Oakdale Central

Riparian Vegetation Management Plan

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Riparian Vegetation Management Plan

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Prepared for

Goodman International Pty Ltd

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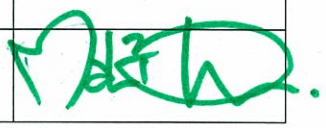
3	14-Jun-2011	Final Report	Mark Blanche Director - Environmental Design	

Table of Contents

Table of Figures

Overview

This Vegetation Management Plan (VMP) applies to two riparian corridors located along the eastern bank of Ropes Creek and both banks of a tributary to Ropes Creek (the tributary) located within the boundaries of the Oakdale Central development site at Horsley Park.

The Oakdale Central site is the first precinct of the larger proposed Oakdale Estate which is a 421 hectare development site within the NSW Department of Planning's Site 8 "Lands South of Sydney Water Pipeline" identified in the Metropolitan Strategy, and is located in Horsley Park and Kemps Creek.

In accordance with the NSW Department of Planning (DoP) Director General's requirements, for the development of Oakdale Central, Goodman International Ltd (Goodman) *as the proponent* is required to establish, conserve and maintain approximately 4.27 hectares of native vegetation on the site. Prior to the commencement of the operation, the proponent is to prepare and implement a Vegetation Management Plan (VMP) for the project to the satisfaction of the Director-General.

AECOM Australia Ltd (AECOM) commissioned Ecohort Pty Ltd (Ecohort) to conduct field investigations and develop the restoration framework, including methods, actions and cost estimates, for the preparation of this VMP.

Site inspections were conducted by AECOM and Ecohort during March 2011 and background information and mapping provided by Goodman for use in the VMP. The scope of on-site investigations conducted by Ecohort comprised:

- Identification of the main target weeds and any threatening processes/constraints affecting the subject site and potentially affecting the success of the proposed riparian restoration works.
- Provision of general resilience assessments of the study area. This includes ranking the study area into high, moderate and low levels of natural resilience.
- Determination of bushland regeneration work and other recommended bushland restoration approaches to be taken and appropriate techniques to be used given the identified constraints/resilience levels.
- Development of measurable targets that the bushland riparian restoration works should achieve.
- Undertaking of soil investigations to determine the suitability of site soils to support the proposed restoration activities and determine amelioration or other remediation works.

Recommendations outlined in the VMP aim to reconstruct riparian corridors that emulate the ecotones of remnant vegetation of the subject site in accordance with the NSW Office of Water's *Guidelines for controlled activities – Vegetation Management Plans* (DWE 2008).

Project Team

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1.0 Introduction

1.1 Background

Goodman International Limited (Goodman) is undertaking the development of a substantial portion of the Western Sydney Employment Hub, identified in the NSW Government's Metropolitan Strategy as a key centre of employment growth over the next 25 years. The 421 hectare development site, described as Oakdale Estate, is within the NSW Department of Planning's Site 8 "Lands South of Sydney Water Pipeline" identified in the Metropolitan Strategy, and is located in Horsley Park and Kemps Creek.

Oakdale Central is the first precinct to be developed within the larger Oakdale Estate (Figure 1-1). Approval for the Concept Plan (08-0065) for Oakdale Central and the Project Application (08-0066) was granted under Part 3a of the *Environmental Planning and Assessment Act 1979*, on the 2 January 2009.

Figure 1-1. Location of Oakdale Central precinct in the context of the larger Oakdale Estate development site (*modified from Oakdale Central: Volume 1 – EA Goodman International May 2008*)

1.1.1 Director General's Requirements

In accordance with NSW Department of Planning (DoP) Director General's requirements (DGRs), Goodman, *as the proponent*, is required to establish, conserve and maintain approximately 4.27 hectares of native vegetation on the site. Prior to the commencement of the operation, the proponent is to prepare and implement a Vegetation Management Plan (VMP) for the project to the satisfaction of the Director-General. The VMP (*this document*) shall:

a) Be prepared by a suitably qualified expert in consultation with the NSW Office of Water (refer **Page 1: Project Team**);

b) Be prepared in accordance with NSW Office of Water's *Guidelines for controlled activities – Vegetation Management Plans* (DWE 2008) (refer **Section 1.1.2**);

c) Describe the detailed measures that will be implemented to enhance and protect the site's designated Environmental Conservation Area (refer **Section 2.0)**, including the timing of these works (refer **Section 3.0**);

d) Detail measures that would be implemented to:

- Minimise impacts on riparian vegetation from the construction of the creek crossing over the Ropes Creek tributary (refer **Section 1.3**), and
- Manage any potential conflicts between riparian zones, bush fire asset protection zones and stormwater infrastructure (refer **Section 2.1**),

e) Assign responsibility for ongoing management of the Environmental Conservation Area (Refer **Section 2.11**); and

f) Detail a program to monitor the effectiveness of those works and measures (Refer **Section 2.8**).

1.1.2 Guidelines for Controlled Activities

The referenced *Guidelines for controlled activities – Vegetation Management Plans* (DWE 2008) requires that the following criteria be considered:

- An appropriate width for the riparian corridor be identified in accordance with the Department's *Guidelines for controlled activities: Riparian corridors*. Refer **Section 2.1.1**
- The full width of the riparian corridor and its functions including accommodating fully structured native vegetation. Refer **Sections 2.1, 2.2** and **2.3**
- Clear identification of the location of the bed and banks of waterfront land and the footprint of the riparian corridor. Refer **Figure 1-2** and **Figure 2-3**
- Identification of measures for controlling access and encroachments (bollards, fences, etc.) into the riparian corridor. Refer **Section 2.4.6**
- Vegetation species composition, planting layout and densities with plantings that emulate the ecotone of vegetation naturally or previously occurring along the waterfront land. Mature vegetation communities should be generally well structured, comprising trees, shrubs and groundcover species. The required mix of these species should relate to the actual community to be emulated and the size of the area/s to be rehabilitated. Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse(s). Refer **Sections 4.1.4** and **4.2.4**
- Identification of seed/plant sources and where possible the utilisation of native plants and seed sources of local provenance. Refer **Section 2.3**
- Avoidance of exotic vegetation with the use of exotic species for the purposes of temporary soil stabilisation permitted provided they are sterile, non-invasive and easily eradicated when permanent vegetation is established. Refer **Section 2.3**
- Provision of a detailed planting program, rehabilitation methods and staging. Other revegetation techniques such as hydro-seeding, direct seeding, brush matting or assisted natural regeneration may be considered. Refer **Section 2.0** and **Appendix A** and **Appendix B**

- Maintenance requirements should extend for a minimum of two years after the completion of works or until such time as a minimum 80% survival rate for all plantings and a maximum five percent (5%) weed cover for the treated riparian corridor (controlled activity) is achieved. Refer **Section 2.7**
- Project tasks should be defined and described, including a schedule detailing the sequence and duration of works necessary for the implementation of the VMP. Refer **Section 3.0**
- Maps or diagrams which identify the proposed riparian area, existing vegetation, vegetation to be retained, vegetation to be cleared, footprint of construction activities, areas of proposed revegetation etc should be prepared (**Figures 1.2, 2.2** and **2.3**)
- Photographs of the site should be supplied and photo points should be identified for future monitoring and reporting purposes. The photo points should be identified by GPS coordinates or by survey particularly for large scale earthworks or extractive industries. Photographs are provided in **Appendix B**
- Cost estimates for the implementation of all components and stages of the work including materials, labour, watering, maintenance, monitoring and reporting, etc should be prepared. **Refer Section 4.0**
- Processes for monitoring and review, including a method of performance evaluation, should be identified. This should include assessing the need for replacing plant losses, addressing deficiencies, problems, climatic conditions, successful completion of works, etc. **Refer Section 2.8**

1.2 Site Description

Oakdale Central is identified as Lot 2 DP 120673, Old Wallgrove Road, Horsley Park in the Fairfield local government area. The site is located south of and adjoining the Sydney Water Main Water Supply Pipeline between Old Wallgrove Road and Mamre Road at Horsley Park (**Figure 1-1**) and is herein referred to as the subject site.

The site is predominantly cleared with pockets of treed vegetation occurring along Ropes Creek and an unnamed tributary to the east. The site has been used for grazing, with a portion of the site used as a clay quarry. Quarrying operations have now ceased, however grazing still occurs on parts of the site. The surrounding areas are primarily rural however the area to the north is becoming more industrial.

The proposed development 'Oakdale Central' will involve the subdivision of Lot 2 DP 120673 to create developable area for industrial and employment purposes, service areas, recreation and open space, road corridors and environmental conservation areas (also known as biodiversity lots).

The proposal will require the removal of approximately 1.35ha of native vegetation including Swamp Oak Floodplain Forest (0.19ha), degraded woodland (0.35ha) and wetland vegetation (0.81). To compensate for the clearing of this vegetation, an area of 4.27ha shall be revegetated.

The removal of vegetation on the site is not considered significant due to the small quantity and generally poor quality of the vegetation. Overall, there would be a net increase in vegetation on site through the implementation of the proposed offset strategy which would ultimately improve the quality of vegetation on site.

Parts of the subject site, and in particular the areas adjacent to Ropes Creek and its tributary, are flood liable. These flood affected areas are primarily reserved as environmental conservation area, which in Oakdale Central are now referred to as Biodiversity Lots A, B and C. Flood liable land (below the 1 in 100 yr flood line), Biodiversity Lots A, B and C, and the land for which this VMP applies are illustrated in **Figure 1-2**.

Also shown in **Figure 1-2** is a Service Lot (located at the south west boundary of the tributary riparian corridor) where a "precinct" scale sewage treatment and recycled water system will eventually be housed. There is no Sydney Water sewerage infrastructure currently available to service the site. Progressive development of building lots will include the provision of dedicated sewage treatment systems until the precinct scale STP is commissioned.

Sewage will be treated in accordance with recycled water standards, and reused on site for non-potable uses, and any excess would be irrigated in accordance with NSW criteria and guidelines. In accordance with these guidelines, the proposed drainage swales and riparian corridors will be irrigated with potable water only, and recycled water from the STP used in landscaping and other non-riparian vegetated zones.

1.3 Staging

Implementation of the VMP will be staged in order to prevent any disturbance from the development on newly prepared substrates and establishing vegetation. At the time of writing this VMP it is anticipated that there will be two stages as set out below:

1.3.1 Stage 1

Stage 1 implementation of the VMP comprises the riparian restoration works associated with the tributary and Biodiversity Lots A and B. Disturbance due to development within the tributary riparian corridor include construction of the Estate Road crossing and the proposed bioretention basin located along the east of the tributary riparian corridor.

Construction of the creek crossing will impact directly on the tributary whereas construction of the bioretention basin will only require access and disturbance to currently cleared areas along and potentially within the eastern riparian zone. Therefore commencement of riparian restoration / revegetation works should not take place until these construction works are completed.

Construction and operation of the bioretention basin is required when 80% of Lots 1a, 1b, 1c, 2a, and 2b (east of the tributary) are developed. Development of 80% of these lots would be reached in approximately two years. Allowing a further six months for the creek crossing and associated works to be completed, Stage 1 of the VMP would be expected to commence in two and a half years.

1.3.2 Stage 2

Stage 2 implementation of the VMP comprises riparian restoration works associated with the eastern bank of Ropes Creek and Biodiversity Lot C. Stage 2 is currently expected to commence in three to four years.

1.4 Existing Vegetation

Mapping undertaken by NSW NPWS (2002) throughout the Western Sydney area indicates that the subject site is largely represented by cleared land with the exception of the two riparian corridors. While the remnant mapping by NPWS (2002) identified the remnants of bushland along the two creek lines as being River-Flat Eucalypt Forest, the Ecological Assessment for the Oakdale Central site carried out by Cumberland Ecology (2007) identified these remnants as being Swamp Oak Floodplain Forest.

The local area overlies the Blacktown Soil landscape group in which South Creek soil landscape occurs along drainage depressions. The latter is expected to occur within the subject site.

Dominant soil materials of the South Creek soil landscape comprise brown sandy loam to sandy clay loams. The colour of the soils range from dull reddish brown to dull yellowish brown and soil materials are usually moderately acidic.

1.4.1 Swamp Oak Floodplain Forest

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (SOFF) is a listed endangered ecological community under Schedule 1 of the *Threatened Species Conservation Act 1995* (TSC Act).

The NSW government profile for this community (DECCW, 2011b) describes the following habitat associated with SOFF:

- Generally associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains.
- Occurs below 20 metres and rarely above 10 metres above sea level.
- The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.

SOFF may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales (including River-Flat Eucalypt Forest). The combination of features that distinguish SOFF from other endangered ecological communities on the coastal floodplains in the Sydney Region include: its dominance by a tree canopy of *Casuarina glauca*; a relatively low abundance of *Eucalyptus* species; and a prominent groundcover of forbs and graminoids (DECCW, 2011c).

1.4.2 River-Flat Eucalypt Forest

River-Flat Eucalypt Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEF) is also listed as an endangered ecological community under Schedule 1 of the *Threatened Species Conservation Act 1995* (TSC Act).

The NSW government profile for this community (DECCW, 2011a) describes the following habitat associated with RFEF:

- Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.
- Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.
- The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees.
- Typically form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semipermanent standing water.

Key indicator species evident at the subject site include *Eucalyptus amplifolia, Eucalyptus tereticornis, Bursaria spinosa, Einadia* spp (*E.hastata* and *E.trigonos*), *Microlaena stipoides*. Other species common to RFEF also observed at the subject site include *Angophora floribunda, Melaleuca decora, Melaleuca styphelioides, Casuarina glauca, Lomandra longifolia, Themeda australis, Imperata cylindrica, Centella asiatica*

1.4.3 Unnamed Tributary

The unnamed tributary which runs through Biodiversity Lots A and B is mapped as containing a small remnant of RFEF supporting a canopy of <10%. NPWS (2002) vegetation mapping was produced at a scale of 1:25,000, which makes the accuracy of locating of small remnants problematic. However, field investigations confirmed that the tributary remnant of RFEF is largely contained within the upstream reaches of proposed Biodiversity Lot B extending into the northern extent of Biodiversity Lot A.

Remnants of RFEF along the tributary are dominated by a canopy of *Casuarina glauca* with individual occurrences of *Angophora floribunda*, *Eucalyptus tereticornis* and *E. amplifolia*. Eucalyptus regeneration is evident to the east of the tributary.

Above: regenerating Eucalypts adjacent tributary to the east

As recorded by Cumberland Ecology (2007) native shrub species are largely absent, with scattered individuals of the exotic *Lycium ferocissimum* (African Boxthorn) representing the majority of the shrub layer species within the remnant.

Despite the presence of encroaching pasture grasses, populations of native grasses (including *Themeda australis*, *Imperata cylindrica* and *Microlaena stipoides*) can be found in the riparian corridor along with native herbs such as *Einadia* and *Atriplex spp*.

Native instream vegetation comprises *Phragmites australis, Typha orientalis*, *Triglochin procerum*, *Juncus usitatus*, *Alternanthera denticulata, Paspalum distichum*, *Persicaria decipiens* and *Potamogeton ochreatus,* although the dominant instream species is the introduced *Juncus acutus* (Spiny Rush).

The offline dam at the downstream end of the tributary is dominated by *Typha orientialis*, with the floating attached native *Ottelia ovalifolia* evident.

1.4.4 Ropes Creek

A larger remnant of vegetation is mapped along Ropes Creek within the proposed Biodiversity Lot C, which is also mapped as River-Flat Eucalypt Forest (RFEF) However, this remnant was recorded by NPWS (2002) as

supporting a canopy cover of >10% (NPWS 2002). Canopy species along the Ropes Creek corridor are comparable to those located along the tributary, with *Casuarina glauca* the dominant canopy species. While the existence of a shrub layer is still negligible along this length of creekline, there was an absence of African Boxthorn, and instead a number of mature *Melaleuca styphelioides* and *M. decora* and small shrubs of *Bursaria spinosa* present.

At time of field investigations, Biodiversity Lot C was still subject to grazing by cattle making positive identification of ground cover species difficult. However individual occurrences of *Microlaena stipoides*, various *Austrodanthonia* spp., *Chloris ventricosa, Lomandra longifolia,* and *Carex appressa* were evident. A small dam has been created across Ropes Creek near the upstream extent of the study site. Spiny Rush is present upstream of the dam, yet largely absent downstream of this point.

A number of saltmarsh species were evident instream at Ropes Creek, these include *Cotula coronopifolia* (Water Buttons), *Triglochin striata* (Streaked Arrow-grass), *Isolepis cernua* and *Tetragonia tetragonoides* (New Zealand Spinach). Large quantities of desiccated Duck Weed (possible Spirodela or Wolfia species) were evident on the banks and creek bed of Ropes Creek which had ceased flowing at the time of the March 2011 inspection.

1.4.5 Exotic / Weed Species

Introduced plant or weed species evident at the subject site include a range of noxious, environmental and less serious weeds. Understorey weed species are dominated by pastoral grasses and Spiny Rush. The shrub layer is dominated by African Boxthorn with occasional *Ricinus communis* (Castor Oil Plant) evident, and *Rubus anglocandicans* (Blackberry) alongside the eastern edge of the dam at the downstream end of the tributary.

Noxious weeds identified during field investigations include Blackberry and Castor Oil Plant both categorised as Class 4[1] weeds in the Fairfield LGA and one mature specimen of *Cortaderia jubata* (Pampas Grass) which is categorised as a Class 3[2] weed in the Fairfield LGA. Table 1-1 lists weed species identified during field investigations at the subject site.

Table 1-1. Weed species evident in November 2010 and March 2011 at the subject site.

Species Name	Common name	Location
Grasses		
Setaria gracilis	Slender Pigeon Grass	All areas
Sporobolus indica var capensis	Parramatta Grass	All areas
Paspalum dilatatum	Paspalum	All areas
Chloris gayana	Rhodes Grass	All areas
Briza minor	Shivery Grass	All areas
Pennisetum clandinestinum	Kikuyu	All areas
Cortaderia jubata	Pampas Grass	Isolated occurrence
Herbs		
Bidens pilosa	Farmers Friends	All areas
Cirsium vulgare	Spear Thistle	All areas
Hypochaeris radicata	Flatweed	All areas
Lepidium sp	Brassica	All areas
Plantago lanceolata	Lambs Tongue	All areas
Ranunculus scleratus	Celery Buttercup	All areas
Rumex crispus	Curled Dock	All areas
Senecio madagascariensis	Fireweed	All areas
Sida rhombifolia	Paddys Lucerne	All areas
Solanum sisymbriifolium	Sticky Nightshade	Tributary
Sonchus oleraceus	Sow Thistle	All areas
Shrubs		
Lycium ferocissimum	African Boxthorn	Tributary
Ricinus communis	Castor Oil Plant	Ropes Creek
Rubus anglocandicans	Blackberry	Adjacent off-line dam

[1] Class 4 noxious weeds must have their growth and spread of controlled according to the measures specified in a management plan published by the local control authority

[2] Class 3 noxious weeds must be fully and continuously suppressed and destroyed

Species Name	Common name	Location
Vines		
Araujia sericea	Moth Vine	Tributary
Instream weed species		
Juncus acutus	Spiny Rush	Tributary and Ropes Creek
Isolepis prolifera		Dam off-line to tributary
Cyperus eragrostis	Umbrella Sedge	Tributary, off-line dam

Flood_extent | Core Riparian Zone | APZ - 10m width | Drainage swales

OAKDALE CENTRAL VEGETATION MANAGEMENT PLAN

Location of Biodiversity Lots & Flood Liable Land

JUN 2011

60197952

0 37.5 75 150 m

Fig. **1.2**

2.0 Project Description

2.1 Riparian Corridor

The riparian corridor which is the subject area of this VMP comprises two separate areas:

1. The eastern bank of Ropes Creek located on Biodiversity Lot C, and
2. Both east and west banks of the unnamed tributary located on Biodiversity Lots A and B, which includes an off-line dam located at the downstream extent of the tributary within the subject area.

The NSW Office of Water (NOW) requires that the following three zones be designed for within the VMP as illustrated in Figure 2-1 and summarised below:

1. The core riparian zone (CRZ) which should be retained, or revegetated with fully structured native vegetation (including groundcovers, shrubs and trees),
2. An outer riparian zone (ORZ) shown as a vegetated buffer in Figure 2-1 which protects the environmental integrity of the CRZ and should be wide enough to protect the CRZ from weed invasion, micro-climate changes, litter, trampling and pollution (usually 10 metres is recommended), and
3. An asset protection zone (APZ) as a requirement of the NSW Rural Fire Service for the protection of assets (houses, buildings, etc.) from potential bushfire damage.

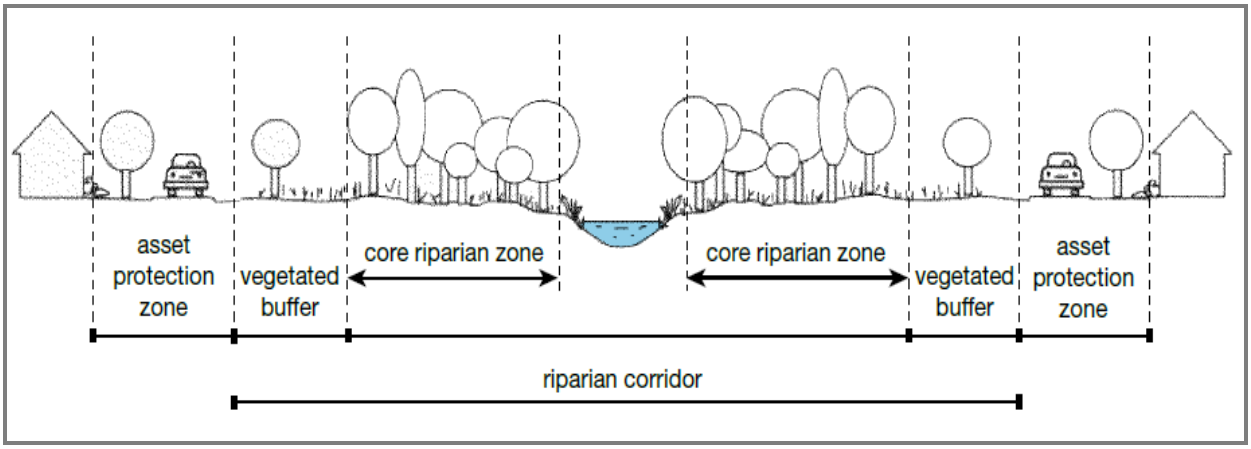


Figure 2-1. Riparian zonation schematic sourced from Riparian Corridor Guidelines (NOW 2011)

2.1.1 Stream categorisation

The riparian corridor guidelines (NOW, 2011) require that watercourses be classified under the Strahler System of ordering when determining the width of the CRZ required to be established, conserved and maintained for each category of stream.

The width of the CRZ from the banks of the stream is also determined by assessing the importance and riparian functionality of the watercourse and merits of the site and long-term land use.

As part of the environmental assessment process for the project, the watercourses within the subject area were investigated with the specific purpose of determining stream categories in accordance with the Strahler System of ordering. This was conducted by GHD (2008) and determined in consultation with the *then* Department of Water and Energy (DWE)[3] and Goodman.

Table 2-1 provides a summary of CRZ widths in relation to the each stream category in relation to the Strahler System of ordering.

[3] DWE is now referred to as the NSW Office of Water (NOW).

Table 2-1. Width of CRZ as per Guidelines (NOW 2011)

Type of watercourse	Width of CRZ
Any first order watercourse and where there is a defined channel where water flows intermittently or any 'river' not identified on a topographic map	10 metres
■ any permanently flowing first order watercourse, or ■ any second order watercourse and where there is a defined channel where water flows intermittently or permanently.	20 metres
Any third order or greater watercourse, where there is a defined channel and where water flows intermittently or permanently. Includes estuaries, wetlands and any parts of rivers influenced by tidal waters.	20 - 40 metres[1]

[1] merit assessment based on riparian functionality of the river, lake or estuary, the site and long-term land use.

On the basis of site investigations, consultation with DWE (GHD 2008), the above CRZ guidelines, the subject site's watercourses were categorised as follows:

- **Category 1 – Environmental Corridor**: the main channel of Ropes Creek, located on Biodiversity Lot C, is delineated as a 3rd order stream which requires:
    - a minimum CRZ of 40 m width from the top of the eastern bank only (not including the instream environment, noting that the western bank lies outside the subject area),
    - a further 10 m width outer riparian zone (ORZ) to counter edge effects, and
    - the entire riparian zone, which comprises the CRZ and ORZ is to consist of local provenance native vegetation.
- **Category 2 – Terrestrial and Aquatic Habitat**: the unnamed tributary located on Biodiversity Lots A and B, is delineated as a 2nd order stream which requires:
    - a minimum CRZ of 20 m width from the top of each bank and including the instream environment,
    - a further 10 m width ORZ to counter edge effects, and
    - the entire riparian zone, which comprises the CRZ and ORZ is to consist of local provenance native vegetation.
- **Category 3: Lesser Streams:** under the classification outlined in Table 2-1 are delineated as 1st order streams. The only stream in this category on the subject site was previously removed during quarrying operations prior to this project.

2.1.2 Category Management Objectives

Each category of stream presents opportunities and constraints to the proposed development. In determining the final stream category, GHD (2008) considered the interaction of the each stream to achieve the development's desired objectives. The management objectives that have been adopted for each stream category are listed below.

Category 1: Ropes Creek

- Conservation and enhancement of existing biodiversity.
- Connectivity with surrounding vegetation and drainage lines.
- Flood management.
- Water quality management.
- Watercourse crossings allowing for continuity of habitat.

Category 2: Tributary

- Linking category 1 steams with pockets of existing vegetation.
- Improve the connectivity of vegetation and drainage lines throughout the site.
- Flood management.
- Stormwater and water quality management.
- Watercourse crossings allowing for continuity of habitat.

In accordance with the above listed objectives, detention basins and bushfire asset protection zones (APZ) are to be located outside the CRZ and the ORZ for the Ropes Creek riparian corridor.

The APZ comprises an additional 10m width immediately adjacent the ORZ for both Ropes Creek and the tributary.

Where necessary the APZ may be located within the ORZ as the requirements of the APZ and the ORZ may conflict in relation to the quantity and type of vegetation cover. These areas are to be managed such that conflicting requirements are addressed and an appropriate compromise reached.

In the case of the tributary and as shown in Figure 2-2, the following applies:

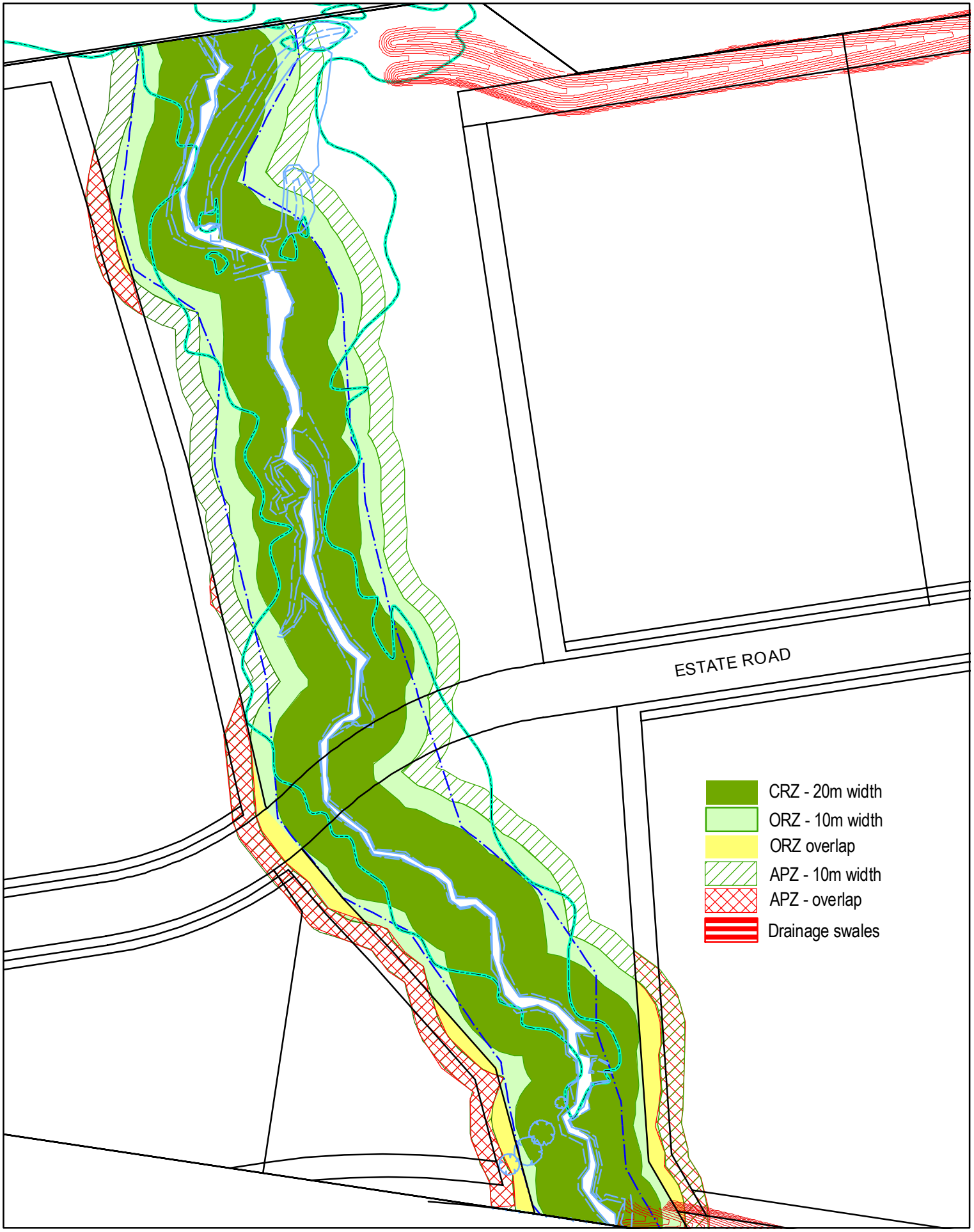
- The Estate Road creek crossing.
- Stormwater inflows from:
    - an overland swale at the northern end of the tributary from the east that will discharge into the creek
    - an overland swale at the southern end of the tributary from the west that will discharge into the off-line dam
    - the STP which enters the tributary from the west, upstream of the road crossing
- A bioretention basin which is located outside of the ORZ.
- Approximately 325 lineal metres collectively in which the APZ lies outside Biodiversity Lot A and B, all located on the western side of the riparian corridor.
- Approximately 120 lineal metres in which the APZ overlaps with the ORZ on the eastern edge of the riparian corridor in the south.

The southernmost extent of the tributary (upstream extent at the subject site boundary) is currently infested with a dense stand of the introduced *Juncus acutus* (Spiny Rush). Spiny Rush is a difficult environmental weed to control, which seeds prolifically and has the capacity to further infest much of the planned riparian restoration areas.

The area of dense infestation coincides with where the APZ encroaches into an adjacent service area and also extends into the adjacent 40m wide RTA road easement adjoining the southern edge of the subject site. The soils underlying the infestation are highly saline. Amelioration options for these soils are discussed in Section 2.4.1 and include excavation to a depth of one metre and replacement with appropriate growth medium or revegetation of the area with salt tolerant species.

Given the unsuitable condition of this area for restoration of the intended riparian assemblages, a potential solution is to plant the area with low growing salt tolerant species following control of *J.acutus*.

In all other areas where the APZ encroaches into adjacent service and development lot areas, the placement of buildings and associated landscaping will need to be considered.



OAKDALE CENTRAL VEGETATION MANAGEMENT PLAN

Tributary Riparian Zones

0 20 40 80 m

JUNE 2011

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Fig. **2.2**

2.2 Restoration Approach

A number of tasks in a staged order will be necessary to fulfil the requirements and objectives of this Plan. As outlined in the preceding sections, these include:

- Plant procurement.
- Site preparation.
- Weed control, including primary and secondary weeding.
- Planting program, including primary and supplementary plantings.
- Maintenance and monitoring.
- Reporting.

Riparian restoration aims to create a fully structured riparian community and ground level connectivity for the length of the works. Restoration will be implemented through '*assisted natural regeneration*' and '*reconstruction*'.

2.2.1 Assisted Natural Regeneration

Assisted natural regeneration is based on the ecological principles of community succession and is reliant on some form or resilience or natural recruitment capacity. Assisted natural regeneration can be described as removing or controlling limiting factors or stressors from an ecosystem to ensure continued or improved regeneration and succession. Assisted natural regeneration generally entails the following:

- Reinstating regeneration/ ecosystem triggers to promote *in situ* regeneration (fire, disturbance, smoke products etc).
- Minimising threats to diversity and promoting ecosystem processes (fencing, stopping access, weed control, buffer creation, control nutrient and hydrological inputs.
- Supplementary planting of native species from structural elements absent from an area, or increased diversity of native species in any given structural layer.

2.2.2 Reconstruction

Reconstruction or reconstruction through revegetation is an approach used when resilience or recruitment of a site are not high enough to achieve the target species mix and/or structure through natural or assisted natural regeneration techniques – *within a realistic project timeframe*.

DIPNR (2003) describes 'bushland reconstruction' as involving initial and ongoing control of weeds using bushland regeneration techniques and the introduction of locally indigenous plant species, modelled on the diversity and structural characteristics of the original plant community. Reconstruction generally entails the following:

- Soil testing.
- Non-selective mechanical and herbicide weed control.
- Ecological burning of introduced / pastoral grass areas.
- Soil tilling/preparation and amelioration.
- Planting of plants from tree, shrub and ground layers in highly degraded areas.
- Planting of native grassland areas.

2.2.3 Proposed Vegetation Assemblages

Two (2) key plant communities are proposed for either regeneration or reinstatement to the riparian corridors:

1. River Flat Eucalypt Forest (RFEF), and
2. Swamp Oak Floodplain Forest (SOFF).

Areas of CRZ and ORZ will be regenerated and / or revegetated to emulate the ecotone of vegetation naturally in RFEF communities (comprising representative RFEF species from all layers of trees, shrubs and groundcover), with the exception of overlapping ARZ and ORZ areas within the tributary riparian corridor. The main areas of conflict are located in Biodiversity Lot A and associated with the Estate Road creek crossing and where the

riparian corridor is constrained between the adjacent Service Lot on the southwest boundary and the southern drainage swale area on the southeast boundary of the riparian corridor. Other smaller areas are located on the western boundary of Biodiversity Lot B (refer Figure 2-2 and Section 2.1.2)..

While it is considered that the regeneration and/or reinstatement of riparian vegetation would be best represented by RFEF, localised areas of salinity warrant the installation of relatively salt tolerant species (refer Figure 2-3). These species are typically representative of SOFF understorey species and will be more suited to localised saline conditions. A number of salt tolerant species are evident in both the riparian and instream areas of Ropes Creek and the tributary. Thus the inclusion of these species in combination with soil amelioration will improve successful plant establishment. Soil testing and amelioration is discussed in Section 2.4.1.

2.2.4 Management Zones

The varying landscape settings, structural and floristic associations of the remnant native vegetation and degraded areas supporting naturalised plant associations at the subject site were classified into four zones for management purposes, as follows:

1. Remnant RFEF vegetation dominated by a canopy of *Casuarina glauca.*
2. Native wetland vegetation dominated by *Typha orientalis* and *Phragmites australis.*
3. Areas dominated by exotic ground cover species, which comprise:
   (a) areas dominated by exotic pasture grasses, and
   (b) creek line areas dominated by exotic sedge species in particular *Juncus acutus*
4. Offline dam within the riparian corridor, which comprise:
   (a) The dam itself supporting a mix of native and exotic wetland plant species, and
   (b) The dam wall currently dominated by exotic pasture grasses

Table 2-2 summarises the proposed restoration approaches relative to each management zones, which are illustrated in Figure 2-3.

Table 2-2. Restoration Approach Summary Table

Zones	Area (m^2)	Description	Management Approach
1	2,883	Remnant RFEF generally within 10m of the creek line. *Casuarina glauca* and scattered Eucalypts and Melaleucas, approximately 30% of ground layer comprising native species	Assisted natural regeneration
2	590	Native wetland vegegtation covering >70% of area dominated by *Typha orientalis* and *Phragmites australis* with scattered *Juncus usitatus*	Assisted natural regeneration
3a	38,282	Exotic pasture grasses. Native groundlayer species represent <5% of zone	Reconstruction / revegetation
3b	3,025	*Juncus acutus* infested creek line areas. Native ground layer species represent <5% of zone	Reconstruction / revegetation
4a	1,150	Off-line dam open water zone and verges	Assisted natural regeneration
4b	295	Off-line dam embankment	Reconstruction / revegetation
	46,225		

Soil sample sites
Saline area
Zone 1
Zone 2
Zone 3a
Zone 3b
Zone 4a
Zone 4b

OAKDALE CENTRAL VEGETATION MANAGEMENT PLAN
Riparian Management Zones

0 60 120 240 m

JUN 2011
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Fig. **2.3**

2.3 Plant Procurement

As far as practicable, all plant material used within the riparian corridors should be of local provenance. An initial plant supply contract should be instigated in the first instance, to ensure that existing provenance material is retained for the project, and if necessary forward order the propagation of species to supplement what is available. Feasibly the program will need to allow a minimum of 16 weeks for medium sized cells to small tubes (e.g. 0.05L and 0.093L size).

Where it is not possible to procure all required species of local provenance, further collection of provenance propagative material should be undertaken during the next available flowering / seed bearing season to procure additional species for supplementary planting to the corridor.

Where further collection or procurement of plant material is required as above, additional provenance locally endemic species will be sought over and above those specified, with the aim of maximising species diversity within the restoration.

Plant material should be collected using principles prescribed in *'Bringing the Bush back to Western Sydney'* document (DWE 2003). Seeds and vegetative propagules are to be of local providence collected from the local area within the Fairfield and adjoining LGA's up to 15km from the study site.

A planting schedule for the project is provided in **Appendix B**.

2.4 Site Preparation

2.4.1 Soil Testing and Amelioration

Soil conditions were investigated by EcoHort during field investigations for the preparation of this VMP. A summary table of investigative results and recommendations are set out below. Laboratory analysis of soils (undertaken by Sydney Environmental Soil and Laboratory SESL) are provided in **Appendix C** and the location where soil samples were collected is illustrated in Figure 2-3.

The main areas identified that require amelioration in order to provide an appropriate growth medium for successful establishment of vegetated riparian corridors include:

- **Soil sample SS1:** Soils are severely alkaline, saline and sodic, and not suitable for planting. Recommendations include:
  - burying this area with appropriate soils to a minimum depth of one metre,
  - excavate to a depth of one metre and replace with appropriate soils, or
  - revegetate with salt tolerant plant species.
- **Soil sample SS2:** Soils have a low effective cation exchange capacity indicating a poor ability to hold and retain nutrients. Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.
  - gypsum at 300g/sqm will bring up the calcium levels and additional organic matter will create a better structured soil and increase water holding capacity. This can be done by using compost, biosoilds or green manure.
- **Soil sample SS3:** Soils have a low calcium magnesium ratio and organic carbon and organic matter are also low. Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.
  - organic matter needs to be increased and soil structure improved. This can be achieved by the addition of a compost, biosolids or green manure.
  - gypsum at 200g/sqm will improve calcium levels.
- **Soil sample SS4:** Soils are low in organic carbon, organic matter, nitrate, phosphate and potassium, have moderate salinity and sodicity with high sodium levels and high in iron and manganese (suggesting water logged soils). Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.

- organic matter needs to be increased and soil structure improved. This can be achieved by the addition of a compost, biosolids or green manure.
- gypsum at 200g/sqm will improve calcium levels and displace sodium levels.

- **Soil sample SS5:** Soils have moderate sodicity with high sodium levels are very low in organic carbon, organic matter, nitrate, phosphate potassium, sulfur and boron. Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.
  - organic matter needs to be increased by the addition of a compost, biosolids or green manure.
  - gypsum at 200g/sqm will improve calcium levels and displace sodium levels.
- **Soil sample SS6:** Soils are slightly acidic, have a very low calcium magnesium ratio, are very low in organic carbon, organic matter, nitrate, phosphate potassium, sulfur and boron. Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.
  - organic matter needs to be increased by the addition of a compost, biosolids or green manure.
  - gypsum at 200g/sqm and lime at 100g/sqm will improve calcium levels, neutralise aluminium and hydrogen and increase soil pH.
- **Soil sample SS7:** Soils are moderately acidic, have a low calcium magnesium ratio, nitrate, phosphate potassium, sulfur and boron are low, and high exchangeable acidity. Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.
  - gypsum at 300g/sqm and lime at 200g/sqm will improve calcium levels, neutralise aluminium and hydrogen and increase soil pH.
  - organic matter needs to be increased and sol structure improved. This can be done by using compost, biosolids or green manure
- **Soil sample SS8:** Soils are moderately acidic, organic carbon and organic matter are low, phosphate potassium and boron are low, and high exchangeable acidity. Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.
  - gypsum at 200g/sqm will improve calcium levels and increase soil pH.
  - organic matter needs to be increased and sol structure improved. This can be done by using compost, biosolids or green manure.
- **Soil sample SS9:** Soils are slightly acidic, moderately sodic (high sodium), calcium magnesium ratio is low, organic carbon and organic matter are low, nitrate, phosphate potassium, sulfate and boron are low. Recommendations include:
  - the addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation.
  - gypsum at 200g/sqm will improve calcium levels and displace sodicity.
  - organic matter needs to be increased by the addition of a compost, biosolids or green manure.

2.4.2 Sediment Controls

Silt fencing has been installed for sediment control purposes to the east of the tributary. Silt fencing should be regularly inspected and repaired or reinstalled as necessary.

Soil and erosion works shall be in accordance with the site Soil and Erosion Management Plan during all earth and civil works (by others) that have any potential to impact on the tributary, off-line dam and Ropes Creek.

2.4.3 Erosion Control

The removal of large areas of weeds may cause instability in some areas of the riparian corridor. Erosion control matting or other temporary erosion control methods (e.g. well anchored/staked hay bales) will be required in areas that become unstable and /or are likely to be subject to erosive forces.

Jute matting is designed to hold soil, decrease the risk of erosion and perform the same functions as other mulch products. When properly installed, jute matting will be less readily washed away during flood events, in comparison to products such as leaf or woodchip mulch.

The jute mat should be composed of 100% jute with a normal thickness of 8-13 mm and be installed as per product specifications. This includes: laying the mat perpendicular to the creek line, so that there are no patches of bare ground visible and with a 150mm overlap; digging-in the top and upstream-most edge; and pinning-down the mat with at least 3 x 300mm long pins per m^2.

Bank stabilisation works are required along a section of the tributary in which the eastern bank forms the embankment to the off-line dam. This section extends from the off-line dam diversion point approximately xxx metres in which the tributary meanders sharply before straightening again as it approaches the southern end of the tributary.

A number of bricks have been placed instream and along the western bank of the tributary in this section. It is recommended that the area of flow diversion (to the off-line dam) be reinforced appropriately and the section of eroding embankment be stabilised either through the use of planted coir logs and/or minor reshaping, jute matting and replanting.

2.4.4 Mulch

It is recommended that all planting areas outside of frequently inundated zones should be mulched, before or directly after planting. Mulch is beneficial as it reduces soil temperatures around newly planted tubes, reduces evaporation of water from soil around the plant, suppresses weed growth and can reduce erosion potential around the seedling.

Use mulch to AS 4454, which is free of deleterious and extraneous matter such as soil, weeds, sticks and stones. Mulch is to be placed to the required depth, clear of plant stems, and raked to an even surface flush with the surrounding finished levels. Spread mulch so that after settling, or after rolling, it is:

- Smooth and evenly graded between design surface levels.
- Flush with adjacent finished levels.
- Of the required depths (100mm depth).
- Sloped towards the base of plant stems in plantation beds, but not in contact with the stem.

It can be expected that mulch will have significantly broken-down after an estimated 12-month period following initial application. It is therefore recommended that all mulch beds are topped-up with a 50mm layer of woodchip/leaf mulch at this stage. This should be accompanied by a topdressing application of a 9-month, slow release, low phosphorous fertiliser to ensure that semi-established plantings do not suffer as a result of potential nitrogen draw-down that may be associated with the application of the 50mm mulch layer at the 12-month period.

2.4.5 Irrigation

A temporary irrigation system should be installed to ensure that plantings establish successfully. Provision should be made to install a permanent Sydney Water meter, with appropriately sized outlets (i.e. 19mm, 50mm or 75mm), with appropriate backflow prevention valves and vandal-proof taps at each revegetation-site.

2.4.6 Fencing

The riparian zone adjacent to Ropes Creek is currently accessible by cattle which are currently grazing the land and sourcing water from the creek. While this land remains as agistment, the riparian zone to the east of the creek will require fencing. At the time of writing the VMP it wasn't clear whether cattle would continue to be grazed to the west of the creek. This needs to be determined and the creek protected accordingly.

The tributary is currently fenced and free of grazing cattle. However civil works on the site may impinge into the riparian zone. Consequently, it is recommended that the width of the CRZ and ORZ alongside the tributary be clearly demarcated (fenced or otherwise) to ensure that vehicles or other machinery do not enter these zones. It is noted that silt fencing has been installed along the perimeter of the eastern riparian zone of the tributary.

2.4.7 Woody Debris / Habitat

The subject site contains a number of felled trees, branches and stumps which are collectively termed woody debris. Woody debris occurs both in riparian areas and instream, the latter more prevalent in the tributary. Woody debris, including standing dead trees provide habitat for a wide range of fauna species. However wood from

introduced species should not be left in situ if there is any potential for the species to re-sprout or provide other forms of propagules that may reinfest the riparian corridor.

A number of trees are likely to be felled during the construction of the Estate Road crossing over the tributary. All trees should be inspected for the presence of bird nests, bee hives and possum dreys prior to clearing. In the event that any of the aforementioned are found, a suitably qualified zoologist should be engaged to supervise the removal of trees and attend to any fauna that may be present.

2.5 Weed Control

2.5.1 Primary Weeding

Primary weeding is the first stage of bushland regeneration. Primary weeding may involve techniques such as:

- Selective hand removal of weeds.
- Selective foliage spraying of weeds with herbicides.
- Cutting/scraping and painting deep rooted woody weeds and climbers.
- Chainsaws and brushcutters and painting cut stumps with herbicide.
- Target drilling and injecting certain large exotic trees.

These selective techniques are focused on avoiding disturbance to remnant native plants and to soil stored seed banks, which may contain dormant native plant propagules. All weeds should be targeted in designated zones during the primary weeding phase.

Damage to native plant species should be avoided during any bush regeneration weeding works. All seed, flowering and invasive vegetative parts of weeds should be bagged and disposed of site in an appropriate green waste recycling facility.

2.5.2 Secondary weeding

Secondary weeding is to be undertaken in areas that have received a primary weeding treatment. It involves the selective removal or treatment of weeds, whilst allowing regenerating or planted native plants to increase in size, abundance and percentage cover. All weeds should be targeted during the follow up weeding phase.

The follow-up bushland regeneration works are likely to be required at least every 2-4 months at a site until weeds are at negligible levels. However it is recommended that woody weeds, climbers and key herbaceous weeds are subject to a program of intense follow up weeding around patches of regenerating native herbaceous plants, to encourage their spread.

2.6 Planting Program

In any native revegetation project it is important to consider the restoration of all structural layers of vegetation. Tree, shrub and ground layers will be restored by planting local native material in tubestock containers, supplemented by years of subsequent recruitment from these plantings and natural regeneration from proximate areas.

2.6.1 Tubestock Installation

Trees, shrubs, ground layer herbs, grasses and climbers in tubestock containers should be planted in designated revegetation areas, using the following specifications.

- Appropriate care should be taken to ensure that all plant stock are planted at the correct depth into the soil, mulch or weed mat layer.
- All tubestock should be watered-in thoroughly after planting to settle any air pockets around the root ball of the plant and to give the plant a good initial supply of water. Further. all tubestock should be watered thoroughly on at least 4 to 6 occasions, as a part of post-planting maintenance.
- Newly planted trees and shrubs should be protected by the installation of tree guards. 750mm x 10-12mm bamboo stakes and 350mm x 450mm tree guard sleeves or equivalent sized alternative should be used. Tree guards offer protection from grazing, against weed competition, frost, high winds and herbicide spray drift during maintenance spraying.

2.6.2 Irrigation

Newly planted stock should be irrigated in the first 3-6 months after planting, (on at least 4-6 occasions, depending on rainfall conditions). Additional irrigation will be required when installing replacement or supplementary plantings.

2.6.3 Maintenance weeding

Maintenance weeding is to be undertaken in areas where native plant regeneration has significantly progressed to the stage where native plants occur at high percentage cover levels. It can be expected that the native vegetation at the site will always require a certain level of bush regeneration maintenance weeding, as weed seeds and vegetative propagules make their way on-site via stormwater during floods, wind and bird droppings. However, the amount of weeding required will decrease significantly as regenerating native plants grow, recover and become more resistant to disturbance and weed colonisation.

All herbaceous weeds should be managed to be at very-low percentage cover levels (as a minimum), or better. Particularly problematic herbaceous weeds with wind blown seeds should be prevented from seeding at all times throughout the site.

Pasture grasses should be prevented from spreading into any bushland zones by applying a spot glyphosate herbicide spray application on the 1-metre wide buffer zone, on a monthly basis or as required.

2.7 Plant Establishment Period

In accordance with the *Guidelines for controlled activities – Vegetation Management Plans* (DWE 2008), maintenance requirements should extend for a minimum of two years after the completion of works (i.e. Practical Completion or PC) or until such time as a minimum 80% survival rate for all plantings and a maximum five percent (5%) weed cover for the treated riparian corridor (controlled activity) is achieved.

This period of time will constitute the Planting Establishment Period (PEP).

Before the PEP commences, the contractor engaged to undertake the PEP will be required to submit a plant establishment program to Goodman for approval. The contractor must then comply with the approved program and will also be required to keep a Maintenance Logbook throughout the PEP (i.e. recording when and what maintenance work has been done and what materials, including toxic materials, have been used).

Recurrent maintenance works will include rubbish removal, pest and disease control, selectively spot spraying and hand weeding around native plants, watering plants as needed and replacing dead and vandalised plants.

Replacement planting is to be carried out throughout the maintenance period to sustain the 80% of original number specification at the end of the maintenance period. Replacement planting must use the same species, or where that species is not available, a species with the same growth form (i.e. a shrub with a shrub etc) of local provenance and from either of RFEF or SOFF.

Losses of greater than 20% or having unacceptable weed issues may result in the PEP to be extended further than two years (as specified in VMP) until survival rates and weed control have been achieved.

Adaptive management/restoration practices should be adopted if any of the recommended actions in this VMP do not lead to expected levels of native plant species regeneration.

2.8 Monitoring

Two mechanisms for record keeping are to be implemented as set out below:

2.8.1 Maintenance Logbook

The Maintenance Logbook is a day-to-day record of prevailing climatic conditions, tasks undertaken and materials used (herbicides, pesticides, volumes of mulch, replacement plantings etc). The Maintenance Logbook is a form of Quality Control and should be recorded using standardised proforma sheets, which are later entered into a site database, or other similar method of quality assured recording of the VMP tasks required.

2.8.2 Monitoring and Reporting

Monitoring and reporting will commence following PC of the riparian corridor works. In order to measure the specified restoration objectives, regular three monthly inspections of works will be conducted to measure both:

a) the extent and percentage of native planting establishment, and

b) weed cover in all areas of the riparian zones.

Three monthly reporting shall include a summary of records from maintenance logbook(s) and specific riparian restoration measurements (i.e. 80% planting success for all species, and 5% weed cover). The following information will typically be reported:

- The time period of report and conditions during that time.
- A summary of all revegetation, primary and follow-up/maintenance weeding activities undertaken in the reporting period.
- Seed certification and local provenance (of any plantings or seeding works, including replacements).
- Identify the body/s that does the propagation of plants or supplies the native grass seed for any revegetation works, (including replacements).
- Dates when planting or seeding was undertaken during the reporting period.
- Any agreed changes to plantings or seeding, species etc during the reporting period.
- Photos of the vegetation and works progress during the reporting period from at least 1-3 photo points from each management zone.
- Densities planted or seeding rate utilised at given zones.
- Survival rates of plantings, coverage of seeded ground covers, native plant regeneration and weed cover percentages for each management zone at reporting. Notes should also be made on what weeds, native plants are regenerating or establishing particularly well at reporting.
- Any problems that impacted upon the survival and regeneration rates for that reporting period, (such as flooding etc).
- A marked-up management zone map showing parts of the site that have been treated during the works period.
- Demonstration of progress of fulfilling the targets of this VMP.
- Qualifications and experience of contractors/persons that undertook works within the reporting period.
- Provide Certification of Compliance that all works within the reporting period were undertaken by persons suitably experienced and qualified in such certification.
- A summary of works that need to be undertaken in the next three month works period.

Annual monitoring should be undertaken similar to three monthly inspections and reporting but provide a summary of the preceding 12months and identification of any emerging trends (issues, opportunities) and need for adaptive management where present approaches may not be adequately meeting restoration objectives.

2.9 Handover / Ongoing Maintenance

At the completion of the PEP, the riparian restoration and revegetation works will require certification (i.e. that the assessment criteria has been met). Goodman, as the landowner, will then manage the site in perpetuity.

Prior to handover, the contractor(s) responsible for the PEP will be required to submit all maintenance records, progress reports and a final monitoring report (i.e. 2nd Annual Monitoring Report). The final monitoring report shall provide a summary of all works undertaken during the PEP and what ongoing bush regeneration or other maintenance tasks, and their frequency, are anticipated over the following two year period.

The preceding two year PEP monitoring and reporting will provide a clearer indication of what tasks are likely to be required, and a new contract issued for post PEP maintenance of the riparian corridor.

A reassessment of bush regeneration needs should be determined every two years after that for the following 10 to 12 years.

2.10 Required Skills

Qualified and experienced Bushland Regeneration Contractors (BRC) should be used for all bushland reconstruction works detailed in this VMP. The BRC engaged to undertake the riparian restoration works should be in compliance with AABR guidelines, which generally includes the following experience:

- TAFE Bushland Regeneration Certificate II, III or IV.
- Must demonstrate a minimum (cumulative) 3 years experience working in riparian vegetation communities.
- Must hold a current membership with the Australian Association of Bush Regenerators.
- Demonstrated experience in seed collection and propagation of native flora.
- Hold relevant licences for seed collection and propagation of native flora, or engage a subcontractor that has relevant experience and licensing.
- The removal of African Boxthorn and similarly sized small trees and smaller woody weeds can be undertaken by appropriately certified bush regenerators with Chainsaw Operator Level 2 qualifications.

Tender submissions must clearly demonstrate the capacity to undertake such works.

In addition to the BRC a qualified and experienced bushland management consultant; plant ecologist; or landscape architect should be engaged to undertake the following tasks:

- Inspection and approval of practical completion.
- Monitoring of the progress and effectiveness of all proposed works.
- Review of reporting.
- Inspection and approval of handover at the end of the PEP in consultation with the consent authority.

2.11 Responsibilities

The roles and responsibilities of relevance to the VMP are listed in Table 2-3. Goodman will be responsible for the implementation of this VMP, and ongoing management of the riparian corridors for the duration of their land ownership or management obligations. This is to include the engagement of a qualified vegetation management consultant (or otherwise commitment of in-house and appropriately qualified personnel) with experience in bush regeneration and ecological assessment for monitoring and auditing.

The vegetation management consultant will be responsible for monitoring and reporting of the works and ensuring that the Bush Regeneration contractor has complied with the requirements of this VMP. Where a consultant is engaged they will report to Goodman on the progress of the project and advise of any rectification where the vegetation management measures are not achieving the aims or specification of this VMP.

Table 2-3. Roles and Responsibilities

Role	Responsibilities
Project Manager (Goodman)	Project management of entire site including planning, contracting and coordination of all construction works, landscaping, VMP implementation, compliance with development consent conditions, liaison with consent authorities, and management of riparian corridor following PEP.
Civil Contractor (CC)	Install and maintain all erosion and sedimentation controls during construction works leading to the riparian corridor. Install and maintain exclusion fencing along Riparian Corridor.
Bush Regeneration Contractor (BRC)	Seed collection, weed control, site preparation, planting, mulching, and plant establishment. Maintenance of Logbook throughout the PEP (i.e. recording when and what maintenance work has been done and what materials, including toxic

Role	Responsibilities
	materials, have been used).
Commercial nursery	Supply of native plant stock. Potential supply of local provenance native plant seed and cuttings if available.
Vegetation Management Consultant (qualified botanist, ecologist or landscape architect) (VMC)	Monitoring / reporting and provision of advice of for restoration and revegetation project in Riparian Corridor Ensuring compliance with VMP. Certification that restoration and revegetation works have met the assessment criteria at completion of PC and PEP in consultation with the Consent Authority.
Consent Authority	Certification / Approval of PC and PEP

3.0 Implementation Summary Table

Task / Method	VMP Reference	Duration	Responsibility
1. Plant Procurement - Letting of plant supply and future plant propagation requirements, including sourcing of native plant material (e.g. collection of seeds & cuttings), - Plant material inspection 2 months prior to delivery, - Plant material inspection 2 weeks prior to delivery	2.3	9-12mths	Goodman / VMC
2. Site Preparation			
- Soil testing	2.4.1	Complete	N/A
- Installation of soil and erosion measures	2.4.2	1 week	CC
- Subsoil and topsoil amelioration as necessary	2.4.1	1 month	BRC
- Stabilisation (matting / mulching)	2.4.3, 2.4.4		
- Irrigation (installation)	2.4.5		
- Delineation / visible marking of area where native plants and trees to be retained	2.4.6		
3. Weed Control - Primary weeding	2.5.1	1 month	BRC
- Secondary weeding	2.5.2		
4. Planting - Plant material inspection at delivery (reject any defects) - Installation of plants	2.7	2 months	BRC
5. **Plant Establishment Period (PEP)** - Irrigation - Weeding - Replacement planting - Supplementary planting	2.7	2yrs	Goodman / BRC
6. Monitoring & Reporting			
- 3 monthly (x 6) - Annually (x 2)	2.8	2yrs	VMC
- Maintenance Logbook (record of tasks as completed)	2.11	2yrs	BRC
7. Post Establishment Maintenance - A reassessment of bush regeneration needs should be determined at the end of the PEP and thereafter every 2 years	2.8	Ongoing	Goodman / VMC

4.0 Cost Estimates

4.1 Stage 1 Unnamed Tributary

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
1	**Primary Weeding Activities**					
1.1	1	**Existing RFEF remnants, largely canopy species only**: Hand removal of scattered African Boxthorn using cut/scrape and paint techniques as well as hand weeding around non-target native plant species in preparation for spot spraying activities of all understorey weeds. Occurrences of *Juncus acutus* are to be slashed using brushcutters and hand tools followed by spraying or painting with a non-selective glyphosate herbicide.	m^2	2883	$2.50	$7,207.50
1.2	2	**Instream environment, lacking overstorey and midstorey species but higher proportion of native instream species.** Primary weeding using a combination of low volume spot spraying using a non-selective glyphosate herbicide, and hand weeding to remove exotic plant species growing in close proximity to regenerating native plant species.	m^2	590	$2.70	$1,593.00
1.3	3a	**Areas of pastoral grasses and weeds, native species comprising <5% of cover.** Undertaking low volume spot spraying activities using a combination of broadleaf selective and non-selective herbicides to spray exotic grasses from around significant populations of native grass species. Large areas dominated by exotic grasses will be sprayed out using a high volume vehicle mounted spray unit and non-selective glyphosate herbicide. Once dead, targeted grass species will be slashed down in preparation for mulching activities, and given a final follow up spot spray where required to ensure a successful kill rate has been attained.	m^2	18439	$0.56	$10,325.84
1.4	3b	**Areas where dense infestation of *Juncus acutus* dominates.** Slashing of *J. acutus* and other exotic ground layer species using a tractor and where machinery access is prohibited, using brushcutters. Remaining material is to be spot sprayed using a non-selective glyphosate herbicide, left for 2 weeks and then sprayed a second time prior to mulching and revegetation activities.	m^2	3046	$1.20	$3,655.20

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
1.5	4a	**Off-line dam, dominated by aquatic and semi aquatic native species.** Primary weeding using a combination of low volume spot spraying using a non-selective glyphosate herbicide, and hand weeding to remove exotic plant species growing in close proximity to regenerating native plant species.	m^2	1159	$0.70	$811.30
1.6	4b	**Off-line dam embankment, dominated by pastoral grasses and weeds.** Undertaking low volume spot spraying activities using a combination of broadleaf selective and non-selective herbicides to spray exotic grasses from around significant populations of native grass species. Large areas dominated by exotic grasses, where possible (i.e. to the east of off-line dam) will be sprayed out using a high volume vehicle mounted spray unit and non-selective glyphosate herbicide. Blackberry (already substantially cleared) will be targeted using a woody weed selective herbicide. Once dead, targeted grass species and blackberry will be slashed down in preparation for mulching activities, and given a final follow up spot spray where required to ensure a successful kill rate has been attained.	m^2	298	$1.20	$357.60
		Sub Total Primary Weeding Activities STAGE 1 (Exc GST)				**$23,950.44**
2	**Soil Preparation Works**					
2.1	3a	Supply a 50mm deep layer of organic compost, within the 50mm deep topsoil layer, as prescribed in soil tests. Spread-out compost at required 50mm depth using a bobcat and by hand-raking. Supply and add gypsum @ 400 grams per m^2 with a tractor drawn-spreader. Supply and add fertiliser at 50 grams per m^2 with a tractor drawn-spreader. Rip and incorporate compost into topsoil using 100-150mm deep tines on the back of a tractor on flat ground or tines on a small excavator on slopes.	m^2	18439	$4.10	$75,599.90
2.2	3b	Soil preparation works to the area currently dominated by higher elevated occurrences of *Juncus acutus* near the southern extent of the site within the area identified for revegetation with salt tolerant species. Supply a 50mm deep layer of organic compost, within the 50mm deep topsoil layer, as prescribed in soil tests. Spread-out compost at required 50mm depth using a bobcat and by hand-raking. Supply and add gypsum @ 400 grams per m^2 with a tractor drawn-spreader. Supply and add fertiliser at 50 grams per m^2 with a	m^2	403	$4.10	$1,652.30

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
		tractor drawn-spreader. Rip and incorporate compost into topsoil using 100-150mm deep tines on the back of a tractor on flat ground or tines on a small excavator on slopes.				
2.3	4b	Supply a 50mm deep layer of organic compost, within the 50mm deep topsoil layer, as prescribed in soil tests. Spread-out compost at required 50mm depth using a bobcat and by hand-raking. Supply and add gypsum @ 400 grams per m^2 with a tractor drawn-spreader. Supply and add fertiliser at 50 grams per m^2 with a tractor drawn-spreader (where possible, manual application may be required where embankment slopes prohibit use of machinery). Rip and incorporate compost into topsoil using 100-150mm deep tines on the back of a tractor on flat ground or tines on a small excavator on slopes.	m^2	298	$4.10	$1,221.80
		Sub Total Soil Preparation Works STAGE 1 (Exc GST)				**$78,474.00**
3	**Mulching Activities**					
3.1	1	Supply and installation of 100mm layer of weed free mulch to 70% of zone 1. Mulch is to be installed to areas beyond the top of the creek bank only. This will suppress weed regrowth, reduce soil water evaporation and provide a soil covering until such time that installed vegetation becomes established.	m^2	2019	$3.80	$7,672.20
3.2	3a	Supply and installation of 100mm layer of weed free mulch. This will suppress weed regrowth, reduce soil water evaporation and provide a soil covering until such time that installed vegetation becomes established.	m^2	18439	$3.80	$70,068.20
3.3	4b	Supply and installation of 100mm layer of weed free mulch. This will suppress weed regrowth, reduce soil water evaporation and provide a soil covering until such time that installed vegetation becomes established.	m^2	298	$3.80	$1,132.40
		Sub Total Mulching Activities STAGE 1 (Exc GST)				**$78,872.80**
4	**Revegetation Activities**					
4.1	ALL	Collection and processing of local seed material for plant propagation.	Plant	377920	$0.05	$18,896.00
4.2	1	Supply and installation of v50 tubestock of RFEF grass and sedge species to be installed at an average density of 8 plants per m^2 to 70% of the zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v50	16145	$2.15	$34,711.75

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
4.3	3a	Supply and installation of v93 tubestock of RFEF tree species within zone 3a as identified in figure 6. Tree species are to be installed at an average density of 1 plant per 16m^2 to the entire zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v93	1148	$2.79	$3,204.71
4.4	3a	Supply and installation of v93 tubestock of RFEF shrub species within zone 3a as identified in figure 6. Shrubs species are to be installed at an average density of 1 plant per 1.44m^2 (i.e. 1200mm spacings) to 50% of the zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v93	6380	$2.79	$17,801.99
4.5	3a	Supply and installation of v50 tubestock of RFEF grass and sedge species within zone 3a as identified in figure 6. Ground layer species are to be installed at an average density of 8 plants per m^2 to 95% of the zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v50	139654	$2.15	$300,254.21
4.6	3b	Supply and installation of v50 tubestock of RFEF sedge species within zone 3b as identified in figure 6. Ground layer species are to be installed at an average density of 8 plants per m^2 over the entire zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v50	24368	$2.15	$52,391.20
4.7	4a	Supply and installation of v50 tubestock of RFEF sedge species in a 3 metre wide edge around the dam within zone 4a as identified in figure 6. Sedges are to be installed at an average density of 8 plants per m^2. Cost per unit includes the supply and installation.	v50	3666	$1.20	$4,399.20
4.8	4b	Supply and installation of v50 tubestock of RFEF sedge species within zone 4b as identified in figure 6. Ground layer species are to be installed at an average density of 8 plants per m^2 over the entire zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v50	2384	$2.15	$5,125.60
Total Number Plants at v50 (note: does not include replacement plants)				186217		
Total Number Plants at v93 (note: does not include replacement plants)				7,528		
Total Number of Plants (note: does not include replacement plants				**193,745**		
Sub Total Revegetation Activities STAGE 1 (Exc GST)						**$436,784.65**

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
5	**Maintenance Activities**					
5.1	1	Maintenance weeding in zone 1 for a period of 24 months after the completion of primary works with an increase in maintenance hours occurring throughout the warmer growing months.	m^2	2883	$3.84	$11,070.72
5.2	1	Allowance to replace 7% of all installed grasses and sedges within zone 1. Includes all associated supply, installation and establishment watering costs.	v50	1131	$2.15	$2,431.65
5.3	2	Maintenance weeding in zone 2 for a period of 24 months after the completion of primary works with an increase in maintenance hours occurring throughout the warmer growing months.	m^2	590	$3.84	$2,265.60
5.4	3a	Maintenance weeding in zone 3a for a period of 24 months after the completion of primary works with an increase in maintenance hours occurring throughout the warmer growing months.	m^2	18439	$3.84	$70,561.38
5.5	3a	Allowance to replace 7% of all installed trees within zone 3a. Includes all associated supply, installation and establishment watering costs.	v93	80	$2.79	$224.99
5.6	3a	Allowance to replace 7% of all installed shrubs within zone 3a. Includes all associated supply, installation and establishment watering costs.	v93	447	$2.79	$1,246.80
5.7	3a	Allowance to replace 7% of all installed grasses and sedges within zone 3a. Includes all associated supply, installation and establishment watering costs.	v50	9976	$2.15	$21,018.74
5.8	3b	Maintenance weeding in zone 3b for a period of 24 months after the completion of primary works with an increase in maintenance hours occurring throughout the warmer growing months.	m^2	3046	$3.84	$11,696.64
5.9	3b	Allowance to replace 7% of all installed sedges within zone 3b. Includes all associated supply, installation and establishment watering costs.	v50	1706	$2.15	$3,667.90
5.10	4a	Maintenance weeding for a period of 24 months after the completion of primary works with an increase in maintenance hours occurring throughout the warmer growing months.	m^2	1159	$1.51	$1,750.09
5.11	4a	Allowance to replace 7% of all installed sedges within zone 4a. Includes all associated supply, installation and establishment watering costs.	v50	257	$1.20	$308.40
5.12	4b	Maintenance weeding for a period of 24 months after the completion of primary works with an increase in maintenance hours occurring throughout the warmer growing months.	m^2	298	$3.84	$1,144.32

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
5.13	4b	Allowance to replace 7% of all installed grasses and sedges within zone 4b. Includes all associated supply, installation and establishment watering costs.	v50	167	$2.15	$359.05
					Sub Total Maintenance Activities STAGE 1 (Exc GST)	**$127,746.28**
					Total Oakdale Central VMP Works STAGE 1 (Exc GST)	$745,828.17
					10% GST	$74,582.82
					Total Oakdale Central VMP Works STAGE 1 (Inc GST)	**$820,410.98**

4.2 Stage 2 Ropes Creek

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
1	**Primary Weeding Activities**					
	3a	Undertaking low volume spot spraying activities using a combination of broadleaf selective and non-selective herbicides to spray exotic grasses from around significant populations of native grass species. Large areas dominated by exotic grasses will be sprayed out using a high volume vehicle mounted spray unit and non-selective glyphosate herbicide. Once dead, targeted grass species will be slashed down in preparation for mulching activities, and given a final follow up spot spray where required to ensure a successful kill rate has been attained.	m^2	19843	$0.56	$11,112.08
2	**Soil Preparation Works**					
	3a	Supply a 50mm deep layer of organic compost, within the 50mm deep topsoil layer, as prescribed in soil tests. Spread-out compost at required 50mm depth using a bobcat and by hand-raking. Supply and add gypsum @ 400 grams per m^2 with a tractor drawn-spreader. Supply and add fertiliser at 50 grams per m^2 with a tractor drawn-spreader. Rip and incorporate compost into topsoil using 100-150mm deep tines on the back of a tractor on flat ground or tines on a small excavator on slopes.	m^2	19843	$4.10	$81,356.30
3	**Mulching Activities**					
	3a	Supply and installation of 100mm layer of weed free to suppress weed regrowth, reduce soil water evaporation and provide a soil covering until such time that installed vegetation becomes established.	m^2	19843	$3.80	$75,403.40

Item No	Zone	Description of Proposed Activity	Unit	Qty	Per unit	Sub Total
4	**Revegetation Activities**					
4.1	3a	Supply and installation of v93 tubestock of RFEF tree species to be installed at an average density of 1 plant per 16m^2 to the entire zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v93	1245	$2.79	$3,471.76
4.2	3a	Supply and installation of v93 tubestock of RFEF shrub species to be installed at an average density of 1 plant per 1.44m^2 (i.e. 1200mm spacings) to 50% of the zone. Cost includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v93	6913	$2.79	$19,285.48
4.3	3a	Supply and installation of v50 tubestock of RFEF grass and sedge species to be installed at an average density of 8 plants per m^2 to 95% of the zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v50	151290	$2.15	$325,275.39
5	**Maintenance Activities**					
5.1	3a	Maintenance weeding in zone 3a for a period of 24 months after the completion of primary works with an increase in maintenance hours occurring throughout the warmer growing months.	m^2	19843	$3.84	$76,441.50
5.2	3a	Replace 7% of all installed trees within zone 3a. Includes all associated supply, installation and establishment watering costs.	v93	88	$2.79	$243.73
5.3	3a	Replace 7% of all installed shrubs within zone 3a. Includes all associated supply, installation and establishment watering costs.	v93	484	$2.79	$1,350.69
5.4	3a	Replace 7% of all installed grasses and sedges within zone 3a. Includes all associated supply, installation and establishment watering costs.	v50	10591	$2.15	$22,770.31
					Total Oakdale Central VMP Works STAGE 2 (Exc GST)	$616,710.65
					10% GST	$61,671.07
					Total Oakdale Central VMP Works STAGE 2 (Inc GST)	**$678,381.72**

Note: the above quantities and cost estimates are based on site conditions and associated assessment of existing riparian condition and requirements in accordance with the objectives specified in this VMP at the time of writing.

The proposed riparian corridor restoration and revegetation works will be staged over a possible four year time frame (refer **Section 1.3**) and the assessed conditions may potentially change over this time frame.

4.3 Subtotals

STAGE 1							
Zone	Plant Procurement	Primary Weeding	Soil Preparation Works	Mulching Activities	Revegetation Activities	Maintenance Activities	Subtotals
All	$18,896.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18,896.00
1		$7,207.50	$0.00	$7,672.20	$34,711.75	$13,502.37	$63,093.82
2		$1,593.00	$0.00	$0.00	$0.00	$2,265.60	$3,858.60
3a		$10,325.84	$75,599.90	$70,068.20	$321,260.90	$93,051.91	$570,306.75
3b		$3,655.20	$1,652.30	$0.00	$52,391.20	$15,364.54	$73,063.24
4a		$811.30	$0.00	$0.00	$4,399.20	$2,058.49	$7,268.99
4b		$357.60	$1,221.80	$1,132.40	$5,125.60	$1,503.37	$9,340.77
	$18,896.00	**$23,950.44**	**$78,474.00**	**$78,872.80**	**$417,888.65**	**$127,746.28**	**$745,828.17**
STAGE 2							
Zone	Plant Procurement	Primary Weeding	Soil Preparation Works	Mulching Activities	Revegetation Activities	Maintenance Activities	Subtotals
3a	$0.00	$11,112.08	$81,356.30	$75,403.40	$348,032.64	$100,806.23	$616,710.65
	$0.00	**$11,112.08**	**$81,356.30**	**$75,403.40**	**$348,032.64**	**$100,806.23**	**$616,710.65**
STAGE 1 & STAGE 2							
STAGE	Plant Procurement	Primary Weeding	Soil Preparation Works	Mulching Activities	Revegetation Activities	Maintenance Activities	Subtotals
1	$18,896.00	$23,950.44	$78,474.00	$78,872.80	$417,888.65	$127,746.28	$745,828.17
2	$0.00	$11,112.08	$81,356.30	$75,403.40	$348,032.64	$100,806.23	$616,710.65
Total	**$18,896.00**	**$35,062.52**	**$159,830.30**	**$154,276.20**	**$765,921.29**	**$228,552.51**	**$1,362,538.82**
						GST	$136,253.88
						Total (incl.GST)	**$1,498,792.70**

5.0 References

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Appendix A

Plant Species Selection

RFEF Plant species that can be used for proposed reconstruction plantings.

All material should be collected from the site or within a 15 Kilometre radius of the site or along similar habitats along Ropes Creek

Plant growth form/genus species	Propagation method	Planting location
Canopy and sub-canopy trees/large shrubs		
Acacia implexa	Seed	CPW
Acacia decurrens	Seed	CPW
Acacia parramattensis	Seed	CPW and RFEF
Angophora floribunda/subvelutina	Seed	RFEF
Casuarina glauca	Seed	RFEF
Eucalyptus amplifolia	Seed	RFEF
Eucalyptus crebra	Seed	CPW
Eucalyptus eugenioides	Seed	CPW
Eucalyptus moluccana	Seed	study site
Eucalyptus tereticornis	Seed	CPW and RFEF
Exocarpus cupressiformis	Seed or cutting	CPW
Melaleuca linariifolia	Seed	RFEF
Melaleuca styphelioides	Seed	CPW and RFEF
Smaller shrubs		
Acacia falcata	Seed	CPW
Acacia floribunda	Seed	RFEF
Breynia oblongifolia	Seed or cutting	CPW and RFEF
Bursaria spinosa	Seed	CPW and RFEF
Clerodendrum tomentosum	Seed	CPW and RFEF
Daviesia genistifolia	Seed	CPW
Daviesia ulicifolia	Seed	CPW
Dillwynia sieberi	Seed	CPW
Dodonaea viscosa spp cuneata	Seed	CPW and RFEF
Goodenia ovata	Seed or cutting	RFEF
Hardenbergia violacea	Seed	CPW
Indigophora australis	Seed	CPW and RFEF
Notelaea longifolia	Seed or cutting	SCRFF
Ozothamnus diosmifolium	Seed	CPW and RFEF
Pultenaea microphylla	Seed	CPW
Rubus parviflorus	Seed or cutting	CPW and RFEF
Broadleaf herbs, grasses and sedges		
Alternanthera denticulata	Seed or cutting	RFEF and Freshwater wetlands
Aristida ramosa or *vagans*	Seed	CPW
Arthropodium spp	Seed or divide tubers	CPW
Bothriochloa decipiens	Seed	CPW and RFEF

Plant growth form/genus species	Propagation method	Planting location
Caesia spp	Seed or divide tubers	CPW
Capillipedium parviflorum	Seed	CPW and RFEF
Centella asiatica	Divide rhizome	CPW and RFEF
Chloris truncata	Seed	CPW
Chloris ventricosa	Seed	CPW and RFEF
Commelina cyanea	Cutting or rhizome	CPW and RFEF
Cyperus gracilis	Seed or rhizome	CPW and RFEF
Danthonia spp (various local native species)	Seed	CPW
Dianella longifolia	Seed	CPW and RFEF
Dianella revoluta	Seed	RFEF
Dicanthium sericeum	Seed	CPW and RFEF
Dichelachne micrantha	Seed	CPW
Dichondra repens	Divide rhizome	CPW and RFEF
Einadia hastata	Seed or cutting	CPW and RFEF
Einadia polygonoides	Seed or cutting	CPW and RFEF
Einadia trigonus	Seed or cutting	CPW and RFEF
Elymus scaber	Seed	CPW and RFEF
Eragrostis leptostachya	Seed	CPW and RFEF
Eriochloa pseudoachritcha	Seed	CPW and RFEF
Eremophila debilis	Seed or cutting	CPW and RFEF
Entolasia marginata	Seed	RFEF
Glycine tabacina	Seed or cutting	CPW and RFEF
Hydrocotyle penduncularis	Divide rhizome	RFEF
Imperata cylindrica	Seed or divide rhizome	CPW and RFEF
Lomandra longifolia	Seed	RFEF
Mentha diemenica	Seed or cutting	CPW
Microlaena stipoides	Seed	CPW and RFEF
Oplismenus imbecillis or *aemulus*	Seed or cutting	RFEF
Poa labillardieri	Seed	CPW and RFEF
Pratia purpurascens	Cutting	RFEF
Ranunculus plebius	Seed	CPW and RFEF
Rumex brownii	Seed	CPW and RFEF
Scaevola albida	Cutting	CPW
Solanum prinophyllum	Seed	CPW and RFEF
Sorghum leiocladum	Seed	CPW and RFEF
Themeda triandra	Seed	CPW and RFEF
Vittadinia spp	Seed or cutting	CPW
Whalenbergia spp	Seed	CPW
Climbers		
Clematis glycinoides	Seed	CPW and RFEF

Plant growth form/genus species	Propagation method	Planting location
Convolvulus erubescens	Seed	CPW and RFEF
Geitonoplesium cynosum	Seed or cutting	RFEF
Polymeria calycina	Seed	RFEF
Wetland Plants		
Alisma-plantago aquatica	Seed	Freshwater wetlands
Baumea articulata	Seed or divide rhizome	Freshwater wetlands
Bolboschoenus caldwelli	Seed or divide rhizome	Freshwater wetlands
Carex appressa	Seed	Freshwater wetlands and RFEF margins
Eleocharis gracilis	Seed or divide rhizome	Freshwater wetlands and RFEF margins
Eleochaeris spachelata	Seed or divide rhizome	Freshwater wetlands
Juncus prismatocarpus	Seed or divide rhizome	Freshwater wetlands
Juncus usitatus	Seed or divide rhizome	Freshwater wetlands and RFEF margins
Ludwigia peploides	Seed, cutting or divide rhizome	Freshwater wetlands and RFEF margins
Marsillea hirsuta	Divide rhizome	Freshwater wetlands
Myriophyllum spp	Seed or divide rhizome	Freshwater wetlands
Nymphoides germinta	Seed or divide rhizome	Freshwater wetlands
Ottelia ovalifolia	Seed	Freshwater wetlands
Paspalum distichum	Seed or divide rhizome	Freshwater wetlands and RFEF margins
Phragmites australis	Seed or divide rhizome	Freshwater wetlands and RFEF margins
Ranunculus inundatus	Seed or divide rhizome	Freshwater wetlands and RFEF margins
Schoenoplectus validus	Seed or divide rhizome	Freshwater wetlands
Triglochin procerum	Seed or divide rhizome	Freshwater wetlands

Swamp Oak Floodplain Forest (SOFF) and Salt Tolerant Plant species that can be used for proposed reconstruction plantings at the southern end of the upper tributary. All material should be collected from the site or within a 15 Kilometre radius of the site or along similar habitats along Ropes Creek

Trees & large shrubs
Casuarina glauca
Melaleuca styphelioides
Smaller shrubs
Indigofera australis
Melaleuca ericifolia
Groundlayer & climbers terrestrial & wetland
Alternanthera denticulata
Atriplex australasica
Atriplex semibaccata
Baumea juncea
Bolboschoenus calwelli
Carex appressa
Commelina cyanea
Centella asiatica
Cynodon dactylon
Einadia hastata
Einadia polygonoides
Einadia trigonus
Hypolepsis muelleri
Imperata cylindrica var. major
Isolepsis inundata
Juncus kraussii subsp. australiensis
Juncus planifolius
Juncus usitatus
Lomandra longifolia
Phragmites australis
Triglochin striatum

Appendix B

Ecohort Investigation Results

Ecohort Investigation Results

Condition Assessment

Alex McCarthy and Edgar Freimanis carried out field investigations of the site during March 2011. During the field investigation phase mapping, field notes, soil samples and photographs were taken on factors relating to the study site. Information recorded during the field investigation phase included comments on:

- The landscape setting and abiotic site observations.
- The floristics of the main plant species present and structure of native and naturalised vegetation associations.
- The influences of various threatening processes on remnant native vegetation, including the resilience and integrity of native vegetation associations at the study site.

Areas within the study site that were in close proximity to one another, and with localised similarities in the following attributes, were grouped and mapped together initially to record the current vegetation and coded management zones, as depicted in Figure 1, using a system similar to that described by Wale (1993):

- The main plant species and associations present and their relevant percentage cover scores.
- Vegetation structure.
- Localized soil landscape, hydrology and landuse conditions.
- Disturbance histories, impacts of threatening processes and management issue.
- Perceived resilience and the integrity of native vegetation associations at each zone by considering the above-factors.
- Perceived responses to appropriate weed control and restoration activities.

Specific data on vegetation within these management zones was compiled by estimating the percentage cover of the dominant and commonly occurring native and naturalised tree, shrub and ground layer plant associations in the field using anecdotal observation using a modified Braun Blanquet scale, similar to that described by McDonald *et al* (1984). The various percentage cover classes of native and naturalised were ranked using the following classes: Very low <5% cover; Low: 6-33% cover; Medium: 34-66% cover; and High: 67%-100% cover. Percentage cover estimates were combined with qualitative and anecdotal site observations and the literature review to formulate descriptions of the native and naturalised vegetation associations throughout the study site. The above field information was gathered by using a ‘random meander’ method similar to that described in Cropper (1993).

Threats

The native vegetation at the study site has been significantly altered by past clearing, soil disturbances, and subsequent weed infestation. Weed associations now occur at varying percentage cover levels over the study area, with most areas being represented by weeds in all habitat niches, previously occupied by native plant species and communities.

Zone Specific Native Vegetation, Naturalised Vegetation and Threatening Process Overviews

The varying landscape settings, structural and floristic associations of the remnant native vegetation and degraded areas supporting naturalised plant associations at the study site were classified into four zones of for vegetation management. These zones are described in **Table 1.**

Also included in **Table 1** are estimates on native plant resilience, the main threatening processes and management issues affecting native vegetation health and structure at each zone. The relative resilience level of each management zone was classified using the following rankings: high; medium to high; medium; low to medium; low; and very low.

Table 1. Descriptions of various management zones at the Oakdale Central project site.

Zone	Photo Example	Description	General Location	Resilience of Native Vegetation	Main Naturalised Plant Associations	Threatening Processes Affecting Native Vegetation
1		Remnant RFEF vegetation dominated by a canopy of *Casuarina glauca*	Located along the middle reaches of the upper tributary within the project site as well as along Ropes Creek	This zone is dominated by a canopy of remnant *Casuarina glauca* within 10 metres of the creek centre line. The shrub layer is absent however native ground layer species particularly *Microlaena stipoides, Clematis glycinoides, Atriplex spp.* and *Einadia spp* are present with an estimated coverage of up to 30% within the remnants.	The upper tributary remnants contain moderate to high % cover of *Juncus acutus* within the channel, dominating the stratum layer. There is a noticeable absence of the species along the Ropes Creek tributary downstream of a small dam located near the south-western boundary of the project area. Away from the drainage channel, exotic grasses dominate much of the ground layer with Paspalum, Rhodes Grass and Kikuyu. The only significant shrub layer species within the upper tributary remnant are scattered occurrences of African Boxthorn.	Remnants of RFEF vegetation within the project area are small and fragmented. Past and present land uses has resulted in the clearing of neighbouring vegetation, disturbance and compaction of soils and the encroachment of pasture grasses of exotic sedges, all of which have put pressures on the ability for the remnant to regenerate and expand.
2		Native wetland vegetation dominated by *Typha orientalis* and *Phragmites australis*	This zone is primarily located on the upper tributary just south of the dam.	The main characteristic of this zone is the presences of significant populations of *Phragmites australis* and *Typha orientalis*. Combined with *Paspalum distichum,* and *Juncus usitatus* which becomes dominate on the western boundary of the zone, the % coverage of native vegetation within this zone is high (>70%).	Given the density in which the native plant species occur within this zone, exotic plant species are limited to the boundaries. Exotic pasture grasses encroach into the zone with some small individual occurrences of blackberry sited.	Like other areas of the project area, this zone has been subjected to land clearing and grazing pressures in the past, however the density of the native vegetation in this zone has been largely successful in preventing the encroachment of exotic plant species, with exception to the zone boundaries.

Zone	Photo Example	Description	General Location	Resilience of Native Vegetation	Main Naturalised Plant Associations	Threatening Processes Affecting Native Vegetation
3a		Areas dominated by exotic pasture grasses	All terrestrial areas of the riparian corridor with the exception of the native remnants outlined above in zones 1 and 2.	Some smaller populations of native grasses are present within this zone however most occurrences were identified within the Ropes Creek channel which at the present time is still subjected to grazing (see photo example). Species identified include *Microlaena stipoides*, *Themeda australis*, *Chloris ventricose*, *Austrodanthonia spp*, representing the <5% coverage of natives	The primary characteristic of this management zone is the high % coverage of exotic pasture grasses from past and current land use activities. A mix of paspalum and couch dominate much of the zone, with large populations of Rhodes Grass, Kikuyu and *Briza minor* also observed.	Areas falling within this management zone are currently indistinguishable from adjoining areas of the same elevation beyond the riparian corridor. Past land clearing as well historical (biodiversity lots A & B) and current (biodiversity lots C) stock grazing combined with the density of the exotic ground covers has limited the opportunities for native RFEF vegetation to regenerate.
3b		Creekline areas dominated by exotic sedge species in particularly *Juncus acutus*.	All creekline channel areas dominated by exotic wetland plant species and therefore not included within zone 1 or 2 areas described above.	Despite the main characteristic of this management zone being the dominance of exotic vegetation, *Phragmites australis* is present amongst the dominating exotic *Juncus acutus*. Populations of *Microlaena stipoides* and *Imperata cylindrica* are present along the outer extent of this zone however their coverage represents < 5% of the total 3b zone area.	As the zone description outlines, *Juncus acutus* is the dominate naturalised plant species within this zone forming a dense coverage over in excess of 90% of the total zone area. A single mature Pampas Grass is also present within the adjoining road easement at the southern extent of the upper tributary within biodiversity lot A.	Soil tests have identified the area within zone 3b as having high levels of salinity. The high salt levels combined with the density of the *Juncus acutus* (a prolific seeder), has limited the ability for native vegetation to re-establish and compete.

Table 1. Management Zone Descriptions

Zone	Photo Example	Description	General Location	Resilience of Native Vegetation	Main Naturalised Plant Associations	Threatening Processes Affecting Native Vegetation
4a		Offline dam supporting a mix of native and exotic wetland plant species.	The offline dam is located at the northern extent of the upper tributary, just east of the creekline in biodiversity lot B.	*Typha orientalis* represents the dominate native plant species around the offline dam, colonising most of the dam's perimeter. Water couch (*Paspalum distichum*) has colonised the waters edge, particularly along the western boundary of the dam, adjoining the dam wall.	*Juncus acutus* appears to be largely limited to the lower elevated areas of the dam wall with exotic grasses particularly paspalum, Rhodes grass and couch dominating the dam wall itself.	Native vegetation dominates this zone with the occurrences of the exotic wetland species which dominate other zones largely absence due to the offline nature of this waterbody. This fragmentation from remnant vegetation and the dominance of the Typha has also provided competition.
4b		Offline dam wall currently dominated by exotic pasture grasses.				

Table 1. Management Zone Descriptions

ZONE 1: 2,883msq remnant RFEF vegetation dominated by a canopy of *Casuarina glauca* within 10m of the creek centre line. Native ground covers also present across approx 30% of the zone.

ZONE 2: 590msq of native wetland vegetation (>70%) dominated by *Typha orientalis* and *Phragmites australis*.

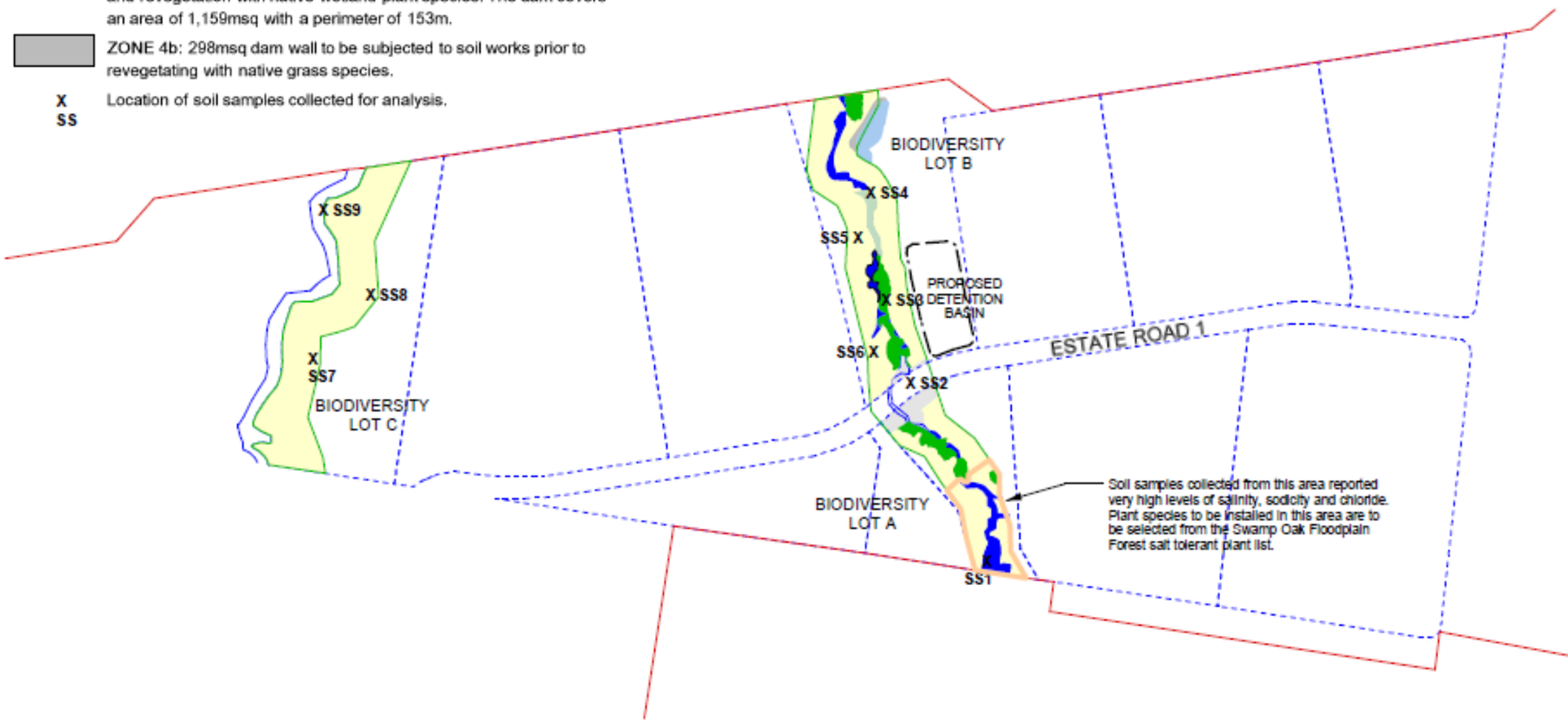
ZONE 3a: 38,282msq area dominated by exotic pasture grasses. Native groundlayer species are also present but represent <5% of the zone.

ZONE 3b: 3,046msq of creekline areas dominated by exotic sedge species in particularly *Juncus acutus*. Native groundlayer species are present on zone boundary but represent <5% of the zone.

ZONE 4a: Offline dam to be subjected to primary weeding activities and revegetation with native wetland plant species. The dam covers an area of 1,159msq with a perimeter of 153m.

ZONE 4b: 298msq dam wall to be subjected to soil works prior to revegetating with native grass species.

X SS — Location of soil samples collected for analysis.



EcoHort Pty Ltd
www.bushregenerators.com

FIGURE 1

OAKDALE CENTRAL, HORSLEY PARK

VEGETATION MANAGEMENT PLAN MANAGEMENT ZONES

DATE DRAWN: 29 MARCH 2011

0 100 200 300 m

Detailed Planting Regimes

Replanting Plants from Tree and Shrub Structural Layers

Areas where no native plants persist will have to be planted-out to reconstruct the tree and shrub layers using local native plant material.

Generally shrubs and climbers are to be planted at 1200mm spacings (at is 1 plant per 1.44 m^2), and trees at a rate of 1 plant per 16m^2, i.e. at 4 metre spacings. Sedges and grasses are to be installed at a density of 8 plants per metre squared. Trees, shrubs and climbers species to be installed are to be supplied in V93 containers with grasses and sedges supplied as V50 cells.

All naturalised plants in these designated cell-grown seedling planting sites should be treated to a slashing treatment followed-up by treatments with a non-selective herbicide spray to attain 100% kill of all weeds prior to any further soil preparation, mulching, jute/coconut fibre matting, direct seeding or planting. It may be necessary to treat herbaceous weeds to an additional non-selective weed treatment to ensure that all naturalised plants are eradicated.

Maintenance of Reconstruction Areas

After planting and native grass seeding and translocation works have been completed, treated areas should be maintained by appropriately qualified people, selectively spot spraying and hand weeding around native plants, watering plants and replacing dead plants as needed.

Provision should be made to irrigate newly reconstructed areas, as required, in the first 3 months after installation, (on at least 4-5 occasions, depending on rainfall conditions, more waterings if required). The Contractor is to be responsible for securing an appropriate water source for this purpose. On the provision that a licence in attained, this may involve pumping water for irrigation purposes directly from Ropes Creek.

Re-growing environmental weeds such as vines, woody trees and shrubs, broadleaf annuals and naturalised grasses should be closely monitored and controlled using ecologically sensitive bushland regeneration hand weeding and spot-spraying methods, to ensure adequate weed control and native plant establishment.

Plants that have died due to drought, flood damage, vandalism or pest and disease damage should be replaced as required.

Soil Preparation Works

Subject to the findings of soil testing undertaken within the riparian corridor at the study site, it is recommended that soil preparation works are undertaken in zones 1, 3a, 3b and 4b prior revegetation activities. This includes the laying of a 50mm layer of organic compost, 50mm layer of topsoil, gypsum at 400g/m^2 and fertiliser at 50g/m^2, and then ripping and incorporating the compost into the topsoil.

Table 2: Location of soil samples collected from the Oakdale Central project site, and a summary of the findings of soil testing. Full reports on the results of soil testing are located in **Appendix C**.

ID	Location Description	Key Observations	Corrective Actions
SS1	Western side of upper tributary in the middle of a large infestation of *Juncus acutus.*	- Very strong alkalinity - Salinity, sodicity and chloride very high - The effective cation exchange capacity of this material is high which is typical in soils with a high fines content (silt + clay) - Calcium magnesium ratio very low and magnesic - Organic carbon (0.2%) and organic matter (0.4%) are very low - Nutrients: nitrate, phosphate, potassium and zinc all very low, rest adequate and manganese high	This area has severe alkalinity, salinity and sodicity and will not be suitable for planting, it is suggested to either bury this layer at least 1m deep or remove and replace. Alternatively, revegetate with salt tolerant plant species
SS2	Western side of upper tributary 18m from creek edge. Located on the top of the bank in paspalum and couch paddock. Approx 10-15m east of African Boxthorn and *Casuarina glauca* corridor.	- pH neutral and low salinity which is desirable - Moderate sodicity - Low effective cation exchange capacity indicating a poor ability to hold and retain nutrients - Calcium magnesium ratio low and magnesic - Organic carbon (0.2%) and organic matter (0.4%) are very low - Low nutrients except for iron (adequate) and manganese (high)	The addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation. Gypsum at 300g/sqm will bring up the calcium levels and additional organic matter will create a better structured soil and increase water holding capacity. This can be done by using compost, biosoilds or green manure
SS3	Amongst Casuarina glauca regrowth on the top of the eastern bank of the upper tributary. Located next to African Boxthorn, in Microlaena, couch and paspalum.	- pH has a slight acidity, salinity and sodicity low - Effective cation exchange capacity moderate which indicates a good nutrient retention capacity - Calcium magnesium ratio is low and magnesic - Organic carbon (0.2%) and organic matter (0.4%) are very low - Low nutrients except for iron (adequate) and manganese (high)	The addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation. Organic matter needs to be increased to bring up the levels and this can be achieved by the addition of a compost, biosolids or green manure. Gypsum at 200g/sqm will improve calcium levels
SS4	Eastern side of the upper tributary upstream of the road crossing which adjoins a significant patch of Typha. Located in couch and paspalum pasture.	- Slight alkalinity in pH - Moderate salinity and sodicity, with high sodium levels - Moderate effective cation exchange capacity with low calcium magnesium ratio (magnesic) - Organic carbon (0.2%) and organic matter (0.4%) are very low - High iron and manganese suggest possible water logging - Nitrate, phosphate and potassium nil to very low levels	The addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation. Organic matter needs to be increased to bring up levels and improve structure. This can be achieved by the addition of a compost, biosolids or green manure. Gypsum at 200g/sqm will improve calcium levels and displace sodium levels.

ID	Location Description	Key Observations	Corrective Actions
SS5	Western side of upper tributary upstream of the road crossing which adjoins a significant patch of Typha. Located in couch and paspalum pasture approx 8m from the edge of the Typha.	- pH slight acidity and low salinity desirable by native plant species - Moderate sodicity and high sodium levels - Moderate effective cation exchange capacity indicating a good nutrient retention capacity - Organic carbon (0.2%) and organic matter (0.4%) are very low - Nitrate, phosphate, potassium, sulphur and boron low	The addition of a well balanced NPK fertiliser at 50g/sqm will help improve nutrients for revegetation. Organic matter needs to be increased by the addition of compost, biosolids or green manure to bring up the levels and improve structure. Gypsum at 200g/sqm will improve calcium levels and displace sodium levels.
SS6	Western side of the upper tributary 19 metres from the creek bank. Located in pasture supporting approx 90% paspalum and 10% Microlaena.	- pH slight acidity, low salinity and sodicity which is desirable by native plant species - Moderate effective cation exchange capacity indicating a good nutrient retention capacity - Very low calcium magnesium ratio (magnesic) - Organic carbon (0.2%) and organic matter (0.4%) are very low - Nitrate, phosphate, potassium, sulphur and boron low - Manganese is high and zinc adequate to high range	The addition of a well balanced NPK fertiliser at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 200g/sqm and lime at 100g/sqm will improve calcium levels, neutralise aluminium and hydrogen and increase the pH. Organic matter needs to be increased by using a compost, biosolids or green manure.
SS7	Located within the Ropes Creek corridor in heavily grazed pasture dominated by couch and paspalum, approx 15m from the edge of the Casuarina glauca canopy. Sample collected approx 15m north of the access road over Ropes Creek.	- Manganese is high and zinc adequate to high range - pH medium acidity, salinity and sodicity are low which is desirable - Effective cation exchange capacity is low indicating a poor ability to hold and retain nutrients - Calcium magnesium ratio low (magnesic) and high exchangeable acidity (hydrogen) - Organic carbon (1.7%) and organic matter (3.7%) are moderate - Nitrate, phosphate, potassium, sulphur and boron low	The addition of a well balanced NPK fertiliser at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 300g/sqm and lime at 200g/sqm will improve calcium levels, neutralise aluminium and hydrogen, displace sodium levels and increase the pH. Organic matter needs to be increased to bring up the levels and improve structure. This can be done by using compost, biosolids or green manure.
SS8	On Ropes Creek just on the edge of the Casuarina glauca tree line near the top of the bank. Heavily grazed pasture supporting Microlaena, couch and paspalum with Casuarina mulch.	- pH medium acidity and salinity low which is desirable for native plant species - Moderate effective cation exchange capacity indicating a good nutrient retention capacity - Calcium magnesium ratio low (magnesic) and high exchangeable acidity (hydrogen) - Organic carbon (1.2%) and organic matter (2.6%) are low - Phosphate, potassium and boron very low, nitrate, sulphate and iron marginal, manganese high	The addition of a well balanced NPK fertiliser at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 200g/sqm will improve calcium levels and increase the pH. Organic matter needs to be increased to bring up the levels and improve structure. This can be achieved by using compost, biosolids or green manure.

ID	Location Description	Key Observations	Corrective Actions
SS9	40 metres from the Ropes Creek centre line in line with a small Eucalypt, next to a mature Melaleuca in the paddock. Pasture heavily grazed and supporting crabgrass, couch and paspalum.	- pH has a slight acidity, low salinity and moderate sodicity (high sodium) - Effective cation exchange capacity is low indicating a poor ability to hold and retain nutrients - Calcium magnesium ratio low (magnesic) - Organic carbon (1.1%) and organic matter (2.4%) are low - Nitrate, phosphate, potassium , sulphate and boron low	The addition of a well balanced NPK fertiliser at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 200g/sqm will improve calcium levels and displace sodium levels. Organic matter needs to be increased by the addition of compost, biosolids or a green manure to bring up the levels and improve structure.

Proposed Bushland Regeneration Works

Aims and Summary of Proposed Bushland Regeneration Works

The aims of the proposed bushland regeneration program are to achieve the following performance based outcomes, using a range of integrated best practice techniques:

- Control threats, affecting the health of remnant RFEF inhibiting the regeneration potential of these plant communities.
- Increase species diversity and percentage cover of RFEF plant species throughout designated bushland areas within the study site.
- Make the RFEF bushland areas more resistant to future weed colonization and establishment related threats, by affecting the two above aims.
- Working towards adequately resourcing vegetation restoration works at the Oakdale Central project site.
- Use measurable indicators to monitor the progress and success of bush regeneration works.

Proposed bushland regeneration works should be approached using the strategies outlined in the VMP.

Consideration should be given to implementing supplementary planting or seeding if natural regeneration does not occur at anticipated levels in low resilience parts of the designated zones. Also the extent of mulching in low resilience parts of the site should be limited so that any potential natural regeneration in not inhibited in these areas, (should supplementary planting and mulching be deemed necessary in such areas).

Primary Weeding

Primary weeding is the first stage of bushland regeneration. Primary weeding may involve techniques such as: the selective spraying of weeds with herbicides; cutting/scraping and painting deep rooted woody weeds and climbers with hand tools, chainsaws and brushcutters and painting cut stumps with herbicide; target drilling and injecting certain large tree weeds such as willow and privet with herbicides such as Glyphosate and a garlon/diesel mix; and selective hand removal of weeds.

Damage to native plant species should be avoided during any bush regeneration weeding works. All seed, flowering and invasive vegetative parts of weeds should be bagged and disposed of site in an appropriate green waste recycling facility.

Primary weeding is required in all zones of the Oakdale Central site. Initial weeding of woody and noxious weeds should be undertaken across all management zones during year 1. It would be expected that maintenance weeding would be required between 2 and 4 months following the completion of primary weeding, and continue for a period of 2 years as outlined in the costing table included the VMP.

Mulch that may be produced from any woody weed material that is chipped during the primary weeding process should in general not be placed in parts of the site where it is intended to promote natural regeneration to ensure that the regeneration process is not inhibited.

Follow up Weeding

Follow-up weeding should be undertaken in areas that have received past primary weeding treatments. Follow-up weeding involves the selective removal or treatment of weeds, whilst allowing regenerating or planted native plants to increase in size, abundance and percentage cover. All weeds should be targeted during the follow up weeding phase. The follow-up bushland regeneration works are likely to be required at least every 2-4 months at a site until weeds are at negligible levels.

It is recommended that woody weeds, climbers and key herbaceous weeds are subject to a program of intense follow up weeding, around any patches of regenerating native herbaceous plants, to encourage the spread of these desirable native plant species for a minimum period of 2-years after primary weeding works are completed.

Maintenance Weeding

Maintenance weeding is undertaken in areas where native plant regeneration has significantly progressed to the stage where native plants occur at high percentage cover levels.

It can be expected that the bushland areas at the study site will always require a certain level of bushland regeneration maintenance weeding, as weed seeds and vegetative propagules make their way on site from the soil stored seedbank, and via wind and bird droppings. However, it can be expected that, the amount of weeding required will decrease once the regenerating native plants grow, recover and become more resistant to disturbance and weed colonisation.

All herbaceous weeds should be managed to be at very-low percentage cover levels, (as a minimum), or better. Particularly problematic herbaceous weeds with wind blown seeds should be prevented from seeding at all times throughout the site.

Pasture grasses should be prevented from spreading into any bushland zones by applying a spot glyphosate herbicide spray application on the 1-metre wide buffer zone, on a monthly basis or as required.

Adaptive management/restoration practices should be adopted if any of the recommended actions do not lead to expected levels of native plant species regeneration.

Aims and Summary of Proposed Bushland Reconstruction Works

The aims of the bushland reconstruction strategies at the site are to achieve the following performance based outcomes, using a range of integrated best practice techniques:

- Decrease the extent of weed competition and other RFEF degrading threats in defined localised zones.
- Strengthen currently degraded, resilience depleted areas against future weed colonization and establishment related threats by reconstructing a competitive and potentially diverse range of native plant species and associations from all structural layers of the RFEF, using a variety of specified revegetation treatments.
- Reconstructing certain structural elements within core bushland areas, in instances where local native plants from these structural layers are unlikely to regenerate naturally, using prescribed techniques, (e.g. high density groundlayer plantings within the immediate drainage line channels).
- A variety of reconstruction strategies that involve the re-planting of local RFEF plant species should be implemented. These include reconstructing plants from tree, shrub and ground structural layers throughout areas with depleted native plant resilience as appropriate.
- Use measurable indicators to monitor the progress and success of Bushland Reconstruction works in the designated management zones and to assist in prioritising bushland reconstruction works during the proposed works program. These indicators include:
    - A revegetation success rate of between 90-100%. Provision has been made for a 10% plant replacement component in this VMP, however this may need to be adjusted to reach the prescribed 90-100% revegetation success rates.
    - An 80-100% reduction in weed cover within all revegetation zones.

Recommended reconstruction strategies in the above-outlined zones should include:

- Initial and ongoing control of weeds using bushland regeneration techniques and conventional best practice chemical and physical strategies.

- Specifically collecting local plant seed and vegetative material and the subsequent propagation of local native plant material in cell-grown seedling containers and for direct seeding of native grasses and forbs.
- Installing suitable propagated cell-grown seedlings, using specified techniques, species composition schedules and rates.
- Stabilising soils and suppressing weeds around reconstruction planting areas using products, such as jute/coconut fibre mats and mulch.
- Maintaining reconstruction treatments (including watering, weeding, replacing dead plant material and repairing / replacing weed mat/mulch), as a part of an ongoing maintenance program.

Selection of Suitable Species for Reconstruction Treatments

Local native RFEF plant species should be used for all proposed reconstruction planting works. This material should be collected using principles prescribed in the recently published *'Bringing the Bush back to Western Sydney'* document (DWE 2003). Seeds and vegetative propagules are to be of local providence collected from the local area within the Fairfield and adjoining LGA's up to 15km from the study site.

Trees, shrubs, broadleaf herbs, grasses and sedges from the RFEF plant communities should be used in all proposed bushland reconstruction plantings (and supplementary seeding works), using schedules and densities outlined in other parts of this report and the VMP. **Appendix A** provides RFEF and SOFF plant species proposed for procurement and revegetation.

Given the results of Soil Sample 1 as outlined in **Table 2,** and the presence of very strong alkaline and very high saline soils, a second plant list outlining more salt tolerant plant species found in saline Swamp Oak Floodplain Forest (SOFF) but also common to the River-Flat Eucalypt Forest (RFEF) Ecological Community has been included in **Appendix A**.

The salt tolerant plant species included in **Appendix A** was compiled from recommendations published in the Department of Infrastructure, Planning and Natural Resources "Salinity Indicator Plants" (2005), a species list of Cumberland Plain Salt Tolerant Species included in Camden Council Development Control Plan No.124 Elderslie Release Area (2006), and following communications and subsequent recommendations from a representative of Sydney Environmental and Soil Laboratory (T. Carroll-McDonald, pers. Comm., 4 Apr) who undertook the soil testing at the study site. The extent of salt tolerant revegetation activities is shown in **Figure 1.**

Collection and Plant production Procedures for Plant Material for Proposed Reconstruction Treatments

Prior to the initiation of bushland reconstruction works it will be necessary to collect or source suitable quantities of local native seed and vegetative material, to ensure suitable numbers of local provenance RFEF seed and vegetative material stocks are available for the plant propagation phase of the proposed bushland reconstruction works program. Local native plants should be grown-on in "hiko" tube, maxi cell or viro-tube, or Forestry Tube-type containers.

Seed and vegetative material collection programs should be implemented using techniques and principles outlined in the "Florabank Guidelines" and by DWE (2003). It may be necessary to get the required amounts of seed and vegetative material contract collected and grown-on by specialist nurseries.

Containerised Plant Installation Considerations

- Planted material should be installed as per recommended plant densities and species mixes and maintained to ensure maximum survival.
- To reduce initial water stress to newly planted cell-grown seedlings, it is recommended that mulch and water retention crystals are applied at planting.
- The addition of slow release, low phosphorous fertiliser at planting may also assist in promoting rapid growth during the establishment period.
- Planted and seeded areas should be maintained by appropriately qualified people selectively spot spraying and hand weeding weeds from around native plants, watering plants as needed and replacing dead plants as required. Plants that have died due to drought, flooding, vandalism or pest and disease should be replaced with appropriate stock, when available.

Detailed Planting Regimes

Replanting Plants from Tree and Shrub Structural Layers

Areas where no native plants persist will have to be planted-out to reconstruct the tree and shrub layers using local native plant material.

Generally shrubs and climbers are to be planted at 1200mm spacings (at is 1 plant per 1.44 m^2), and trees at a rate of 1 plant per 16m^2, i.e. at 4 metre spacings. Sedges and grasses are to be installed at a density of 8 plants per metre squared. Trees, shrubs and climbers species to be installed are to be supplied in V93 containers with grasses and sedges supplied as V50 cells.

All naturalised plants in these designated cell-grown seedling planting sites should be treated to a slashing treatment followed-up by treatments with a non-selective herbicide spray to attain 100% kill of all weeds prior to any further soil preparation, mulching, jute/coconut fibre matting, direct seeding or planting. It may be necessary to treat herbaceous weeds to an additional non-selective weed treatment to ensure that all naturalised plants are eradicated.

Maintenance of Reconstruction Areas

After planting and native grass seeding and translocation works have been completed, treated areas should be maintained by appropriately qualified people, selectively spot spraying and hand weeding around native plants, watering plants and replacing dead plants as needed.

Provision should be made to irrigate newly reconstructed areas, as required, in the first 3 months after installation, (on at least 4-5 occasions, depending on rainfall conditions, more waterings if required). The Contractor is to be responsible for securing an appropriate water source for this purpose. On the provision that a licence in attained, this may involve pumping water for irrigation purposes directly from Ropes Creek.

Re-growing environmental weeds such as vines, woody trees and shrubs, broadleaf annuals and naturalised grasses should be closely monitored and controlled using ecologically sensitive bushland regeneration hand weeding and spot-spraying methods, to ensure adequate weed control and native plant establishment.

Plants that have died due to drought, flood damage, vandalism or pest and disease damage should be replaced as required.

Soil Preparation Works

Subject to the findings of soil testing undertaken within the riparian corridor at the study site, it is recommended that soil preparation works are undertaken in zones 1, 3a, 3b and 4b prior revegetation activities. This includes the laying of a 50mm layer of organic compost, 50mm layer of topsoil, gypsum at 400g/m^2 and fertiliser at 50g/m^2, and then ripping and incorporating the compost into the topsoil.

Table 3: outlines the general restoration treatments recommended for each management zone within the Oakdale Central project area.

Zone	Description	Treatment
1	Remnant RFEF vegetation dominated by a canopy of *Casuarina glauca*	- Hand removal of scattered African Boxthorn using cut/scrap and paint techniques. - Chipping up of woody weeds and removal of green waste. - Hand weeding around non-target native plant species in preparation for spraying activities. - Slashing of *Juncus acutus* followed by non-selective spot spraying of slashed Juncus and exotic groundlayer species. - Supply and spread 50mm layer of organic compost within 50mm layer of topsoil. Add 400g/m2 gypsum and 50g/m2 of fertiliser with a tractor drawn spreader. - Rip and incorporate compost into topsoil using a tractor or small excavator - Spreading of a 100mm layer of weed free mulch to areas beyond the top of the creek bank. - Installation of local RFEF grasses, sedges and ground cover species to lower resilience areas (approx. 70% of the zone area) in V50 containers at a density of 8 plants per m^2. - Follow up maintenance of the zone for 2 years.
2	Native wetland vegetation dominated by *Typha orientalis* and *Phragmites australis*	- Combination of low volume spot spraying using a non-selective glyphosate herbicide and hand weeding to removal occurrences of herbaceous weeds in close proximity to native plant species. - Removal of green waste. - Follow up maintenance of the zone for 2 years.
3a	Areas dominated by exotic pasture grasses	- Use of selective and non-selective herbicides to undertake low volume spot spraying around significant populations of native grass species. - Targeting of remaining large areas dominated by exotic grasses using a non-selective glyphosate solution and a vehicle mounted spray unit. - Slashing down of dead plant material. - Follow up spraying of previously treated exotic grasses to ensure successful kill. - Supply and spread 50mm layer of organic compost within 50mm layer of topsoil. Add 400g/m2 gypsum and 50g/m2 of fertiliser with a tractor drawn spreader. - Rip and incorporate compost into topsoil using a tractor or small excavator - Spreading of a 100mm layer of weed free mulch. - Installation of local RFEF trees, shrubs and ground cover species. Trees and shrubs are to be supplied in V93 containers, with grasses and ground covers in V50 containers. Trees are to be installed at a density of 1 plant per $16m^2$ (i.e. at 4 metre centres) over the entire zone. Shrubs are to be installed at a density of 1 plant per $1.44m^2$ (i.e. 1200mm centres) over 50% of the zone. Grasses and ground cover species are to be installed at a density of 8 plants per m^2 over 95% of the zone. - Follow up maintenance of the zone for 2 years.

Zone	Description	Treatment
3b	Creekline areas dominated by exotic sedge species in particularly *Juncus acutus*.	- Slashing of *Juncus acutus* using a tractor - Spraying of Juncus using a non-selective glyphosate herbicide - Supply and spread 50mm layer of organic compost within 50mm layer of topsoil. Add 400g/m2 gypsum and 50g/m2 of fertiliser with a tractor drawn spreader. - Rip and incorporate compost into topsoil using a tractor or small excavator - Installation of local RFEF sedge species to be supplied in V50 containers at a density of 8 plants per m^2 over the entire zone. - Follow up maintenance of the zone for 2 years.
4a	Offline dam supporting a mix of native and exotic wetland plant species.	- Combination of low volume spot spraying using a non-selective glyphosate herbicide and hand weeding to removal occurrences of herbaceous weeds in close proximity to native plant species. - Installation of local RFEF sedge species to be supplied in V50 containers at a density of 8 plants per m^2 around the edge of the dam to a n average width of 3 metres. - Follow up maintenance of the zone for 2 years.
4b	Offline dam wall currently dominated by exotic pasture grasses.	- Use of selective herbicide to spot spray occurrences of blackberry at the northern extent of the zone. - Slashing of *Juncus acutus* using brushcutters - Use of non-selective glyphosate herbicide to spray out exotic grasses and Juncus located on the dam wall. - Slashing down of dead material prior to soil works. - Follow up spot spray of any remaining exotic vegetation. - Supply and spread 50mm layer of organic compost within 50mm layer of topsoil. Add 400g/m2 gypsum and 50g/m2 of fertiliser with a tractor drawn spreader. - Rip and incorporate compost into topsoil using a tractor or small excavator - Spreading of a 100mm layer of weed free mulch - Installation of local RFEF sedge and grass species to be supplied in V50 containers at a density of 8 plants per m^2 throughout the zone. - Follow up maintenance of the zone for 2 years.

Appendix C

Soil Laboratory Result

Sydney Environmental and Soil Laboratory

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 106 810 708

Sample Drop Off: 16 Chivers Road Thornleigh NSW 2120 Australia

Mailing Address: PO Box 357 Pennant Hills NSW 1715

Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **1** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration	
Client Contact:	Ed Freimanis	Location:	Ropes Creek	
Client Job N°:		SESL Quote N°:		Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 1	
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil	
		Test Type:	FSC (M3), OC-DC	

RECOMMENDATIONS

Key Observations

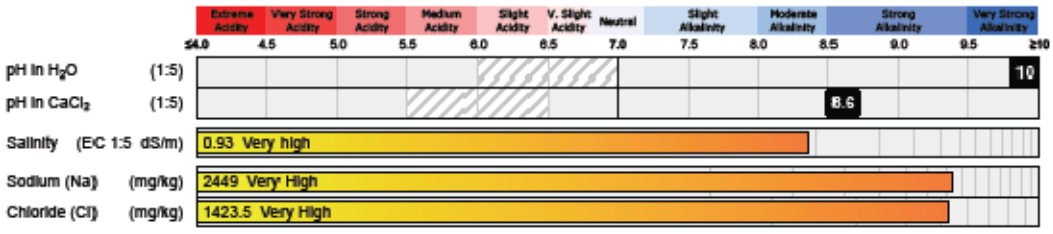
- Very strong alkalinity
- Salinity, sodicity and chloride very high
- The effective cation exchange capacity of this material is high which is typical in soils with a high fines content (silt+ clay)
- Calcium magnesium ratio very low and magnesic
- Organic carbon (0.2%) and organic matter (0.4%) are very low
- Nutrients: nitrate, phosphate, potassium and zinc all very low, rest adequate and manganese high

Corrective Actions

This area has severe alkalinity, salinity and sodicity and will not be suitable for planting, it is suggested to either bury this layer at least 1m deep or remove and replace.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ○ Moderate ◉ High

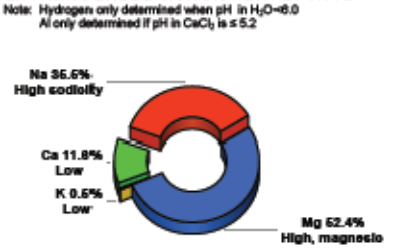
pH and ELECTRICAL CONDUCTIVITY



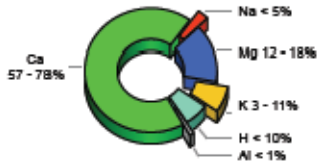
CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<8.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL



IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.2	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	98.3	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.01	< 0.07
Comment: Acceptable		
K:Na	0	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI):
0.03 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessment

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

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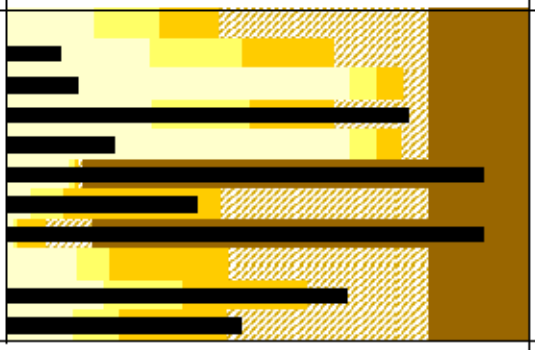
Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **1** Report Status: ○ Draft ◉ **Final**

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	<0.05	<0.3	10	9.7
Phosphate-P (PO_4)	7.7	1.5	12.6	11.1
Potassium (K)	62.8	12.5	77.4	64.9
Sulphate-S (SO_4)	65	13	13.6	.6
Calcium (Ca)	698	139.3	551.2	411.9
Magnesium (Mg)	1902	379.4	57.7	Drawdown
Iron (Fe)	249	49.7	110.1	60.4
Manganese (Mn)	256	51.1	8.8	Drawdown
Zinc (Zn)	<0.65	0.1	1	.9
Copper (Cu)	5.1	1	1.3	.3
Boron (B)	1.5	0.3	0.5	.2



Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >60%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

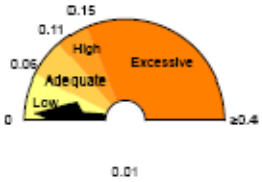
High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

- g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely..

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (meq/100g^{-1}):	30
Eff. Cation Exch. Capacity (eCEC):	30
Base Saturation (%):	100
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	0
– to neutralise Al (g/sqm):	-

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm):	2878

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	0.2 – Very low
Organic Matter (OM%):	0.4

Additional comments:

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7D1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Page 2 of 2

Sydney Environmental and Soil Laboratory

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

Mailing Address: PO Box 357 Pennant Hills NSW 1715

Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: **17682** Sample N°: **2** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration	
Client Contact:	Ed Freimanis	Location:	Ropes Creek	
Client Job N°:		SESL Quote N°:		Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 2	
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil	
		Test Type:	FSC (M3), OC-DC	

RECOMMENDATIONS

Key Observations

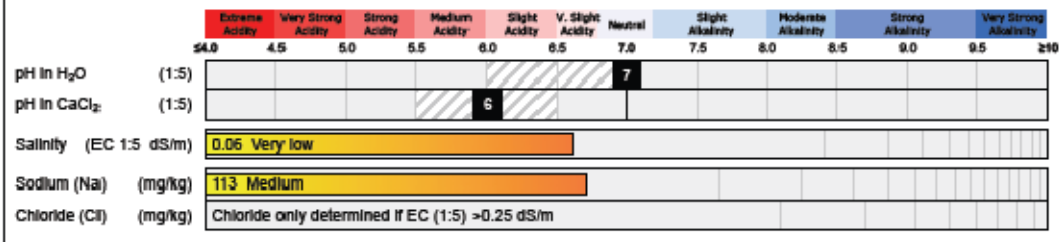
- pH neutral and low salinity which is desirable
- Moderate sodicity
- Low effective cation exchange capacity indicating a poor ability to hold and retain nutrients
- Calcium magnesium ratio low and magnesic
- Organic carbon (0.2%) and organic matter (0.4%) are very low
- Low nutrients except for iron (adequate) and manganese (high)

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 300g/sqm will bring up the calcium levels and additional organic matter will create a better structured soil and increase water holding capacity. This can be done by using compost, biosolids or green manure.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ◉ Low ○ Moderate ○ High

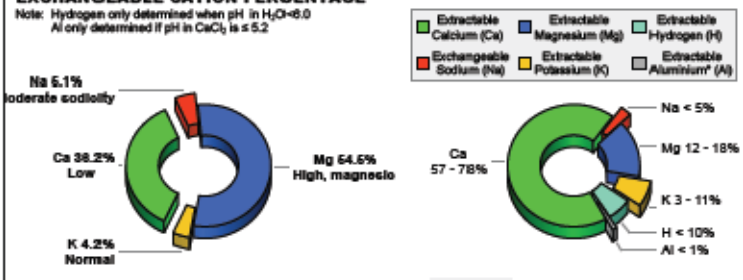
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.7	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	12.9	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.05	< 0.07
Comment: Acceptable		
K:Na	0.8	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI): 0.01 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessment

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

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Em: info@sesl.com.au
Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **2** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	<0.05		<0.3	4.2	3.9
Phosphate-P (PO_4)	4.4		0.9	12.6	11.7
Potassium (K)	158		31.5	43.9	12.4
Sulphate-S (SO_4)	17		3.4	13.6	10.2
Calcium (Ca)	701		139.8	312.4	172.6
Magnesium (Mg)	640		127.7	32.5	Drawdown
Iron (Fe)	366		73	110.1	37.1
Manganese (Mn)	79		15.8	8.8	Drawdown
Zinc (Zn)	1.7		0.3	1	.7
Copper (Cu)	2.5		0.5	1.3	.8
Boron (B)	0.4		0.1	0.5	.4

Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

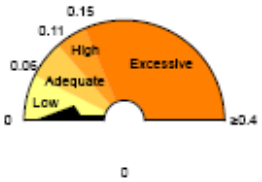
High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



0

Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (meq/100g^{-1}):	9.7
Eff. Cation Exch. Capacity (eCEC):	9.7
Base Saturation (%):	100
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	0
– to neutralise Al (g/sqm):	-

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm):	522

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	0.2 – Very low
Organic Matter (OM%):	0.4
Additional comments:	

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7D1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

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Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **3** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration
Client Contact:	Ed Freimanis	Location:	Ropes Creek
Client Job N°:		SESL Quote N°:	Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 3
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil
		Test Type:	FSC (M3), OC-DC

RECOMMENDATIONS

Key Observations

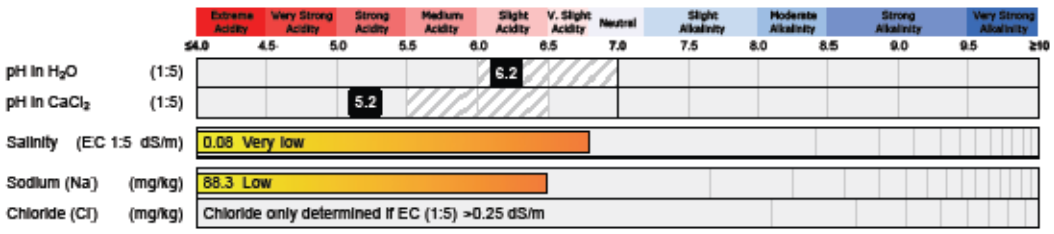
- pH has a slight acidity, salinity and sodicity low
- Effective cation exchange capacity moderate which indicates a good nutrient retention capacity
- Calcium magnesium ratio is low and magnesic
- Organic carbon (0.2%) and organic matter (0.4%) are very low
- Low nutrients except for iron (adequate) and manganese (high)

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm will help improve nutrients for revegetation. Organic matter needs to be increased to bring up the levels and this can be achieved by the addition of a compost, biosolids or green manure. Gypsum at 200g/sqm will improve calcium levels.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

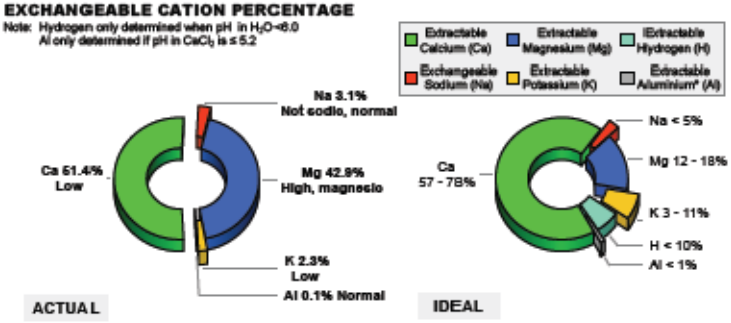
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<8.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1.2	4.1 – 6.0
Comment: Calcium low		
Mg:K	18.9	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.02	< 0.07
Comment: Acceptable		
K:Na	0.7	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI):
0.03 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

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Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **3** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	5.7		1.1	4.2	3.1
Phosphate-P (PO_4)	7.7		1.5	12.6	11.1
Potassium (K)	111		22.1	52.3	30.2
Sulphate-S (SO_4)	28		5.6	13.6	8
Calcium (Ca)	1263		252	372.1	120.1
Magnesium (Mg)	639		127.5	38.7	Drawdown
Iron (Fe)	349		69.6	110.1	40.5
Manganese (Mn)	128		25.5	6.8	Drawdown
Zinc (Zn)	3.3		0.7	1	.3
Copper (Cu)	2.5		0.5	1.3	.8
Boron (B)	0.4		0.1	0.5	.4

Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

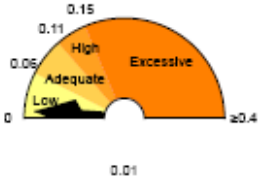
High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	7.3
Sum of Base Cations (meq/100g^{-1}):	12.3
Eff. Cation Exch. Capacity (eCEC):	12.3
Base Saturation (%):	100
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	0
– to neutralise Al (g/sqm):	1

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm):	340

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	0.2 – Very low
Organic Matter (OM%):	0.4
Additional comments:	

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7D1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessment

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

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Certified System Quality ISO 9001

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Batch N°: **17682** Sample N°: **4** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration
Client Contact:	Ed Freimanis	Location:	Ropes Creek
Client Job N°:		SESL Quote N°:	Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 4
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil
		Test Type:	FSC (M3), OC-DC

RECOMMENDATIONS

Key Observations

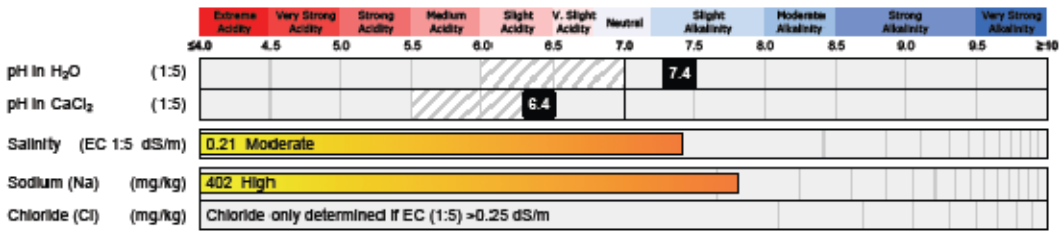
- Slight alkalinity in pH
- Moderate salinity and sodicity, with high sodium levels
- Moderate effective cation exchange capacity with low calcium magnesium ratio (magnesic)
- Organic carbon (0.2%) and organic matter (0.4%) are very low
- High iron and manganese suggest possible water logging
- Nitrate, phosphate and potassium nil to very low levels

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm will help improve nutrients for revegetation. Organic matter needs to be increased to bring up the levels and improve structure. This can be achieved by using compost, biosolids or green manure. Gypsum at 200g/sqm will improve calcium levels and displace sodium levels..

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

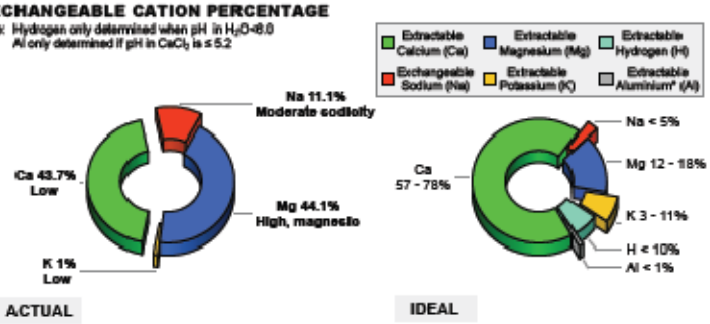
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<8.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1	4.1 – 6.0
Comment: Calcium low		
Mg:K	46.2	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.01	< 0.07
Comment: Acceptable		
K:Na	0.1	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI): 0.02 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

Tests are performed under a quality system certified as complying with ISO 9001: 2000. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Page 1 of 2

Sydney Environmental and Soil Laboratory

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

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Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **4** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	<0.05	<0.3	4.2	3.9
Phosphate-P (PO_4)	3.1	0.6	12.6	12
Potassium (K)	58.6	11.7	60.6	48.9
Sulphate-S (SO_4)	48	9.6	13.6	4
Calcium (Ca)	1372	273.7	431.7	158
Magnesium (Mg)	838	167.2	44.9	Drawdown
Iron (Fe)	644	128.5	110.1	Drawdown
Manganese (Mn)	230	45.9	6.8	Drawdown
Zinc (Zn)	1.4	0.3	1	.7
Copper (Cu)	1.4	0.3	1.3	1
Boron (B)	0.8	0.2	0.5	.3

Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

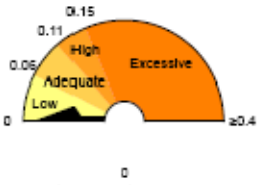
Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.
- g/sqm measurements are based on soil bulk density of 1.33 ton·m^{-3} and selected soil depth.

Phosphorus Saturation Index



0

Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (meq/100g^{-1}):	15.7
Eff. Cation Exch. Capacity (eCEC):	15.7
Base Saturation (%):	100
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	0
– to neutralise Al (g/sqm):	-

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): 642

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	0.2 – Very low
Organic Matter (OM%):	0.4

Additional comments:

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7D1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessments

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

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Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **5** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration	
Client Contact:	Ed Freimanis	Location:	Ropes Creek	
Client Job N°:		SESL Quote N°:		Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 5	
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil	
		Test Type:	FSC (M3), OC-DC	

RECOMMENDATIONS

Key Observations

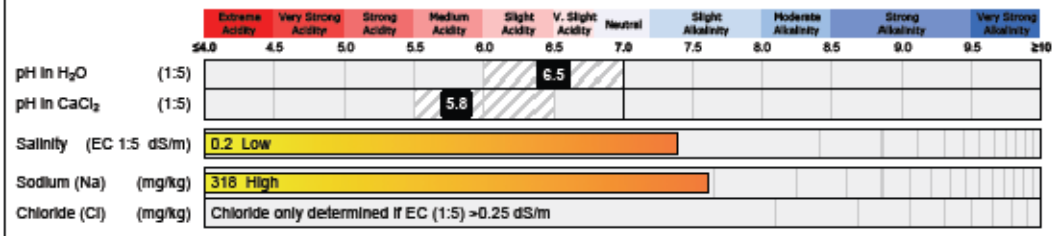
- pH slight acidity and low salinity desirable by native plant species
- Moderate sodicity and high sodium levels
- Moderate effective cation exchange capacity indicating a good nutrient retention capacity
- Organic carbon (0.2%) and organic matter (0.4%) are very low
- Nitrate, phosphate, potassium, sulphur and boron low

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm and will help improve nutrients for revegetation. Organic matter needs to be increased by the addition of compost, biosolids or green manure to bring up the levels and improve structure. Gypsum at 200g/sqm will improve calcium levels and displace sodium levels.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

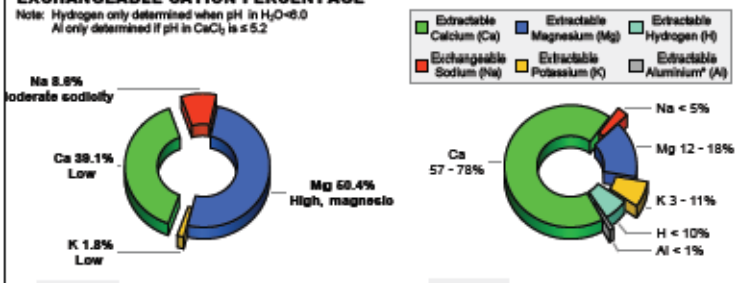
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.8	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	27.8	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.02	< 0.07
Comment: Acceptable		
K:Na	0.2	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI):
0.02 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na:	K:	Ca:	Mg:

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contaminated Assessments

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

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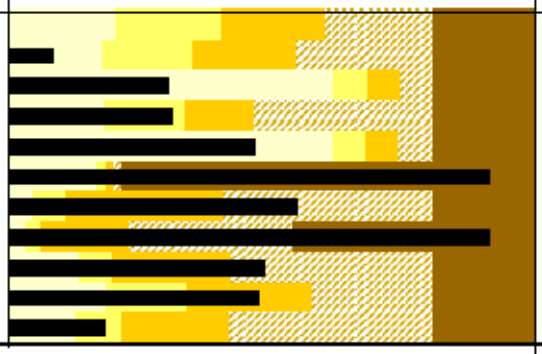
Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **5** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	<0.05	<0.3	4.2	3.9
Phosphate-P (PO_4)	6.3	1.3	12.6	11.3
Potassium (K)	114	22.7	60.6	37.9
Sulphate-S (SO_4)	26	5.2	13.6	8.4
Calcium (Ca)	1251	249.6	431.7	182.1
Magnesium (Mg)	976	194.7	44.9	Drawdown
Iron (Fe)	375	74.8	110.1	35.3
Manganese (Mn)	75	15	8.8	Drawdown
Zinc (Zn)	3	0.6	1	.4
Copper (Cu)	3.7	0.7	1.3	.6
Boron (B)	0.6	0.1	0.5	.4



Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

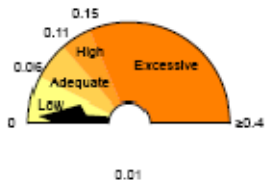
High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

- g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (meq/100g^{-1}):	16
Eff. Cation Exch. Capacity (eCEC):	16
Base Saturation (%):	100
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	0
– to neutralise Al (g/sqm):	-

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm):	780

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential Infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	0.2 – Very low
Organic Matter (OM%):	0.4
Additional comments:	

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Sydney Environmental and Soil Laboratory

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

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Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **6** Report Status: ○ Draft ◉ Final

Client Name: **Ecohort Pty Ltd**
Client Contact: **Ed Freimanis**
Client Job N°:
Client Order N°:
Address: **40 Bannerman Rd Glenhaven NSW 2156**

Project Name: **Oakdale Central Regeneration**
Location: **Ropes Creek**
SESL Quote N°:
Sample Name: **SS # 6**
Description: **Soil**
Test Type: **FSC (M3), OC-DC**

Date Received: **17/3/11**

RECOMMENDATIONS

Key Observations

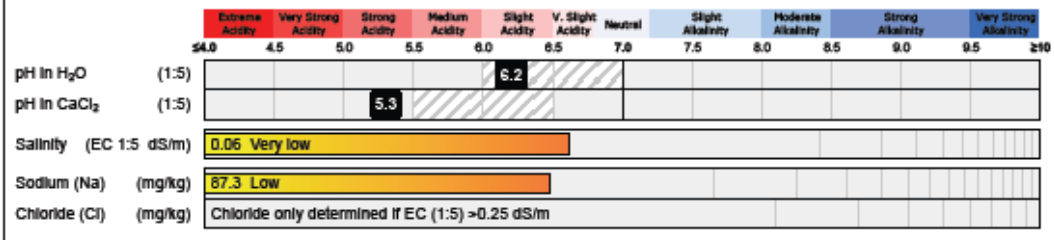
- pH slight acidity, low salinity and sodicity which is desirable by native plant species
- Moderate effective cation exchange capacity indicating a good nutrient retention capacity
- Very low calcium magnesium ratio (magnesic)
- Organic carbon (0.2%) and organic matter (0.4%) are very low
- Nitrate, phosphate, potassium, sulphur and boron low
- Manganese is high and zinc adequate to high range

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 200g/sqm and lime at 100g/sqm will improve calcium levels, neutralise aluminium and hydrogen and increase the pH. Organic matter needs to be increased by using a compost, biosolids or green manure.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

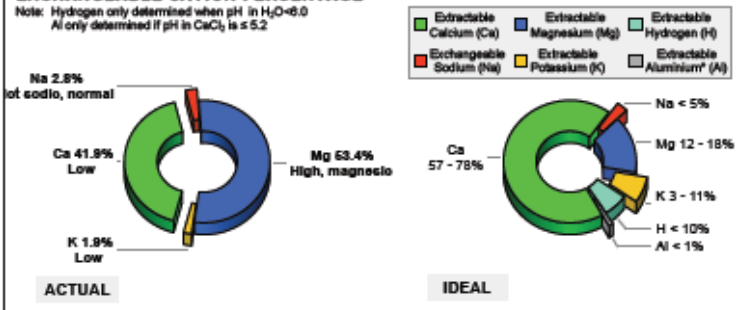
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.8	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	28.2	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.02	< 0.07
Comment: Acceptable		
K:Na	0.7	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI):
0.02 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

Sydney Environmental and Soil Laboratory

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 610 708

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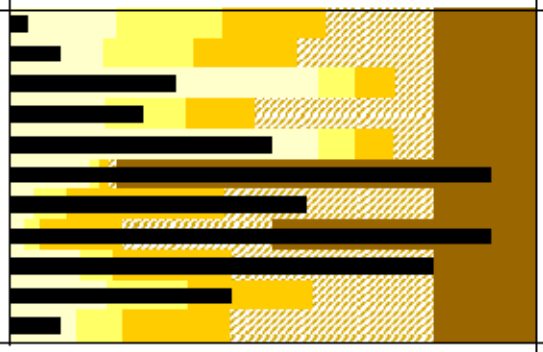
Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **6** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	0.7	0.1	4.2	4.1
Phosphate-P (PO_4)	7.3	1.5	12.6	11.1
Potassium (K)	101	20.1	52.3	32.2
Sulphate-S (SO_4)	21	4.2	13.6	9.4
Calcium (Ca)	1149	229.2	372.1	142.9
Magnesium (Mg)	885	176.6	38.7	Drawdown
Iron (Fe)	386	77	110.1	33.1
Manganese (Mn)	81	16.2	8.8	Drawdown
Zinc (Zn)	5	1	1	0
Copper (Cu)	3.3	0.7	1.3	.6
Boron (B)	0.3	0.1	0.5	.4



Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

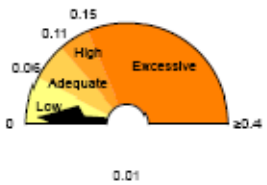
High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

- g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



0.01

Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	7.3
Sum of Base Cations (meq/100g^{-1}):	13.7
Eff. Cation Exch. Capacity (eCEC):	13.7
Base Saturation (%):	100
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	0
– to neutralise Al (g/sqm):	-

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm):	602

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{se} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	1.9 – Moderate
Organic Matter (OM%):	4.1

Additional comments:

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7D1
Aluminium - SESL In-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contaminated Assessments

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

Mailing Address: PO Box 357 Pennant Hills NSW 1715

Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **7** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration	
Client Contact:	Ed Freimanis	Location:	Ropes Creek	
Client Job N°:		SESL Quote N°:		Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 7	
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil	
		Test Type:	FSC (M3), OC-DC	

RECOMMENDATIONS

Key Observations

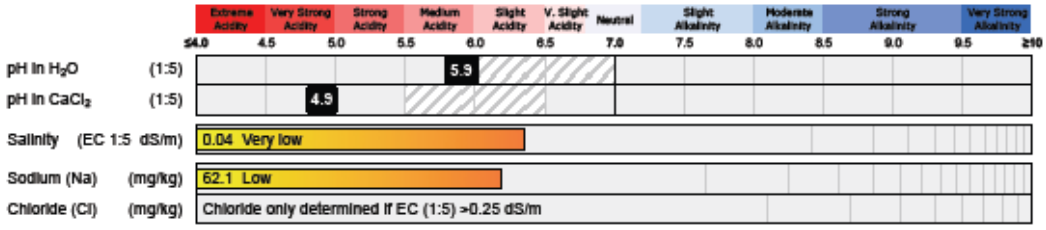
- pH medium acidity, salinity and sodicity are low which is desirable
- Effective cation exchange capacity is low indicating a poor ability to hold and retain nutrients
- Calcium magnesium ratio low (magnesic) and high exchangeable acidity (hydrogen)
- Organic carbon (1.7%) and organic matter (3.7%) are moderate
- Nitrate, phosphate, potassium, sulphur and boron low

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 300g/sqm and lime at 200g/sqm will improve calcium levels, neutralise aluminium and hydrogen, displace sodium levels and increase the pH. Organic matter needs to be increased to bring up the levels and improve structure. This can be done by using compost, biosolids or green manure.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ◉ Low ○ Moderate ○ High

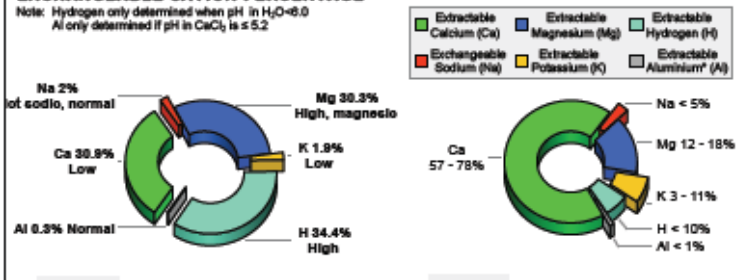
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	1	4.1 – 6.0
Comment: Calcium low		
Mg:K	16.4	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.03	< 0.07
Comment: Acceptable		
K:Na	0.9	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI):
0.02 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contaminated Assessment

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

Mailing Address: PO Box 357 Pennant Hills NSW 1715

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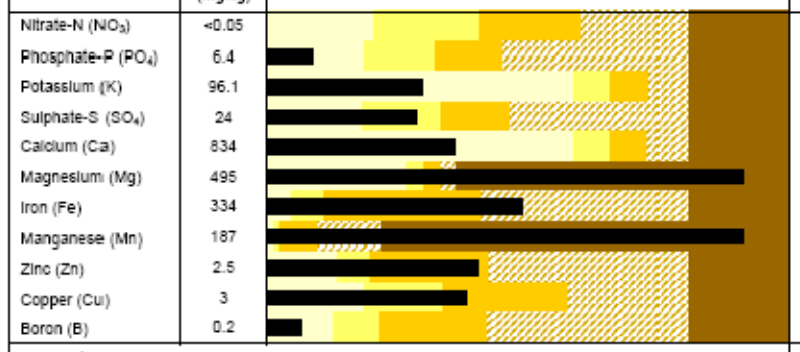
Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **7** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	<0.05		<0.3	4.2	3.9
Phosphate-P (PO_4)	6.4		1.3	12.6	11.3
Potassium (K)	96.1		19.2	52.3	33.1
Sulphate-S (SO_4)	24		4.8	13.6	8.8
Calcium (Ca)	834		166.4	372.1	205.7
Magnesium (Mg)	495		98.8	38.7	Drawdown
Iron (Fe)	334		66.6	110.1	43.5
Manganese (Mn)	187		37.3	8.8	Drawdown
Zinc (Zn)	2.5		0.5	1	.5
Copper (Cu)	3		0.6	1.3	.7
Boron (B)	0.2		0	0.5	.5



Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

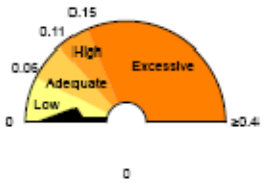
High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

- g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	7.3
Sum of Base Cations (meq/100g^{-1}):	8.8
Eff. Cation Exch. Capacity (eCEC):	13.5
Base Saturation (%):	65.19
Exchangeable Acidity (meq/100g^{-1}):	4.64
Exchangeable Acidity (%):	34.37

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	271
– to neutralise Al (g/sqm):	6

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm):	383

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	1.7 – Moderate
Organic Matter (OM%):	3.7

Additional comments:

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Page 2 of 2

Sydney Environmental and Soil Laboratory

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

Mailing Address: PO Box 357 Pennant Hills NSW 1715

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Em: info@sesl.com.au
Web: www.sesl.com.au

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Batch N°: **17682** Sample N°: **8** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration
Client Contact:	Ed Freimanis	Location:	Ropes Creek
Client Job N°:		SESL Quote N°:	Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 8
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil
		Test Type:	FSC (M3), OC-DC

RECOMMENDATIONS

Key Observations

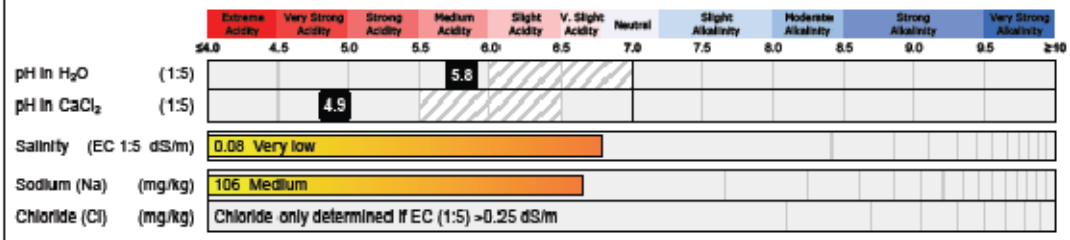
- pH medium acidity and salinity low which is desirable for native plant species
- Moderate effective cation exchange capacity indicating a good nutrient retention capacity
- Calcium magnesium ratio low (magnesic) and high exchangeable acidity (hydrogen)
- Organic carbon (1.2%) and organic matter (2.6%) are low
- Phosphate, potassium and boron very low, nitrate., sulphate and iron marginal, manganese high

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 200g/sqm will improve calcium levels and increase the pH. Organic matter needs to be increased to bring up the levels and improve structure. This can be achieved by using compost, biosolids or green manure.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

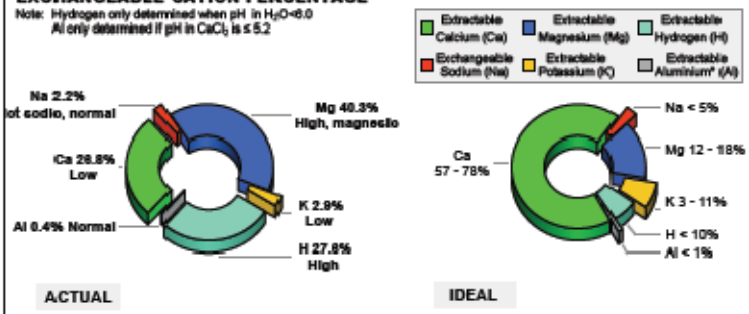
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<8.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.7	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	14.2	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.04	< 0.07
Comment: Acceptable		
K:Na	1.3	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI): 0.04 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

Sydney Environmental and Soil Laboratory

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

Sample Drop Off: 16 Chilvers Road Thornleigh NSW 2120 Australia

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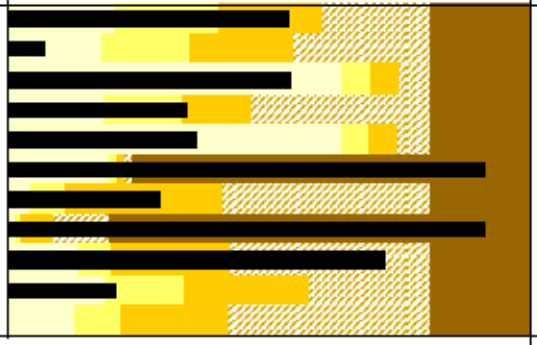
Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **8** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	14	2.8	4.2	1.4
Phosphate-P (PO_4)	5.1	1	12.6	11.6
Potassium (K)	232	46.3	69	22.7
Sulphate-S (SO_4)	29	5.8	13.6	7.8
Calcium (Ca)	1108	221	491.6	270.6
Magnesium (Mg)	1010	201.5	51.3	Drawdown
Iron (Fe)	197	39.3	110.1	70.8
Manganese (Mn)	216	43.1	8.8	Drawdown
Zinc (Zn)	4.5	0.9	1	.1
Copper (Cu)	1.6	0.3	1.3	1
Boron (B)	0	0	0.5	.5



Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >50%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

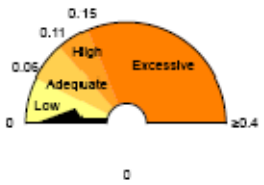
High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potentiall response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

- gram measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	7.1
Sum of Base Cations (meq/100g^{-1}):	14.9
Eff. Cation Exch. Capacity (eCEC):	20.7
Base Saturation (%):	71.98
Exchangeable Acidity (meq/100g^{-1}):	5.72
Exchangeable Acidity (%):	27.63

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	391
– to neutralise Al (g/sqm):	12

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): 777

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	1.2 – Low
Organic Matter (OM%):	2.6

Additional comments:

Consultant: Tiffany Carroll-MacDonald

Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7D1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Sydney Environmental and Soil Laboratory

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 106 810 708

Sample Drop Off: 16 Chivers Road Thornleigh NSW 2120 Australia

Mailing Address: PO Box 357 Pennant Hills NSW 1715

Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au

Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **9** Report Status: ○ Draft ◉ Final

Client Name:	Ecohort Pty Ltd	Project Name:	Oakdale Central Regeneration	
Client Contact:	Ed Freimanis	Location:	Ropes Creek	
Client Job N°:		SESL Quote N°:		Date Received: 17/3/11
Client Order N°:		Sample Name:	SS # 9	
Address:	40 Bannerman Rd Glenhaven NSW 2156	Description:	Soil	
		Test Type:	FSC (M3), OC-DC	

RECOMMENDATIONS

Key Observations

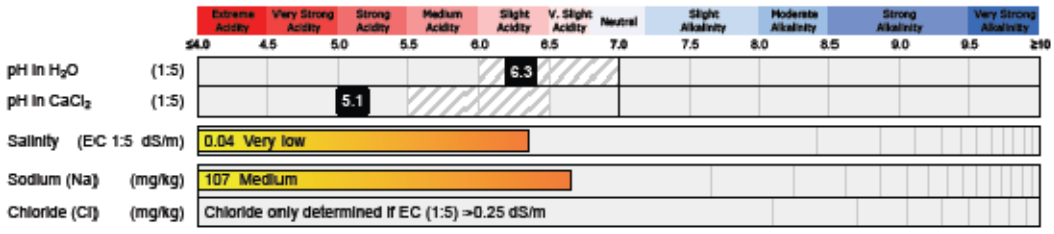
- pH has a slight acidity, low salinity and moderate sodicity (high sodium)
- Effective cation exchange capacity is low indicating a poor ability to hold and retain nutrients
- Calcium magnesium ratio low (magnesic)
- Organic carbon (1.1%) and organic matter (2.4%) are low
- Nitrate, phosphate, potassium , sulphate and boron low

Corrective Actions

The addition of a well balanced NPK fertiliser (e.g. N: 10.5, P:3.5, K:5.5) at 50 g/sqm will help improve nutrients for revegetation. Gypsum at 200g/sqm will improve calcium levels and displace sodium levels. Organic matter needs to be increased by the addition of compost, biosolids or a green manure to bring up the levels and improve structure.

SOIL SAMPLE DEPTH (mm): ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ◉ Low ○ Moderate ○ High

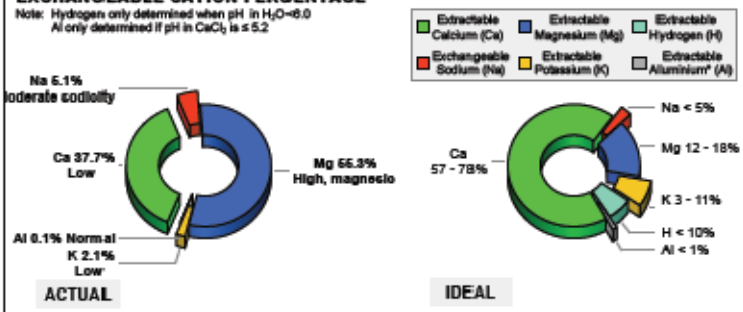
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H_2O<8.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.7	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	26.2	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	0.02	< 0.07
Comment: Acceptable		
K:Na	0.4	N/A

Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI):
0.01 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

Sydney Environmental and Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessment

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 105 810 708

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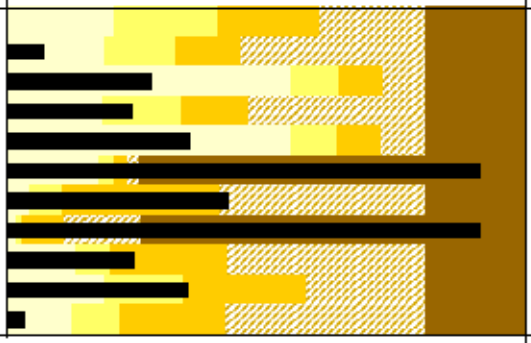
Certified System Quality ISO 9001

Batch N°: **17682** Sample N°: **9** Report Status: ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	<0.05	<0.3	4.2	3.9
Phosphate-P (PO_4)	5.2	1	12.6	11.6
Potassium (K)	75.2	15	43.9	28.9
Sulphate-S (SO_4)	20	4	13.6	9.6
Calcium (Ca)	679	135.5	312.4	176.9
Magnesium (Mg)	602	120.1	32.5	Drawdown
Iron (Fe)	292	58.3	110.1	51.8
Manganese (Mn)	159	31.7	8.8	Drawdown
Zinc (Zn)	1.5	0.3	1	.7
Copper (Cu)	2.7	0.5	1.3	.8
Boron (B)	0.1	0	0.5	.5



Explanation of graph ranges:

Very Low – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

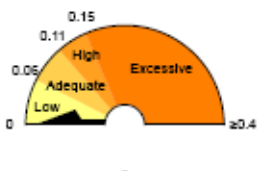
Marginal – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.
- g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	7.4
Sum of Base Cations (meq/100g^{-1}):	9
Eff. Cation Exch. Capacity (eCEC):	9
Base Saturation (%):	100
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm):	0
– to neutralise Al (g/sqm):	1

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): 461

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	Did not test
Typical clay content:	Did not test
Size:	
Gravel content:	Not gravelly
Aggregate strength:	Did not test
Structural unit:	Did not test
Potential infiltration rate:	Did not test
Permeability (mm/hr):	Did not test
Calculated EC_{SE} (dS/m):	-

Requires EC and Soil Texture result.

Organic Carbon (OC%):	1.1 – Low
Organic Matter (OM%):	2.5
Additional comments:	

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Authorised Signatory: Simon Leake

Date of Report: 24 Mar 2011

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

Page 2 of 2