna

3.3.1 General

The site is significantly altered from its original condition and represents a modified semi-rural/developing suburban landscape. The narrow riparian zone, with its semi-permanent water bodies and fragmented canopy, provides some habitat for native and introduced fauna.

The *Flora and Fauna Assessment* (Biosis 2004) recorded 14 animal species on the study site, and concluded that fauna habitats where very limited and in poor condition. The 14 species included 11 native birds, 2 mammals and one reptile. Additionally, the site provides few resources and opportunities for native fauna, particularly rare and threatened species. The study area is likely to be utilised intermittently by a range of bird, reptile and invertebrate species, both native and introduced. The available canopy provides limited foraging resources (eg nectar, blossom and seed) for birds such as Doves, Pigeons, Cockatoos and Rosellas.

Narrabeen Creek is generally highly degraded containing a considerable amount of silt with few pool and riffle sequences. The Creek bank at the rear of Lot 20 ('Flower Power') has been partially rehabilitated and regenerated, providing shelter and foraging for common animal species including birds reptiles and frogs (Biosis 2004).

A more detailed assessment of the fauna on the site can be found in the *Flora and Fauna Assessment* conducted by Biosis (2004).

3.3.2 Conservation Significance

The Pacific Black Duck *Anas superciliosa*, a "migratory" species listed on the Schedules of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was also observed on the site (Biosis 2004). Two Koala feed trees, as listed under Schedule 2 of SEPP 44 'Koala Habitat', were recorded on the site. The Flora and Fauna Assessment concluded that although the Swamp Mahogany and Forest Red Gum *Eucalyptus tereticornis* trees found on the site could be considered as 'Potential Koala Habitat', a SEPP 44 Assessment was not recommended as no 'Core Koala Habitat' exists on the site. No other animal species of conservation significance were recorded on the site.

3.4 Weeds and Resilience

3.4.1 General

Weed growth recorded within the study area generally comprises:

- opportunistic and annual and perennial species (eg Cobblers Peg and Crofton Weed) that have colonised disturbed ground;
- exotic grasses (eg Couch); and
- woody weeds (eg Lantana and Narrow-leaf Privet).

Resilience refers to the manifested recovery of a plant community, species or ecosystem following disturbance, as well as the potential of the plant community, species or ecosystem to recover after disturbance (DIPNR 2003).

There are a number of site features and variables that can assist in predicting the likely resilience of a site, and consequently in guiding the appropriate levels of bushland management (DIPNR 2003). Key ones include:

- The nature and quality of existing native vegetation (identifies ongoing sources of propagules);

- The extent, nature, condition and diversity of structural elements present (indicates whether representatives of all principal elements of structure are likely to regenerate);
- The individual native species present (indicates the minimum range of diversity to be expected). The presence of certain disturbance-sensitive ground cover species (eg *Aristida* spp. *Dianella* spp. and *Lomandra filiformis*) can be particularly good indicators of general resilience;
- The nature of reproductive habit and dispersal mechanisms of existing plant species (indicates the persistence and ease of spread);
- Observed recruitment and regeneration occurring;
- Remnant size and connectivity (proximity to other native vegetation);
- Land use and disturbance history, including fire history (may suggest the likely size and viability of the native propagule bank in the soil);
- The nature of current and ongoing level of disturbance (including adjacent land use) and whether this can be controlled or not (indicates the type and level of threat to regeneration); and
- Types of weed infestation and their extent and density (suggests the type and extent of weed management likely to be required).

3.4.2 Resilience Assessment

The resilience of the plant communities on the site was assessed according to the above principles. Weed diversity and densities vary across the site, however the resilience of the whole site is very low. The canopy, understorey and groundcover strata contain limited numbers of native species and are primarily dominated by a range of exotic horticultural species. High levels of disturbance, caused by construction of the existing infrastructure, have occurred across the site. The soil profile would have been altered through the levelling of the site and excavations for laying of foundations. Scattered weed species are present in moderate densities within the understorey and groundcover, such as Crofton Weed, Wandering Jew and Lantana.

3.4.3 Noxious Weeds

Ten noxious weed species listed under the *NSW Noxious Weeds Act 1993* (NW Act, Order No.18, 2003) were recorded within the study area (Table 1). These species must be removed from the site or controlled on-site (depending on the category of weed) by the landowner according to the provisions of the NW Act.

Table 1 Weed species recorded within the study area listed under the NW Act for Pittwater Council

Common Name	Scientific Name	Control Category[1]
Moth Vine	*Araujia sericifera*	W4c
Asparagus Fern	*Asparagus sp*	W4c
Fireweed	*Senecio madagascariensis*	W2
Morning Glory	*Ipomea indica*	W4c
Small-leaf Privet	*Ligustrum sinense*	W4b
Bamboo	*Phyllostachys sp*	W4a
Turkey Rhubarb	*Acetosa sagittata*	W4b
Willow	*Salix sp*	W4g
Green Cestrum	*Cestrum parqui*	W2
Pellitory	*Parietaria judaica*	W3
Lantana	*Lantana camara*	W2

4 VEGETATION MANAGEMENT MEASURES

The general approach within the study site will be to protect the existing Swamp Mahogany trees, and revegetate and restore the proposed landscaping areas with plant species typical of the Warriewood Valley and those listed in the Final Determination for the Endangered Ecological Community Sydney Coastal Estuary Swamp Forest (SCESF, NPWS 2004) (sourced from local provenance). Vegetation management measures will also aim to enhance the variety, quality and extent of fauna habitats on the site. Management measures will require:

- weed removal and control;
- tree protection
- stormwater and erosion control; and
- revegetation.

The proposed management strategy for this VMP has been divided into four phases, with Phase 1 incorporating the initial site preparation works and weeding activities, Phase 2 the creek stabilisation and regrading, Phase 3 being the main revegetation works, and Phase 4 comprising the maintenance period.

[1] Noxious weed control categories (pursuant to the *NSW Noxious Weeds Act 1993*):
W1 The presence of the weed on the land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
W2 The weed must be fully and continuously suppressed or destroyed.
W3 The weed must be prevented from spreading and its number and distribution reduced.
W4b The weed must not be sold, propagated or knowingly distributed and any part of the weed must be prevented from growing within 3 metres of the boundary of a property.
W4c The weed must not be sold, propagated or knowingly distributed and the weed must be prevented from spreading to an adjoining property.
W4g The weed must not be sold, propagated or knowingly distributed.

For the purposes of vegetation management and weed control the study area has been divided into three management zones. The zones, shown in Figure 2, and are as follows:

- Zone 1 is the Multiuse Corridor (25m width) and associated Buffer (25m width) running parallel to Narrabeen Creek;
- Zone 2 is the area of trees to be protected in the south-east corner of the site, near the junction of Brands Lane and Macpherson Street.
- Zone 3 is the remainder of the site.

4.1 Phase 1 - Site Establishment and Preparation

4.1.1 Overview

Site establishment and preparation works will form Phase 1 of the management strategy and will involve:

- project initiation meeting between the BR Contractor, Construction Contractor and Mirvac to ensure coordination of site activities;
- preparation of a time line showing the order of the main vegetation management works with start and finish times and milestones;
- site inductions for bush regeneration staff;
- addressing occupational health and safety (OH&S) issues, including preparation of a site hazard assessment and safe work method statement;
- stormwater and erosion control; and
- Weed removal and control

Site preparation works, including any earthworks or construction of temporary or permanent stormwater control devices, should occur prior to the commencement of the vegetation management works.

4.1.2 Occupational Health and Safety

The appointed BR Contractor will have a formal Occupational Health and Safety Program (OH&S Program), set up in accordance with the *NSW Occupational Health & Safety Act 2000* (OH&S Act) and the *NSW Occupational Health & Safety Regulation 2001* (OH&S Act), incorporating:

- workplace principles and policies relating to Quality Assurance;
- reporting systems;
- project management system;
- training and education;
- workplace inspections, evaluations and audits; and
- staff manuals.

The appointed BR Contractor will ensure that the following OH&S issues are addressed:

- a hazard assessment is conducted for the site prior to commencement of works;
- preparation of a safe work method statement covering all vegetation management actions for the contract and all areas of the site;
- site induction for bush regeneration crews, identifying all relevant safety issues and environmental risks;
- ongoing reviews of safe work methods and hazards; and
- self-auditing of OH&S procedures.

4.1.3 Erosion Control

All erosion and sedimentation controls will be installed by the construction contractor incorporating:

- installation and maintenance of silt fences where appropriate, as indicated in the Soil and Water Management Plan or as required by Pittwater Council, to prevent the dispersal of sediment into Narrabeen Creek during construction;
- construction of a stabilised site access;
- application of mulch or jute mesh/matt to exposed soil and disturbed ground immediately after disturbance; and
- planting of local native tubestock, as outlined below (see Section 4.2).

4.1.4 Weed Control

Weeding activities within the site occur in three stages: primary, secondary and maintenance. Weed control works will aim to treat noxious weeds over the site as a priority and maintain or enhance the resilience of the retained stands of native vegetation by focusing weed removal activities on those areas.

Weeds that are listed as 'noxious' for Pittwater LGA must be removed from the sites or controlled, depending on the category of weed, according to the provisions of the NW Act.

Primary weeding

Primary weeding is the first round of weeding activity and involves the removal of most of the weed biomass present. The vast majority of weeds are likely to be removed during the demolition of the existing buildings on the site. Any weeds that are not removed during this stage, including those adjacent to the trees to be retained, should be controlled using the following methods:

- 'cut-and-paint' or target spraying of woody weeds (eg Lantana, Blackberry and Narrow-leaf Privet);
- hand-removal of smaller woody weeds and herbaceous weeds (eg. Paddys Lucerne, Cobblers Pegs and Flaxleaf Fleabane) within and around the edges of the trees to be retained; and
- spot-spraying and hand-weeding of exotic grasses (eg. Common Couch, Whiskey Grass and Paspalum).

Primary weeding will occur immediately after site preparation and will take less than one week to complete. Weed biomass can either be transported off site or retained on-site in compost piles. Noxious weeds that have potential for vegetative reproduction that are not target sprayed must be removed from site and disposed of appropriately. Wood debris from noxious weeds that have little potential for vegetative reproduction (eg Narrow-leaf Privet) can remain on site for composting.

Secondary weeding

Secondary weeding works will most likely be confined to the for the Multiuse Corridor and Buffer (Zone 1) and around the protected trees in Zone 2. Secondary weeding will occur three to six months after the completion of primary weeding, depending on the amount of regrowth of herbaceous annuals (and other weeds that have an abundant seed source present in the soil) that typically occurs after primary weeding. The site will be inspected at regular monthly intervals by the BR Contractor to determine the need and appropriate timing of secondary weeding. This will vary according to the timing of the primary weeding, insofar as regrowth will be stronger if primary weeding occurs during spring and summer, and slower during autumn and winter. The need for secondary weeding will also depend on climatic conditions in the intervening period (eg periods of sustained rainfall will promote germination of weed seeds and require secondary weeding to occur sooner than it would under dry conditions).

Secondary weeding will require targeted removal of noxious weed regrowth using selective herbicide spraying and hand removal of exotic grasses, herbaceous weeds and seedlings of woody weeds.

Maintenance weeding

Maintenance weeding will be required to ensure that weed growth following secondary weeding is controlled in the long-term. Maintenance weeding is required for two years from the completion of planting. This will involve a minimum of four visits to the site per year by a qualified BR Contractor. Activities will include follow-up application of herbicide (by the 'cut-and-paint' and 'spraying' method) and hand-weeding wherever necessary.

4.1.5 Vegetation Management Measures

The trees to be retained on the site are to be protected using temporary exclusion fencing (as shown in Figure 2). Exclusion fencing is to extend to the 'drip line' or to the Primary Root Zone (whichever is the largest) of trees to be protected. PRZ is calculated at radius = 10 x dbh.

4.2 Phase 2 – Creek Bank Stabilisation and Regrading

4.2.1 Overview

The southern bank of Narrabeen Creek will be regraded to a maximum slope of 1:3 and stabilised using sandstone rock armouring. All works in this area should be done in conjunction with the 'Landscape Plan for the Creekline Corridor' (currently being prepared by Oculus).

4.2.2 Tree Removal

All exotic plants (including noxious weeds) in this area should managed as per Section 4.1.4. Native trees (excluding Swamp Mahoganies) should be felled by a qualified contractor and chipped and retained on site. The chipped material is to be stockpiled on geotextile fabric away from the flood zone. Alternatively, any trunks and hollow section of native trees are to be cut into manageable lengths and stockpiled on flat ground outside flood zone on geotextile fabric, for later use in revegetation works.

4.2.3 Bank Stabilisation and Regrading

The southern bank of Narrabeen Creek is to be regraded to a maximum grade of 1:3 as specified in Section C-1 of the Landscape Masterplan and Design Guidelines (Pittwater Council 2004). Additional bank stabilisation works including sandstone rock armouring as shown in Section C-4 of the Landscape Masterplan and Design Guidelines (Pittwater Council 2004). The works are to be undertaken by a qualified BR or Civil Contractor. The sandstone boulders should be laid on a geotextile fabric to reduce scouring and erosion.

4.2.4 Soils

Where possible original site soils should be retained for use as a planting medium. It is possible there will be fill material present, or at least heavily degraded soil. In this situation, the introduction of Virgin Excavated Natural Material (VENM, ie crushed sandstone) as a planting medium may be considered. The VENM shall be spread within the riparian zone to achieve design levels.

4.2.5 Erosion Control

Mulching of the exposed soil (depth of approximately 25mm) should occur progressively as earthmoving and stabilisation works are completed. A single strip of jute matt (1.8m width, 850 gsm)

should be installed immediately above (up the bank) the sandstone boulders to provide additional protection from stream erosion. Jute mesh should then be used on a as needs basis above this to provide additional erosion protection. The revegetation works should commence immediately after completion of these works.

4.3 Phase 3 - Revegetation

4.3.1 Planting Area

Revegetation works will be required at various stages throughout the construction period. Revegetation of the Narrabeen Creek riparian zone will occur following completion of earthworks associated with the realignment of the Creek and construction of the pedestrian/bicycle footbridges. Other revegetation works across the site will be dependent on the timing of construction.

The Landscape Plan (currently being prepared Oculus) as shown in Figure 4 illustrates the areas to be revegetated.

4.3.2 Suitable Species for Planting

Revegetation works will aim to create a community of canopy, understorey and groundcover species similar to that which occurs within the vicinity of the site. A list of plant species has been provided in Appendix B. A proposed planting list for the Multiuse Corridor and Buffer (Zone 1) and more broadly across the site is provided in Appendix B. It has been compiled giving consideration to the following factors:

- DCP 29 (Pittwater Council 2001) and the Warriewood Valley Urban Release Area, Landscape Masterplan and Design Guidelines (Pittwater Council 2004);
- the list of characteristic species for the Endangered Ecological Community Sydney Coastal Estuary Swamp Forest (SCESF, NPWS 2004);
- existing soil conditions, including soil type (refer Section 3.1), disturbance levels and soil moisture;
- the need to minimise disturbance and maintenance requirements; and
- the commercial availability of local species, and their growth rates.

The appointed BR Contractor shall order plant stock using only those species listed in Appendix B. Evidence of the plant source should also be provided to Mirvac.

4.3.3 General Planting Requirements

Following is a list of general planting requirements for the site:

- Planting will take place once the development works on the site are complete, or following stabilisation/earthworks along creekline corridor. Planting prior to completion of development may compromise the reinstatement objective for native species even if plant protection measures are in place.
- Replanting of existing tree species is to occur in areas as per the Landscape Plan (currently being prepared Oculus).
- All planting should be from native species propagated from local stock.
- Planting should occur within weed-free lightly mulched soil. Mulch should be to a depth of approximately 25mm.
- Where native vegetation is to be removed for construction, the removed vegetation should be chipped and used within the site. The natural mulch of the site (ie existing leaf litter and organic layer) is to be retained to prevent weed growth and retain habitat.
- The plantings must be pre-watered, watered immediately after planting and then watered weekly for the first month or as weather conditions dictate.

- The planting holes must be twice the diameter and depth of the pot size.
- The planting hole must be pre-watered.
- The soil use for planting must be free of clods.
- The soil must be lightly compacted around the plant roots to ensure that no voids or air pockets are present around the roots.
- A dish-shaped ring of soil should be formed around each plant to assist in harvesting rainwater. The plants must be well watered in and then lightly mulched.

Recommended species for planting on the site for revegetation and weed suppression have been outlined in Appendix B.

4.3.4 Seed Collection

It is recognised that there is very limited opportunity for seed collection on the study site, however, it is recommended that the BR Contractor collect seed from native plants (as listed in Appendix B) on nearby properties (with permission) and reserves on an opportunistic basis both before and during the revegetation program. The BR Contractor (or its appointed sub-contractor) will possess the necessary licence for seed collection issued by DEC under the *National Parks & Wildlife Act 1974* and will obtain permission from Pittwater Council for collection activities within any Council reserves (if necessary).

Any seed collected from the Swamp Mahoganies should be retained for plant propagation, as it is not envisaged that any broadcasting of seed will be undertaken. The time required for propagation will vary according to the availability of seed and the germination and growth rates of different plant species (Ralph 1999; Langkamp 1987). The time frame for seed collection to planting of tubestock, therefore, may extend over several months. Hence, the revegetation program cannot rely solely upon seed collected at the commencement of the bush regeneration contract. Accordingly, it is probable that supplementary plant stock will need to be obtained from local nurseries or suppliers to allow planting to commence early in the program.

4.3.5 Planting Density

Planting densities have been based on standard Department of Infrastructure Planning and Natural Resources (DIPNR) requirements, and in consideration of the requirements of the sites:

- one stem per square metre for canopy trees, small trees and understorey shrubs; and
- four stems per metre for groundcovers (ie grasses, vines, herbs, ferns).

Planting densities for each plant species are listed in Appendix B.

4.4 Phase 4 - Maintenance

4.4.1 General

Maintenance of the plantings and landscaped areas in the Multiuse Corridor and Buffer (Zone 1) and more broadly across the site is will be required for two years from the date of final plantings and primary weeding. Maintenance activities will include:

- maintenance weeding, as described above (Section 4.1.4);
- replacement of plant stock. The vegetation management consultant will ensure that a minimum of 80% of the original plant stock is maintained for the contract period;
- monitoring the implementation of measures outlined in the VMP

4.4.2 Monitoring

A program of regular monitoring and inspection will be carried out by a qualified vegetation management consultant (or qualified botanist) during the entire contract period. The consultant will be responsible for ensuring the measures outlined in this VMP are implemented and that performance criteria are satisfied. The monitoring program will commence prior to the commencement of site preparation works and will continue until completion of the maintenance period. The program will include:

- general observations will be made of the nature and condition of the trees to be retained on site:
- estimates of the success rate of plantings and assessment of plant replacement requirements;
- evidence of erosion and sedimentation and the correct function of erosion control devices; and
- recommendations for corrective measures and/or vegetation management.

An example of a monitoring sheet is attached in Appendix C, which provides an indication of the parameters to be assessed during monitoring surveys.

A weed density map will also be prepared at commencement of the monitoring program and will be updated on a biannual basis. The vegetation management consultant will ensure that the map is prepared on a suitable base plan, which will remain as the base plan for the duration of the monitoring period.

4.4.3 Disease and Feral Animal Control

Specific measures for disease and feral animal are not recommended for this VMP, as they are not likely to be effective on a site of such small area. However, rabbit control will be considered as a vegetation management measure, if through the monitoring program it becomes apparent that rabbit herbivory is reducing the success of plantings within revegetation areas.

4.4.4 Fire

The use of controlled burning as a regeneration tool is not appropriate for the vegetation to be retained on the site.

5 VEGETATION MANAGEMENT ACTION PLAN

5.1 Roles and Responsibilities

The roles and responsibilities of all project staff of relevance to the VMP are listed in Table 3. The vegetation management consultant will be primarily responsible for the implementation of this VMP, and will have appropriate qualifications in botany, biology and/or bushland management. The consultant will monitor the vegetation management works and ensure that the BR Contractor has complied with the requirements of this VMP. The consultant will act as a communication link between the BR Contractor and Mirvac.

Table 3 Project Staff Roles and Responsibilities

Role	Responsibilities
Construction Project Manager	▪ Project management of site, including all road works, landscaping, etc
Construction Contractor	▪ Implementation road works ▪ Tree exclusion fencing ▪ Stormwater infrastructure

Role	Responsibilities
	▪ Erosion and sedimentation controls
BR Contractor	▪ Vegetation management within areas designated for bush regeneration, revegetation or management ▪ Implementation of VMP actions ▪ Weed control, seed collection, planting, erosion control (in bush regeneration areas only), and mulching and watering of planted stock.
Vegetation Management Consultant (or qualified botanist)	▪ Supervision and monitoring of bush regeneration works ▪ Ensuring compliance with VMP ▪ Certification

5.2 Schedule of Activities

The vegetation management contract will extend for approximately 27 months, allowing three to six months for site preparation, primary and secondary weeding and planting, and a further two years for maintenance. Table 4 details the vegetation management actions to be carried out for the site and identifies responsibilities, performance criteria and timing for each recommended action.

Table 4 Proposed Vegetation Management Actions for Sector 3 Warriewood Valley, Warriewood.

Action	Responsibility	Performance Criteria	Timing
Phase 1 Site Establishment and Preparation			
Project and contract establishment meeting. Preparation of a proposed timeline for the tree protection and revegetation works showing the order of start and completion, dependencies and milestones.	BR Contractor/Mirvac/Civil Contractor Timeline/Gantt chart to be prepared by BR Contractor in consultation with Mirvac and the Construction Contractor	Representatives of all the listed organisations attend meeting and discuss contract details and nominate staff that will be a main point of contact Timeline/Gantt chart submitted to Mirvac showing start and finish times of major tasks and milestones	Prior to commencement of tree protection and revegetation works.
OH&S. Hazard & risk assessment for BR Contractor. Prepare Safe Work Method Statement. Conduct construction contractor induction. Conduct internal safety and environmental induction.	BR Contractor/Construction Contractor.	Safe Work Method Statement completed.	Prior to commencement.
Verify and update (if required) weed density map of the site.	BR Contractor/Vegetation Management Consultant.	Weed map prepared.	Prior to any weeding activity.
Install silt fences where appropriate.	Civil Contactor (for development area).	Controls must conform to Landcom (2004) guidelines and are installed as per an approved Soil & Water Management Plan.	During site preparation.
Fence off protected trees as shown in Figure 2.	Construction Contractor.	Access restricted around trees.	During site preparation.
Topsoil for restoration/landscaping works to be weed-free imported soil. Imported fill (if required) shall not contain weeds or other organic material. Dispose of any topsoil contaminated by construction wastes (eg cement, oil, and phytotoxic material) to an approved facility and replace with clean imported topsoil.	BR Contractor.	Topsoil to be used for revegetation is certified to be free of weed propagules and contaminants.	Throughout site preparation.

Table 4 Cont'd Proposed Vegetation Management Actions for Sector 3 Warriewood Valley, Warriewood.

Action	Responsibility	Performance Criteria	Timing
Fell and chip or relocate trunks of trees identified for removal. Chips/mulch to be stockpiled on flat ground outside flood zone on geotextile fabric, for later use in revegetation works. Trunks and any hollow section of native trees are to be cut into manageable lengths and stockpiled on flat ground outside flood zone on geotextile fabric, for later use in revegetation works. Prune broken branches off trees and place on the ground (as habitat micro-sites). Collect any seed present on felled tress or pruned branches of protected trees.	Civil Construction Contractor (under supervision of BR Contactor). Tree Felling Contractor. BR Contractor.	Woodchips stockpiled as stated. . Whole tree trunks placed and hollow branches to be stockpiled for use in revegetation works. Any seed collected during tree removal or pruning is to be used for revegetation works or direct broadcast.	Following tree felling.
Carry out primary weeding (refer Sections 4.1.4 and 4.1.5).	BR Contractor.	Main weed infestations and targeted or noxious weeds removed	Following site preparation, preferably in winter.
Ensure compliance with *Noxious Weeds Act 1993*; ie organise on-site destruction or removal from site of noxious weed propagules and biomass, as per specific action control categories for each species.	BR Contractor.	Noxious weeds controlled as per *Noxious Weeds Act 1993* provisions.	Duration of bush regeneration program.
Carry out secondary weeding (refer Section 4.1.4).	BR Contractor	Weed regrowth following primary weeding removed.	3 to 6 months following primary weeding, depending on observed levels of weed regrowth.
Weed biomass to be either composted on-site or disposed of at an approved waste management centre, as appropriate for each weed species.	BR Contractor.	Evidence of receipts for disposal fees.	Duration of maintenance period.

Table 4 Cont'd Proposed Vegetation Management Actions for Sector 3 Warriewood Valley, Warriewood.

Action	Responsibility	Performance Criteria	Timing
Phase 2 – Creek Bank Regrading and Stabilisation			
The southern bank of Narrabeen Creek to be regraded to a maximum slope of 1:3 or as per the approved Landscape Plan. Earthworks and final levels for the Multiuse Corridor and Buffer are completed as per approved Landscape Plan. Southern bank of Creek to be armoured with sandstone boulders (refer Section 4.2)	Either Civil Construction Contractor or Creek Rehabilitation Contractor or BR Contractor	Multiuse Corridor and Buffer are implemented as per approved Landscape Plan	Following Phase 1 - Site Establishment and Preparation.
Jute mesh/matt and mulch to be installed. Bank to be capped with crushed sandstone (refer Section 4.2).	Either Civil Construction Contractor or Creek Rehabilitation Contractor or BR Contractor	Works as per approved Landscape Plan. Works must conform to Landcom (2004) guidelines and are installed as per an approved Soil & Water Management Plan.	Following completion of earthworks.
Phase 3 - Revegetation			
Apply mulch at minimum depth 100mm to bare or disturbed ground. Use chipped trees or branches felled within the site as a priority; supplement with purchased mulch.	BR Contactor.	Mulch applied where required to minimum 100mm depth.	Prior to planting.
Plant areas identified for revegetation. Plant tubestock of shrub species at mean density of 1 stem per m^2, and groundcovers at 4 stems per m^2, as per Appendix B.	BR Contractor.	Plantings are at required mean densities in locations shown in Landscape Plan. Minimum 80% of the original plant stock should be maintained.	Following mulching.
Only locally indigenous plant stock to be planted.	BR Contactor.	Tubestock and cellstock comprise locally indigenous species, as listed in Appendix B.	Following mulching.

Table 4 Cont'd Proposed Vegetation Management Actions for Sector 3 Warriewood Valley, Warriewood.

Action	Responsibility	Performance Criteria	Timing
Phase 3 - Maintenance			
Carry out maintenance weeding throughout the study area.	BR Contractor.	Existing weed growth minimised or controlled. Regrowth following secondary weeding controlled. No new weed species or infestations.	Four times per year, for two (2) years from date of final planting. Three maintenance visits to occur between September and March.
Carry out replacement of plant stock. Maintain mulch layer, as required.	BR Contractor.	Minimum 80% original quantity of plant stock maintained one year from the date of final planting. No dead plant stock left in ground. Mulch layer intact and minimum depth of 100mm.	Four times per year, for two (2) years from date of final planting. Three maintenance visits to occur between September and March.
Phase 4 - Monitoring and Auditing			
Update project timelines.	BR Contractor in consultation with the Mirvac and Construction Contractor	Updated Gantt charts submitted to the Mirvac.	As required
Regular inspections of bushland to check levels of weed regrowth following primary weeding.	BR Contractor.	Levels of weed regrowth reported to Vegetation Management Consultant.	Monthly following completion of primary weeding.
Certify plant stock is locally indigenous. Certify required planting densities have been achieved.	Vegetation Management Consultant.	Certification forwarded to Mirvac.	Date of final planting.

Table 4 Cont'd Proposed Vegetation Management Actions for Sector 3 Warriewood Valley, Warriewood.

Action	Responsibility	Performance Criteria	Timing
Certify plant stock has been maintained at a minimum of 80% of original quantity of plantings.	Vegetation Management Consultant.	80% success rate for tubestock plantings one year from date of final plantings. Certification forwarded to Mirvac.	One year from date of final planting.
Inspect erosion and sediment controls (eg. sediment fences).	Construction Contractor/Vegetation Management Consultant.	Any erosion control devices are regularly cleaned and fully functional.	Weekly during construction, and following rainfall events.
Site inspections.	Vegetation Management Consultant.	Inspection checklist completed.	At Site Establishment, then quarterly for duration of contract.
Final Inspection of Works.	Vegetation Management Consultant.	Final Inspection carried out at completion of contract.	Completion of contract.

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