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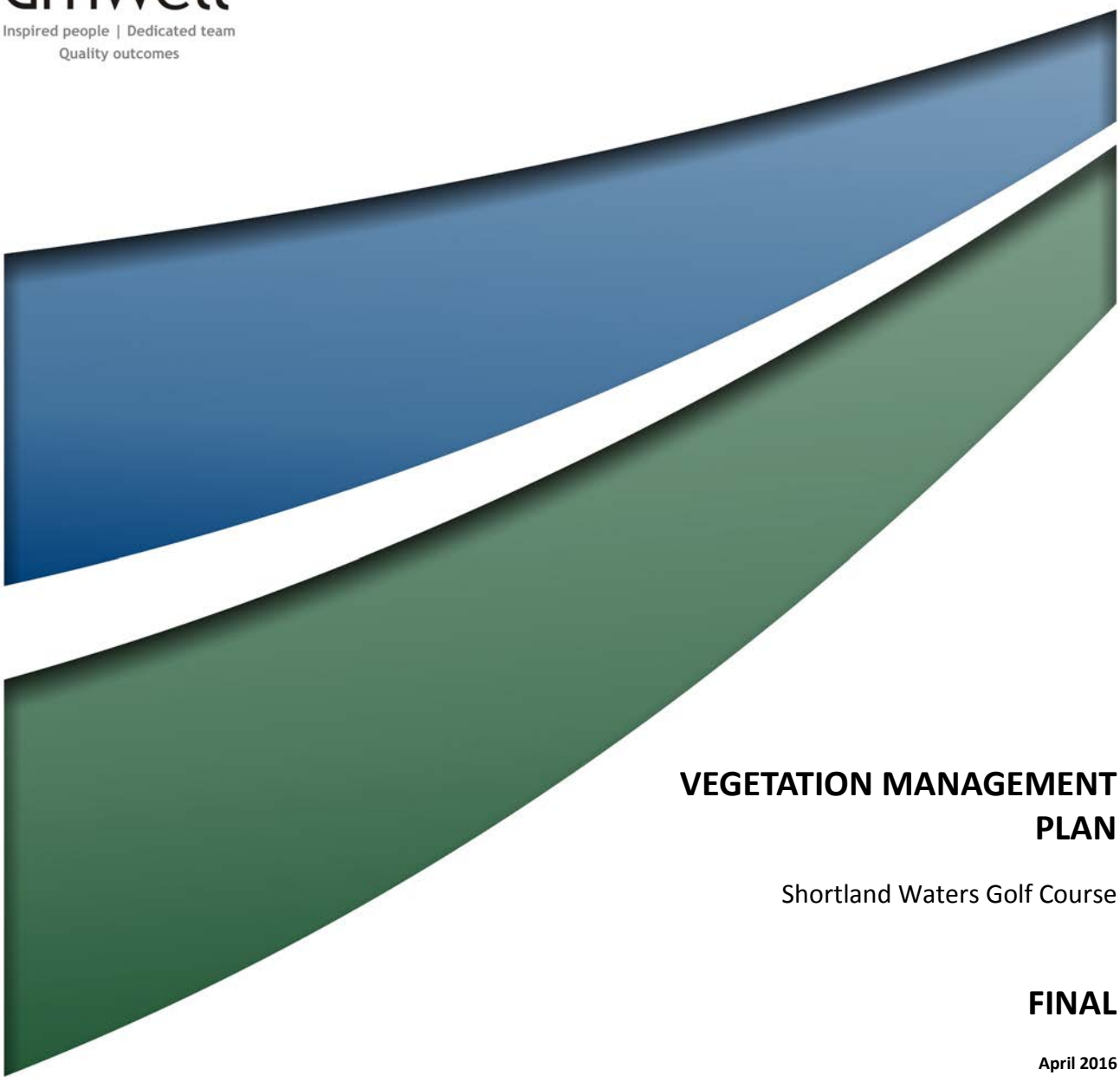

VEGETATION MANAGEMENT PLAN

Shortland Waters Golf Course

FINAL

April 2016

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Prepared by
Umwelt (Australia) Pty Limited
on behalf of
[On behalf of]

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1.0 Introduction

Umwelt (Australia) Pty Limited (Umwelt) was engaged by City Plan Services and Aveo Group Limited (Aveo) to prepare a Vegetation Management Plan (VMP) for remediation works to create a 20 metre buffer to the State Environmental Planning Policy No.14 (SEPP 14) wetland at their Shortland Waters Golf Course development site (**Figure 1.1**).

As per Development Consent DA 2012/419 Consent Condition Schedule 1 Section C (i) part 2, *"Prior to the commencement of any controlled activity (works) on waterfront land, the consent holder must obtain a Controlled Activity Approval (CAA) under the Water Management Act from the NSW Office of Water. Waterfront Land for the purposes of this DA is land and material in or within 40 metres of the top of the bank or shore of the lake identified"*. As part of the CAA, the consent holder must prepare or commission the preparation of a number of plans including a VMP.

The VMP has been prepared in accordance with the NSW Office of Water (NOW) Guidelines for Vegetation Management Plans on Waterfront Land (NOW 2012) to support the CAA application for remediation works within 40m of the wetland.

1.1 Objectives

The VMP has been prepared in accordance with Development Consent DA 2012/419 and the NSW Office of Water (NOW) Guidelines for Vegetation Management Plans on Waterfront Land (NOW 2012). The objectives of the VMP are to:

- identify and map the riparian zone
- photograph and record species composition of existing riparian land
- develop management guidelines including weed management
- develop recommended species lists for use in revegetation and
- recommend ongoing monitoring and management of the riparian zone until such time as floristic criteria are met.

1.2 Site Inspection

A site inspection was conducted on 6 March 2015, consisting of a visual inspection of those sections of the Newcastle Wetlands Reserve which were able to be accessed. Rapid vegetation assessment of the riparian zone was undertaken during the site inspection, from nearby vantage points when access on foot was prevented by impassable vegetation.

Image Source: Google Earth (Jan 2016)
Data Source: CANRI (2009), DEP (2016)

0 50 100 200m
1:3500

Legend

- SEPP14 Wetlands
- Approximate Extent of Proposed Rehabilitation

FIGURE 1.1

Location of Riparian Buffer

2.0 Background

2.1 Existing Environment

The riparian area pertaining to this VMP was mapped by RPS (2011) as 'Unmanaged Exotic Shrubs and Grassland' and described a hummocky area comprising an uneven soil surface as a result of backfilling and landfill activities. The area was described as being dominated by a dense layer of exotic shrubs including lantana (*Lantana camara*), blackberry (*Rubus fruticosus* sp. agg.) and wild tobacco (*Solanum mauritianum*). This area is directly adjoining a SEPP14 wetland and forms part of the Newcastle Wetland Reserve.

2.2 Existing Vegetation Communities

The site inspection found the riparian zone inaccessible on foot due to extreme weed infestation between the riparian zone and Shortland Waters Gold Course. The riparian zone was assessed from the dam wall to the south of the Newcastle Wetland Reserve. From this vantage point is was possible to determine that the 20m buffer was severely infested with invasive exotic species and noxious weeds. Very small areas of broadleaf cumbungi (*Typha orientalis*) were the only native species clearly visible.

The site inspection confirmed the mapping by RPS 2011 as 'Unmanaged Exotic Shrubs and Grassland' (refer to **Figure 2.1**).

2.3 Ecological Values of SEPP 14 Wetland

The Wetland Action Plan for Market Swamp and Newcastle Wetland Reserve (BMT WBM 2011) found while the ecological value of Newcastle Wetland Reserve was in decline, more than 120 species of waterbirds had previously been observed in the wetlands. Of these, six are listed as threatened species and 14 as migratory species under various Australian and International legislation. Notable bird species sighted previously at the wetland include magpie goose (*Anseranas semipalmata*) and the black-necked stork (*Ephippiorhynchus asiaticus*). Other rare bird species sighted previously at the wetlands include the garganey (*Anas querquedula)* and the glossy ibis (*Plegadis falcinellus*).

BMT WBM (2011) found that the decline in the ecological values of the area can be related to the increase in depth and permanence of water in the wetlands.

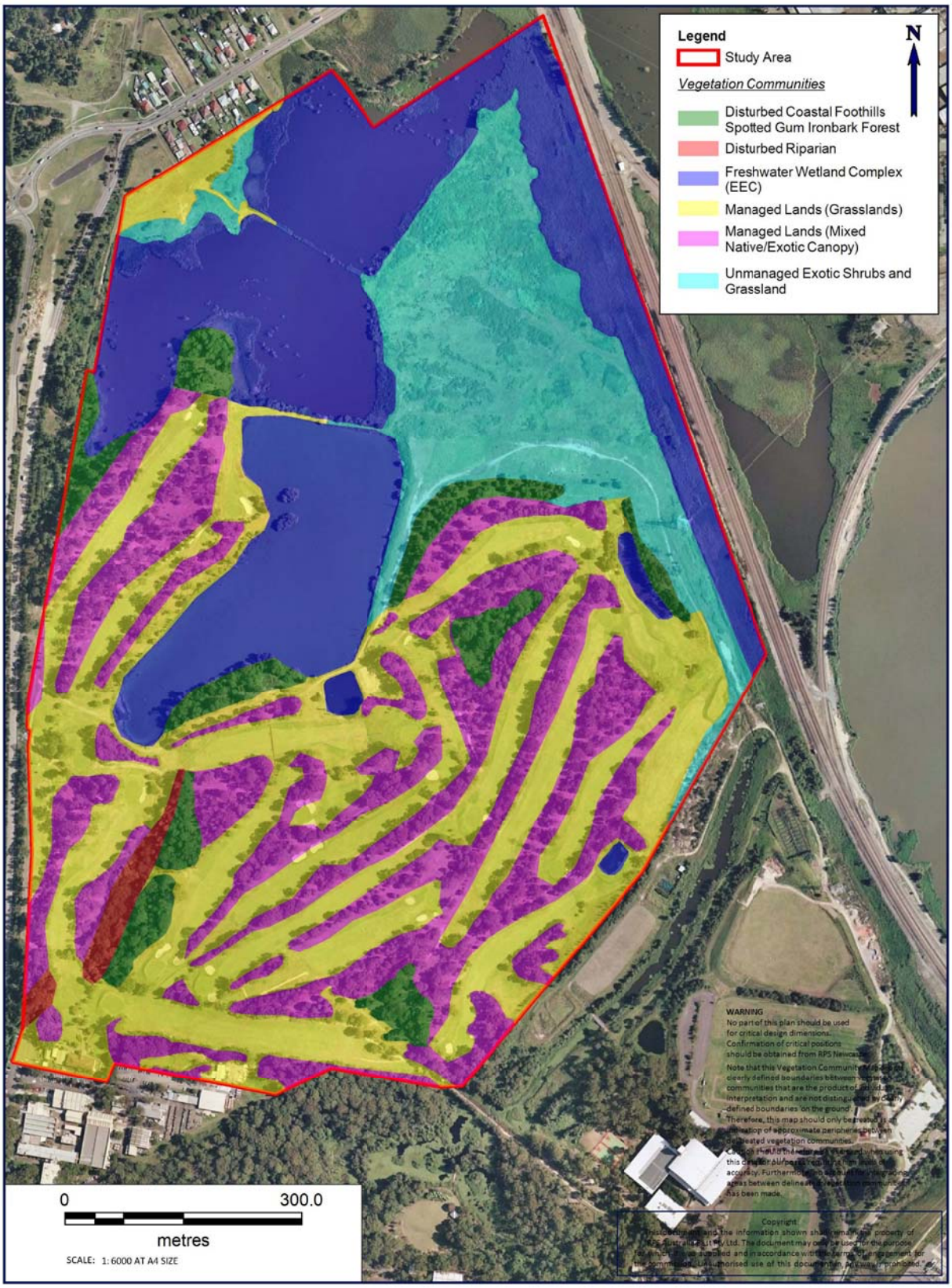

FIGURE 2.1

Vegetation Map

Image Source: RPS Australia East Pty Ltd

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3.0 Management Actions

3.1 Remediation/Restoration of Riparian Buffer Zone

It is recommended that the remediation of the riparian zone is conducted concurrently with the remediation/capping of the remainder of the Newcastle Wetland Reserve as per Development Consent 2012/419.

Remediation works will involve removal and management of noxious and invasive weed species within 20m of the SEPP14 wetland and replacing these with locally sourced suitable native species outlined below, as per the requirements in Schedule 1, Section C Item 22 of Consent 2012/419.

Due to the severe weed infestation in the riparian zone, it was not possible to assess the landform and integrity of the banks bounding the wetland However it was previously described as unstable and hummocky (RPS 2011). Stabilisation and modification earth works may be required during remediation works to create more natural landforms and allow for a more natural ecosystem to develop.

It is important to consider and manage sediment and erosion during proposed earthworks. A suitable silt fence should be constructed immediately bellow the edge of earthworks to prevent sediment entering the wetland. The use of management tools such as hydro-mulching/seeding and jute meshing should be utilised to prevent/manage dirty run off entering the SEPP14 wetland during earthworks and establishment of the plants in the remediated areas. Very high planting densities are also recommended to speed up the establishment of ground cover species. Exposed earth should be either mulched to a depth of 100mm with a hardwood mulch or suitable alternative or direct seeded with a mixture of native species (refer to **Section 3.2**) and a sterile cover crop of oats or millet to obtain suitable soil coverage and stability.

3.2 Weed Management

Consistent with the development consent conditions, an effective weed control program will be implemented to limit the spread and colonisation of noxious and invasive weeds within the riparian zone.

3.2.1 Weed Control Methods

Targeted and repeated control of noxious and invasive weeds across the entire development area is required, including the riparian buffer zone, utilising removal methods most suited to the sensitive nature of riparian areas adjoining SEPP14 wetlands. Treatment methods within the riparian buffer zone should be restricted to herbicides registered for use around waterways. Manual removal, frill or basal injection, scrape and paint and cut and paint methods, using a Glyphosate product designed for use around waterways such as " Roundup bioactive ®" or " Wipeout Bio®" should be the preferred methods within the buffer zone. **Table 3.1** details the preferred removal method for each of the weed species that are known or expected to occur in the buffer zone.

Table 3.1 Preferred Weed Control Methods

Species:	Recommended treatment methods outside of buffer.	On label use/ permit number
Lantana camara (Lantana)	• Spray with Glyphosate 360g/l at a ratio of 10/1 "Splatter gun method". • Foliar spray with Glyphosate360 at 50/1 • Cut and paint with neat Glyphosate 360g/l	PERMIT NUMBER - PER9907
Ligustrum lucidum (Large-leaved Privet)	• Cut and paint with neat Glyphosate 360gl/L • Cut and paint with neat Glyphosate 360g/l	PERMIT NUMBER - PER9907
Chrysanthemoides monilifera subsp. *rotundata* (Bitou Bush)	• Spray with Glyphosate 360g/l at a ratio of 10/1 "Splatter gun method". • Foliar spray with Glyphosa- Cut and paint with neat Glyphosate 360g/l te360 at 50/1	PERMIT NUMBER - PER9907
Senna pendula var. glabrata (Senna)	• Spray with Glyphosate 360g/l at a ratio of 10/1 "Splatter gun method". • Foliar spray with Glyphosate360 at 50/1 • Cut and paint with neat Glyphosate 360g/l	PERMIT NUMBER - PER9907
Phytolacca octandra (Inkweed)	• Spray with Glyphosate 360g/l at a ratio of 10/1 "Splatter gun method". • Foliar spray with Glyphosate 360ml/l at 50/1 • Cut and paint with neat Glyphosate 360g/l	PERMIT NUMBER - PER9907
Ochna serrulata (Mickey Mouse Plant)	• Spray with Glyphosate 360 g/L and metsulfuron-methyl 600 g/kg Tank mixes of up to 2 L glyphosate + 15 g metsulfuronmethyl per 100 L water	PERMIT NUMBER - PER9907

Species:	Recommended treatment methods outside of buffer.	On label use/ permit number
Solanum mauritanium (Wild Tobacco)	• Foliar spray with Glyphosate360 at 50/1	PERMIT NUMBER - PER9907
Ricinus communis (Caster Oil Plant)	• Picloram 44.7g/kg+ Aminopyralid4.47g/l (Vigilant II®) • spray with Glyphosate 360ml/l at 50/1 (seedlings only)	On label PERMIT NUMBER - PER9907
Ligustrum sinense (Small-leaved Privet)	• Cut and paint with neat Glyphosate 360g/l	PERMIT NUMBER - PER9907
Erythrina sykesii (Coral Tree)	• Drill, frill, axe or stem Injection with Glyphosate 360 g/L at1/1.5 with water to undiluted herbicide	PERMIT NUMBER - PER9907
Cinnamomum camphora (Camphor Laurel)	• Drill, frill, axe or stem Injection with Glyphosate 360 g/L at1/1.5 with water to undiluted herbicide	PERMIT NUMBER - PER9907
Asparagus aethiopicus (Asparagus Fern)	• Glyphosate 360 g /L and metsulfuron-methyl 600 g/kg • Tank mixes of up to 2 L glyphosate + 15 g metsulfuronmethyl per 100 L water • Spot spray	PERMIT NUMBER - PER9907
Verbena bonariensis (Purpletop).	• Foliar spray with Glyphosate360 at 50/1	PERMIT NUMBER - PER9907
Solanum nigrum (Black Nightshade)	• Foliar spray with Glyphosate360 at 50/1	PERMIT NUMBER - PER9907
Anagallis arvensis (Scarlet Pimpernel)	• Foliar spray with Glyphosate360 at 50/1	PERMIT NUMBER - PER9907
Lilium formosanum (Formosan Lily)	• Glyphosate 360 g /L and metsulfuron-methyl 600 g/kg • Tank mixes of up to 2 L glyphosate + 15 g metsulfuronmethyl per 100 L water • Spot spray	PERMIT NUMBER - PER9907

Species:	Recommended treatment methods outside of buffer.	On label use/ permit number
Agapanthus praecox (Agapanthus)	• Manual removal	N/A
Marrubium vulgare (White Horehound)	• Foliar spray with Glyphosate360 at 50/1	PERMIT NUMBER - PER9907
Cirsium vulgare (Spear Thistle)	• Foliar spray with Glyphosate360 at 50/1	PERMIT NUMBER - PER9907
Ageratina adenophora (Crofton Weed)	• Foliar spray with Glyphosate360 at 50/1-Folier spray with Glyphosate360 at 50/1	PERMIT NUMBER - PER9907
Ipomoea cairica (Coastal Morning Glory)	• Glyphosate 360 g /L and metsulfuron-methyl 600 g/kg • Tank mixes of up to 2 L glyphosate + 15 g metsulfuronmethyl per 100 L water • Spot spray	PERMIT NUMBER - PER9907
Lonicera japonica (Japanese Honeysuckle)	• Glyphosate 360 g /L and metsulfuron-methyl 600 g/kg • Tank mixes of up to 2 L glyphosate + 15 g metsulfuronmethyl per 100 L water • Spot spray	PERMIT NUMBER - PER9907
Rubus fruiticosa species compex (Blackberry)	• Glyphosate 360 g /L and metsulfuron-methyl 600 g/kg • Tank mixes of up to 2 L glyphosate + 15 g metsulfuronmethyl per 100 L water • Spot spray	PERMIT NUMBER - PER9907

(Ensbey *et al*, 2015)

3.3 Establishment of Native Vegetation

As discussed above, following reshaping of the buffer zone as part of remediation works, native vegetation should be established within the riparian zone. Very high planting densities are recommended to accelerate the establishment of ground cover species that will assist with preventing erosion. Exposed earth should be either mulched to a depth of 100mm with a hardwood mulch or suitable alternative or direct seeded with a mixture of native species and a sterile cover crop of oats or millet to obtain suitable soil coverage and stability.

Native plants that have been selected for planting within the buffer zone were identified based on the native vegetation occurring in the wider Shortland Waters site and the local area.

Planting for regeneration purposes should aim for a density of:

- 1 canopy species per $5m^2$
- 1 shrub species per $1m^2$
- 4 ground cover species per m^2

A selection of suitable species for planting within the buffer zone are listed below:

Trees
Casuarina cunninghamiana River Oak
Casuarina glauca Swamp Oak
Glochidion ferdinandii Cheese Tree
Angophora costata Smooth-barked Apple
Angophora floribunda Rough-barked Apple
Corymbia gummifera Red Bloodwood
Corymbia maculata Spotted Gum
Eucalyptus acmenoides White Mahogany
Eucalyptus amplifolia Cabbage Gum
Eucalyptus capitellata Brown Stringybark
Eucalyptus crebra Narrow-leaved Ironbark
Eucalyptus fibrosa Broad Leaved Ironbark
Eucalyptus microcorys Tallowwood
Eucalyptus pilularis Blackbutt
Eucalyptus propinqua Small Fruited Grey Gum
Eucalyptus punctata Grey Gum
Eucalyptus robusta Swamp Mahogany
Eucalyptus saligna Sydney blue gum
Eucalyptus tereticornis Forest Red Gum
Eucalyptus umbra Broad-leaved White Mahogany
Melaleuca linariifolia Snow in Summer
Melaleuca quinquenervia Broad-leaved Paperbark
Melaleuca stypheloides Prickly-leaved Tea Tree
Syncarpia glomulifera Turpentine
Aquatic Plants
Bolboschoenus caldwellii Caldwell's Clubrush
Cyperus difformis Variable Flat-sedge
Isolepis inundata Swamp Club-rush
Ficinia nodosa Knobby Club-rush

Shrubs
Notelaea longifolia Mock Olive
Polyscias sambucifolia Elderberry Panax
Ozothamnus diosmifolius Ball Everlasting
Acacia falcata - Hickory Wattle
Acacia longifolia var. longifolia Sydney Golden Wattle
Acacia ulicifolia Prickly Moses
Callistemon salignus Willow Bottlebrush
Melaleuca armillaris Bracelet Honey Myrtle
Ground Covers
Pseuderanthemum variabile Pastel Flower
Adiantum formosum Giant maiden hair
Wahlenbergia communis Tufted Bluebell
Entolasia stricta Wiry Panic
Hemarthria uncinata var. uncinata Matgrass
Imperata cylindrica Blady Grass
Microlaena stipoides var. stipoides Weeping Rice
Oplismenus aemulus Basket Grass
Sporobolus creber Slender Rat's Tail Grass
Sporobolus elongatus Slender Rat's Tail Grass
Schoenoplectus littoralis Coast Club-rush
Hardenbergia violacea False Sarsparilla
Kennedia rubicunda Dusky Coral Pea
Eustrephus latifolius Wombat Berry
Passiflora herbertiana Native Passionfruit
Billardiera scandens Hairy Appleberry

3.4 Sediment and Erosion Control

Sediment and erosion will be managed as per the site Construction Environmental Management Plan with particular emphasis placed on prevention of erosion during the rehabilitation phase in the riparian zone.

The NOW guidelines recommend an integrated approach to erosion management and prevention should consider and utilise:

- planting densities selected for rapid establishment and stabilisation of soil rather than cost (refer to **Section 3.3**)
- techniques such as hydro-seeding, combined planting and direct seeding, brush matting, and jute meshing and
- measures for limiting access to the riparian zone, such as signage
- sediment fencing installed between proposed works and the edge of the wetland.

3.5 Maintenance and Monitoring

It is recommended that a comprehensive monitoring program be implemented to ensure the success of the rehabilitation program. Maintenance and monitoring should include:

- maintenance of established vegetation for a minimum of two years after the completion of works or until such time as a minimum 80 per cent survival rate of each species planted and a maximum 5 per cent weed cover for the treated riparian corridor is achieved and
- a method of performance evaluation. This should include replacing plant losses, addressing deficiencies, problems, climatic conditions and successful completion of works.

Biannual (twice yearly) monitoring inspections across the riparian zone are recommended and are to be conducted by a suitably qualified and experienced ecologist. Monitoring inspections will include the following, with results recorded on a standardised pro-forma to allow comparison between monitoring events:

- assessment of the success of the replanting program, including recommendations for any replacement planting required
- identification and mapping of the extent and density of weed species and extent of weed re-infestations and
- assessment of the effectiveness of the weed control program and recommendations for necessary modifications to the program.

3.6 Adaptive Management

Management practices are to be modified where required to best suit the findings of the biannual (twice yearly) monitoring inspections, or where situations change (such as major bank destabilisation due to a rainfall event or flooding).

3.7 Potential Risks and Corrective Actions

There are a number of potential risks, or situations where preliminary performance indicators and completion criteria are not being achieved. The key risk of the VMP not succeeding relates to the establishment of a functioning riparian habitat, and to the management of threats such as weeds and pests. A list of potential situations where objectives of this VMP are not being met is provided in **Table 3.2** along with potential corrective actions. This list is adapted from Rawlings *et al* (2010).

Table 3.2 Potential Risks and Recommended Corrective Actions

Risk/Issue Identified by Monitoring	Recommended Corrective Actions
General Management Risks	
Unauthorised access.	• identify access points and repair fences appropriately; and • install signposting warning against access.
Infestations of noxious and invasive weeds are increasing or new species detected.	• adapt the weed management program and modify strategies accordingly.
Infestations of pest animals are increasing or new species detected.	• prepare a targeted pest management program and implement strategies accordingly.
Risk to Success of Regeneration of Riparian Areas	
Actively re-vegetated areas not establishing as required	• assess fencing and ensure there is no un-authorised access; • review weed strategies to reduce competition; and • adapt management to include additional rounds of planting
Low species diversity.	• targeted weed control; • supplement initial planting/seeding after initial establishment results are assessed.
Exotic species re-invading from adjacent areas	• initiate weed control in adjacent areas to prevent spread; • frequent re-treatment of weeds before they reach reproductive age.
Dense stands of colonising tree or shrub species dominate regeneration areas.	• assess whether thinning is necessary; • leave if patches are small and plants are native; and • thin manually if appropriate.
Scarcity of key habitat features present in relation to reference sites.	• add logs or branches; • increase the number of vegetation layers in the patch; and • establish nest boxes for target species.

4.0 Roles and Responsibilities

AVEO group will be responsible for works and monitoring in accordance with the Development consent.

5.0 References

BMT WBM 2011. The Wetland Action Plan for Market Swamp and Newcastle Wetland Reserve.

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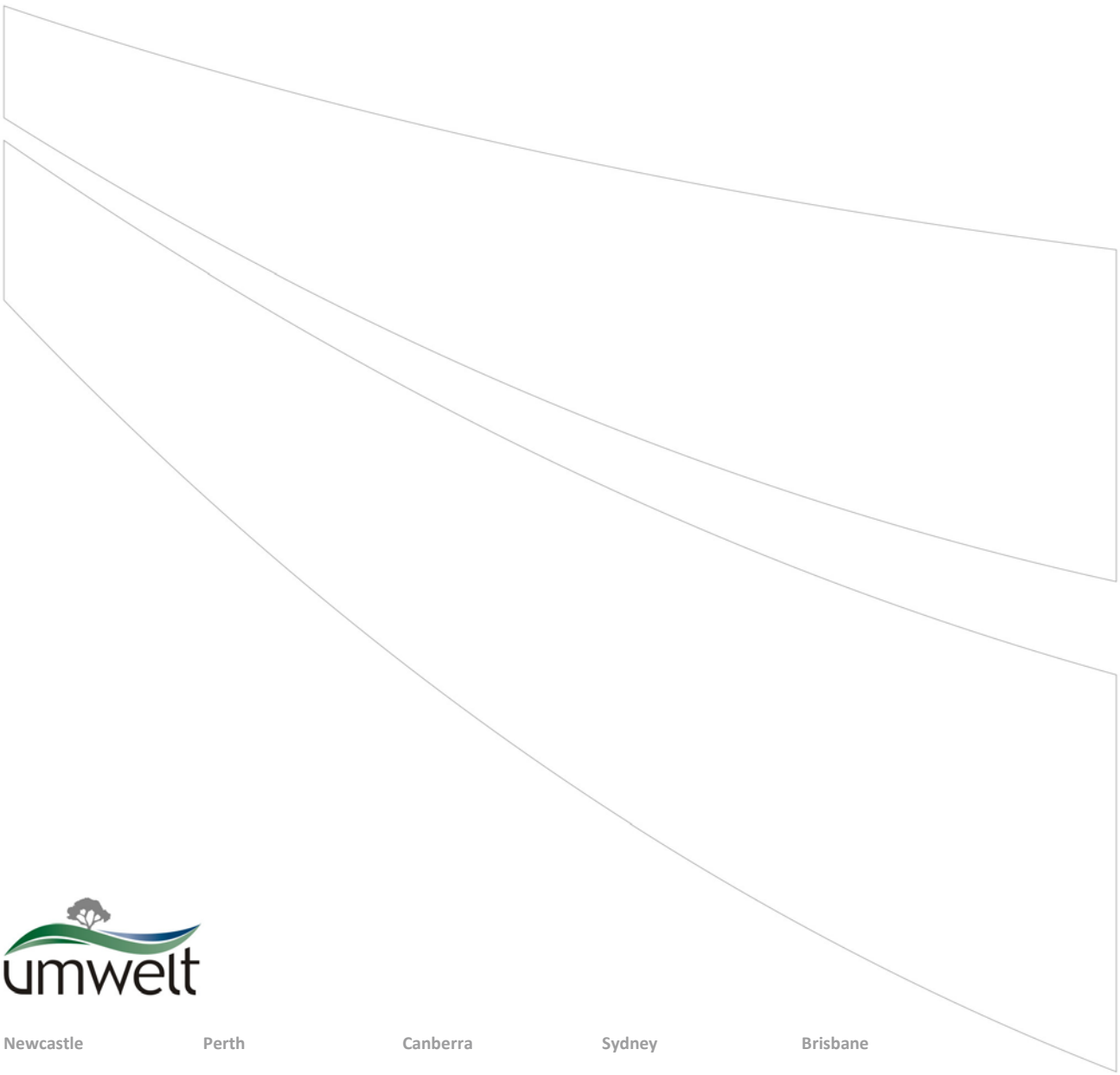

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