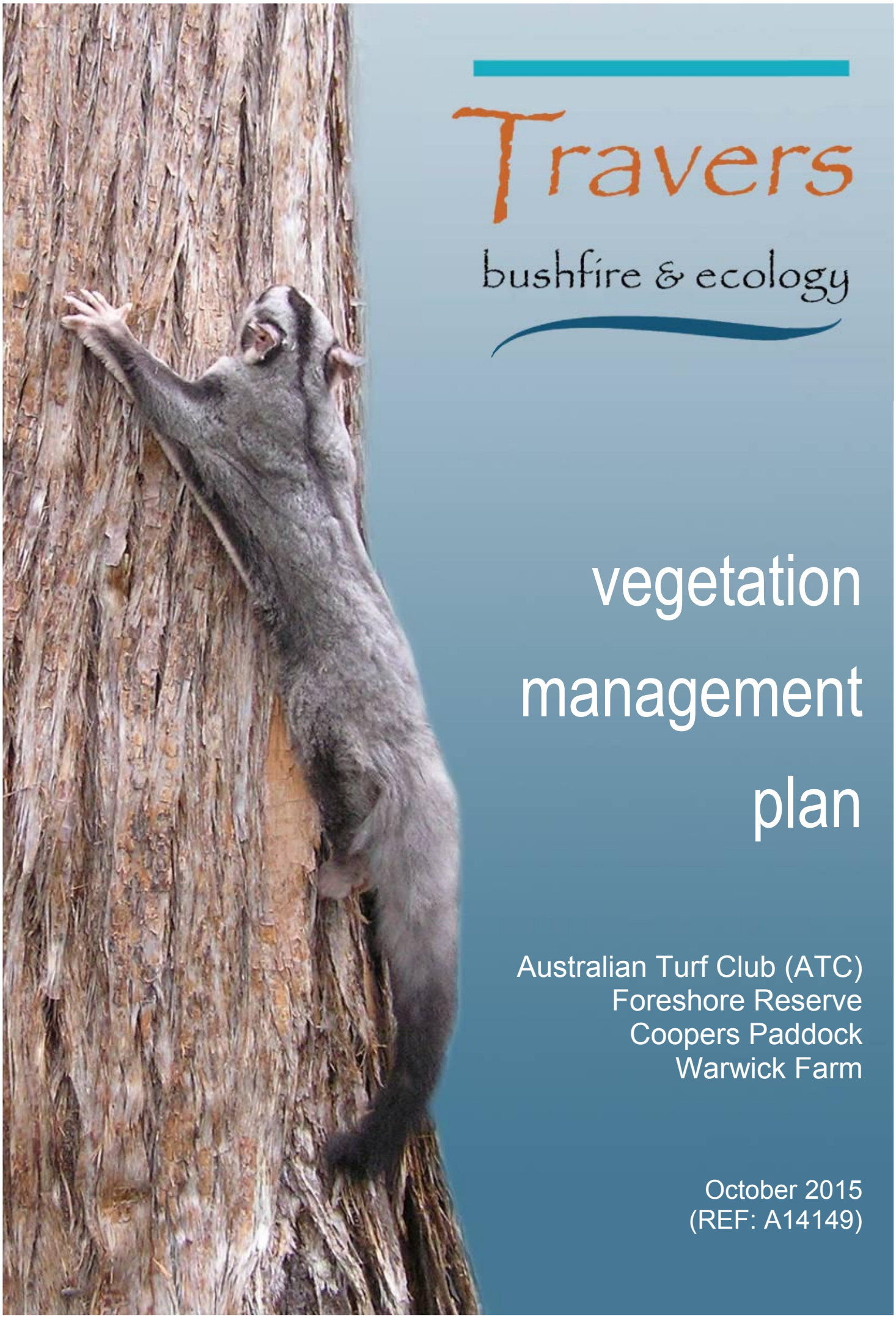

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vegetation management plan

Australian Turf Club (ATC)
Foreshore Reserve
Coopers Paddock
Warwick Farm

October 2015
(REF: A14149)

Vegetation Management Plan

Coopers Paddock
Warwick Farm, NSW
October 2015

Report Authors:	Michael Sheather-Reid, Lindsay Holmes
Checked by:	Michael Sheather-Reid
Date:	1st October 2015
File:	A14149

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Acknowledgement:
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ABN 64 083 086 677
PO Box 7138
Kariong NSW 2250

38A The Avenue
Mt Penang Parklands
Central Coast Highway
Kariong NSW 2250

t: 02 4340 5331
e: info@traversecology.com.au
www.traversecology.com.au

Table of Contents

Figures

Appendices

Schedules

Introduction 1

This Vegetation Management Plan (VMP) has been prepared in accordance with the Voluntary Planning Agreement (VPA) between Liverpool City Council and the Australian Turf Club to restore existing vegetation and insitu fauna habitat within the Coopers Paddock Foreshore Reserve, Warwick Farm NSW.

In accordance with the timeframe agreed under the VPA the VMP is intended to be undertaken over a total 3 year period inclusive of progressive targeted weed control, revegetation and regeneration works. After the completion of works, the Foreshore Reserve will be handed over the Liverpool Council for long term management and control.

1.1 Background information

The Coopers Paddock Industrial subdivision is located within the south-eastern part of the Australian Turf Club (ATC) landholdings. These areas have been used over a long period of time for the training of racehorses, horse stables and other buildings.

Figure 1 – Coopers Paddock, Warwick Farm
(Source: Google EarthPro, accessed 100910)

Coopers Paddock encompasses 30.97 ha to the south of Warwick Farm Racecourse, within Lot 1 DP 581034.

The Coopers Paddock Foreshore Reserve is located on the southern and eastern portions of lot 1 DP 581034 which includes remnant native vegetation and cleared lands.

Figure 2 – Proposed Foreshore Reserve (17.4 ha)

1.2 Purpose of the Vegetation Management Plan (VMP)

The purpose of the VMP is to define and document the actions required to be implemented to protect, conserve and restore remnant native vegetation and fauna habitats within the Foreshore Reserve.

The following objectives also apply:

- To regenerate existing native vegetation to a standard to allow transfer of the foreshore reserve to Liverpool City Council,
- Maximise native vegetation cover and species diversity within the foreshore reserve,
- To undertake revegetation works to restore degraded areas to fully structured native vegetation community representative of the EEC - River-Flat Eucalypt Forest on Coastal Floodplains,
- To protect and avoid significant disruption to the breeding of rare and threatened native flora and native fauna.
- To utilise innovative weed control and restoration methods to ensure cost effective and timely achievement of the restoration performance targets.

In accordance with the above objectives and as illustrated on Schedule 1 – Restoration Works Plan the following strategies will form the basis of long term management of the Coopers Paddock Foreshore Reserve:

- Regenerate and revegetate degraded areas with locally occurring native species,
- Promote the regeneration of diverse fully structured vegetation communities,
- Translocate valuable habitat resources such as high quality hollows being removed within the adjoining industrial subdivision area into degraded areas of the reserve,
- Undertake habitat enrichment works to promote diverse on ground, mid storey and canopy habitat.
- To ensure adequate protection of threatened species breeding habitat such as for the Powerful Owl and Varied Sittella,
- To ensure that the banks of Georges River are protected from erosion and destabilisation
- To effectively control and suppress and if possible eradicate noxious weeds such as Alligator Weed (*Alternanthera philoxeroides*)
- To exclude grazing animals from revegetation areas during establishment periods where practical to promote regeneration, and
- To undertake pest control targeting rabbits, feral cats and foxes
- To undertake monitoring and maintenance activities to ensure adequate implementation of the mitigation measures and a stable restoration outcome.

The VMP identifies guidelines for the management of vegetation and foraging resources, revegetation works and mitigative measures to protect habitat within the Foreshore Reserve. Schedule 1 of this Vegetation Management Plan defines the restoration management zones and relevant management requirements.

The Foreshore Reserve provides for protection for existing vegetation, allows a significant regeneration area within core areas of the park and its layout includes provision of cycleways and maintenance access.

Consequently whilst public access under this VMP is via the proposed cycleway, maintenance access will need to be maintained as indicated on Schedule 1 – Restoration Works Plan and Schedule 2 – Weed Clearance Plan

1.3 Information collation

To achieve the above aims, *Travers bushfire & ecology* carried out a review of the following reports relating to environmental and ecological issues raised by the previous environmental assessments. Information sources reviewed include the following:

- Ecological Constraints Report (*Travers bushfire & ecology* 2011)
- Bushfire Protection Assessment (*Travers bushfire & ecology* 2010)
- Ecological and Riparian Issues Report (*Wheelans Insites* 2007)
- Habitat Offsets Analysis (*Wheelans Insites* 2009)

The VMP has integrated the recommendations of the above reports and provides a long

term vegetation management framework for landscaping and restoration works within Coopers Paddock Foreshore Reserve.

1.4 Recommendations of the ecological assessment

The Ecological Assessment for the rezoning of Coopers Paddock is a combination of recommendations as made by *Travers bushfire & ecology*, Mr John Young (Owl Specialist) and Dr Richard Noske (Woodland Birds Specialist).

The following recommendations have been identified for the protection and management of Powerful Owl habitat and the roosting areas:

- A recommended conservation area boundary line has been identified as necessary to maintain a viable nesting and roosting area for observed pair of owls (Figure 2). The foreshore reserve covers all of the major fauna activity areas as well as including all major connective strips of forest habitat. Native habitat enhancement works are to be undertaken where possible to improve habitat for prey species.
- The 70 m wide Powerful Owl buffer is to be revegetated (refer Schedule 1 – restoration Works Plan). Revegetation should utilise plants native to the area such as the dark rough barked eucalypt species preferred by Powerful Owl.
- Disturbance is to be minimised during key breeding periods within the core roosting and nesting territory for Powerful Owl (Schedule 1). At present Lantana is providing a positive role to this by preventing human access and disturbance. Construction, revegetation works or weed control works are not to be undertaken in the breeding period between March and November or any time the owls are observed present. No machinery is permitted during this period and native regeneration should be undertaken in small areas at a time with no large open clearings at any time.
- The existing horse trail which runs through the Powerful Owl roosting site, will be closed and relocated to reduce the risk of disturbance to the Powerful Owl during the laying/nesting period.

The following recommendations are to be incorporated into the management of the proposed conservation area (Figure 6) in order to reduce potential impacts on threatened species and their habitat:

- It was recommended that the VMP (prepared by *Travers bushfire & ecology, 2010*) be updated to identify the ongoing management of habitat resources, weeds, future landscaping and site works to retain mature trees and habitat movement corridors to ensure the access options to foraging resources are maintained for the Powerful Owl, Varied Sittella and other recorded threatened birds.
- The proposed cycleway is to be re-routed to the north along the rezoning boundary which is then away from the core Powerful Owl roosting/breeding areas. Modifications to the route are permissible subject to the slopes and safety of path users. The proposed cycleway can then pass into existing bushland areas along the existing walking trail.
- All pedestrian/contractor access within the Powerful Owl roosting area will be avoided during the breeding period of March to November.
- Weed control within the Powerful Owl revegetation buffer to the north of the core Powerful Owl roosting area is also only to be undertaken outside of the breeding period of March to November.
- Weed control is to be progressively implemented over a 3 year period within all remaining vegetation areas outside of the core Powerful Owl roosting and nesting area. The weed control works are to ensure adequate regeneration of native

understorey species to maximise foraging habitat minimise disturbance to existing fauna. Low impact bush regeneration methods are to be implemented across the site in preference to large scale and rapid works. Ongoing weed control will be required upon handover to Council after the three year program.

- In respect to the East-coast Freetail Bat, semi-cleared (open space) landscapes should be represented within the subject site in areas such as within asset protection zones that occur along the open forest fringes.
- Dead trees and limbs within the open forest areas are to be retained for foraging and nesting by Varied Sittella and walk/cycleways should be located to avoid any removal of deadwood and dead trees.
- Revegetation and restoration practices within the subject site should also provide a high representation of non-eucalypt rough-barked tree species for the Varied Sittella and to mitigate against the further encroachment of Noisy and Bell Miners into quality passerine bird habitat areas. These miner species tend to have higher presence in eucalypt dominant areas.
- Shrub layer revegetation works are to use locally endemic native plant species that may permit foraging by Grey-headed Flying-fox as well as other Powerful Owl prey species.
- The boundaries of the protected areas should be clearly marked out on-site to ensure their protection.
- The felling of all hollow-bearing trees should be conducted under the supervision of a fauna ecologist. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse. Re-used hollows or those with likely occupation are to be relocated to natural areas within close proximity to the site.
- Where possible existing EEC - *River-Flat Eucalypt Forest on Coastal Floodplains,* should be restored or regenerated is open areas through a combination of biotic translocation and revegetation works.

The following measures are proposed to mitigate against edge effects surrounding the proposed development:

- The forest remnant is to be delineated and protected by a pathway or similar structure that forms a barrier to invasive grasses and weeds.
- Native vegetation on the remnant side of the pathway is to be regenerated and planted densely to out-compete invasive weed species. In this case the outer 20m of the EEC buffer is to be densely planted or regenerated with acacias and other similar sub-canopy species to suppress weed regrowth.
- Surface drainage is to be collected and directed away from the remnant edge so as to minimise the potential for weed invasion.
- The 10 m asset protection zone setback is to be landscaped with native canopy and understorey vegetation that complies with the minimum requires for fuel management within asset protection zones. The use of non-native turf is to be avoided within the asset protection zone.

These recommendations are embodied within the Schedule 1 - Restoration Works Plan where appropriate and Schedule 2 – Weed Clearance Plan.

Management Context 2

The following sections provide a brief description of proposed Coopers Paddock foreshore reserve, its natural habitat features and its current condition.

As previously discussed the proposed Foreshore Reserve (17.4 ha) incorporates a 6.76 ha protection and enhancement offset for the removal of native vegetation within the proposed industrial development lands.

The proposed restoration works will ensure a net maintain outcome in the total area of vegetation being removed. Consequently degraded areas will be rehabilitated to ensure the required offset outcome.

2.1 Site description

The planning and cadastral details of the site are provided in Table 1 which summarise the geographical characteristics of the site.

Table 1 - Site details

Location	Lot 1 DP 581034 – Governor Macquarie Drive, Warwick Farm
Description of Location	Situated on the southern side of Governor Macquarie Drive with borders to the Georges River (east and south) and a Sewage Treatment Plan (west). Approximately 3km to the north-east of Liverpool and part of the Warwick Farm Racecourse (horses)
Area	30.97 ha
Topographic map	Liverpool 1:25000
Local government area	Liverpool City Council
Existing land use	Partly remnant riparian vegetation and partly for horse training
Elevation	Approximately 0-10m AHD
Topography	Situated on gentle slopes, mostly less than 5% gradients except immediate adjacent to Georges River
Geology and soils	Geology within the site is medium rained sand, silt and clay as well as Clayey quartzose sand, and clay. Soils are weakly pedal orange heavy clays and clayey sands along the open forest areas which are often mottled; and disturbed in south-western portions where previous sandmining excavation appear to have occurred. The remaining areas have shallow to moderately deep (<100cm) hardsetting mottled texture contract soils.
Catchment	Georges River
Drainage	George River
Vegetation	Open forest or woodland that is riparian in nature
Introduced weeds	Exotic vegetation occurs in high frequencies across the subject site. Within remnant bushland areas the mid-storey has been highly degraded through the explosion of Lantana, Green Cestrum, Privet and Balloon Vine.
Evidence of feral, introduced or domestic fauna	Feral Cat, Horses, European red Fox, Common Blackbird, Common Mynas, Black Rat, Rock Dove, Red-Whiskered Bulbul, Spotted Turtle-doves and non-native snails were recorded during survey. These species have varying

	impacts on locally occurring native fauna species with particular impacts resulting from the presence of terrestrial feral mammal species.

Coopers Paddock contains moderate to steep slopes along the Georges River frontage and in the southern part of the site, with most areas vegetated occupied by degraded riparian forest communities. The site is directly connected to the Georges River foreshore.

Significant portions of the site have been heavily disturbed for past land uses including horse stables and training trails.

2.2 Vegetation communities

The following description of vegetation and selected images has been extracted from Ecological Constraints Report (*Travers bushfire & ecology,* 2011).

Three (3) vegetation communities (Figure 3) were identified within the subject site through aerial photographic interpretations and extensive ground truthing. These include;

- Riparian Open Forest (and variant – Planted *Corymbia citriodora*)
- Riparian Woodland (Managed Understorey)
- Cleared or Managed Landscape

2.3 Endangered Ecological Communities

***RIVER-FLAT EUCALYPT FOREST ON COASTAL FLOODPLAINS (RFEF)* – Listed Endangered Ecological Community**

General Description
The ecological community associated with silts, clay loams and sandy loams on periodically inundated alluvial flats, drainage lines and river terraces of coastal floodplains.

Habitat Requirements
- Geology / Soils: Alluvial soils of fluvial origin.
- Topography: Flood plains and associated flats and terraces.
- Most dominant canopy species of River-Flat Eucalypt Forest on Coastal Floodplains: *Eucalyptus amplifolia*, *Eucalyptus tereticornis, Angophora floribunda, Angophora subvelutina, Eucalyptus baueriana, Eucalyptus botryoides* and *Eucalyptus elata.*

Conservation Status and Distribution
Small areas of River-Flat Eucalypt Forest on Coastal Floodplains occur in existing conservation reserves, including: Blue Mountains NP, Cattai NP, Dharug NP, Georges River NP, Marramarra NP, Morton NP, Deua NP and Wadbilliga NP.

Key Threatening Processes
Clearing of native vegetation; alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; invasion of native plant communities by exotic perennial grasses; predation, habitat destruction, competition and disease transmission by feral pigs;

Riparian Open Forest (and variant – Planted *Corymbia citriodora*)

This vegetation community occupies the majority of the more heavily vegetated sections of the subject site in close proximity to Georges River. The estimated coverage of this community is 15.48 ha or 50 % of the subject site. The Riparian Open Forest is considered to be commensurate with the EEC – River-flat Eucalypt Forest on Coastal Floodplains (RFEF).

The canopy is generally 18-25m in height with the presence of common Eucalypt/Angophora species such as *Eucalyptus baueriana* (Blue Box), *Eucalyptus amplifolia, Eucalyptus bosistoana* (Coast Grey Box), *Eucalyptus botryoides* (Bangalay) and *Angophora subvelutina,* and the projected foliage cover is 10-30%. Some portions contain an overstorey of *Casuarina glauca* (Swamp Oak) on the western side of Coopers Paddock.

There was a sub-canopy layer present throughout most of the vegetation in close proximity to Georges River, dominated by *Acacia binervia* (Coast Myall) to a height of around 10-15m tall.

The native mid-storey layer has been heavily reduced because of the overwhelming presence of Lantana and vines. Common mid-storey species include *Acacia decurrens* (Black Wattle), *Acacia parramattensis* (Sydney Golden Wattle) and *Bursaria spinosa* (Blackthorn). There were very few other native shrubs encountered and they were generally sparse.

Photo 1 – Riparian forest vegetation 150m north of the Powerful Owl nesting area.

The ground layer of vegetation rarely exceeds 10% projected foliage cover for native species unless dominated by *Pteridium esculentum* (Bracken) and *Carex* species

around the swale areas. Common species include *Themeda australis* (Kangaroo Grass), *Cynodon dactylon* (Couch), *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* var. *stipoides* (Weeping Rice Grass), *Einadia hastata* (Berry Saltbush) and *Glycine clandestina* (Twining Glycine).

The vegetation comprising this community is heavily disturbed throughout by the introduction of in particular *Lantana camara* (Lantana) to the mid-storey. In some of the more gullied areas near flora quadrats 5, 6, 9, 10 and those located in swale areas including quadrats 7 and 8, the additional moisture content within the soil has allowed for a significant incursion of *Cardiospermum grandiflorum* (Balloon Vine) and *Ligustrum sinense* (Small-leaved Privet).

In the north-eastern portion of the subject site, *Corymbia cirtiodora* (Lemon-scented Gum) is a dominant species in the canopy as it has been planted. Within this same area were some Large Ironbark trees *(Eucalyptus fibrosa*) and occasional Turpentine trees (*Syncarpia glomulifera*).

Photo 2 – Riparian forest vegetation just south of the Powerful Owl nesting area.

Photo 3 – Corymbia citriodora variant in the north-eastern corner of the subject site

Riparian Woodland (Managed Understorey)

This vegetation community occurs as small highly disturbed clumps of vegetation in the northern portion of the subject site, typically distinguished by scattered remnant trees with a mown or cleared understorey. This vegetation community is estimated to occupy 0.7ha or 2 % of the subject site.

This area is slightly higher in elevation to the surrounding vegetation hence the useability for recreation (less constrained by flooding events).

The vegetation here is on the verge of being Cumberland Plain Woodland, a critically endangered ecological community however there is very little variation to that further south considering the grasses present and the saplings of shrub layer vegetation. Hence, the patchy fragmented vegetation is considered to be part of the same EEC, River-flat Eucalypt Forest on Coastal Floodplains. The determination is relatively consistent with that mapped by NPWS in 2003.

Vegetation would generally be similar to that described for Riparian Open Forest had it not been previously cleared.

Photo 4 – Riparian woodland vegetation in the central northern portion of the subject site.

The structure is more a woodland because of past clearing events and lack of shrub layer with a projected foliage cover of 3-10%. The most common tree was *Eucalyptus eugenioides* (Thin-leaved Stringybark). These were recorded within the Riparian Open Forest but not as a common species.

Cleared or Managed Landscape

This vegetation community occurs in all un-vegetated areas or those which are essentially just a grassland community that is typically mown. Those areas which are not mown normally contain well in excess of 50% weed coverage in the understorey. This community occupies 14.93 ha or 48% of the subject site and contains the grassed and landscaped area near the central building and the tracks nearer the western portion of the subject site. Prior to vegetation clearing it would have likely been further EEC – River-flat Eucalypt Forest on Coastal Floodplains.

Previous sand mining within the southern portion of the subject site has changed the natural topography and levels and caused some un-natural swales which would occasionally contain water after heavy rain, hence there is a presence of occasional tussock-type grasses, Carex and sedge species within this community.

Photo 5 – Cleared / managed vegetation in the far north-western corner looking south-east.

Photo 6 – Heavily disturbed weedy vegetation in the central western portion of the subject site.

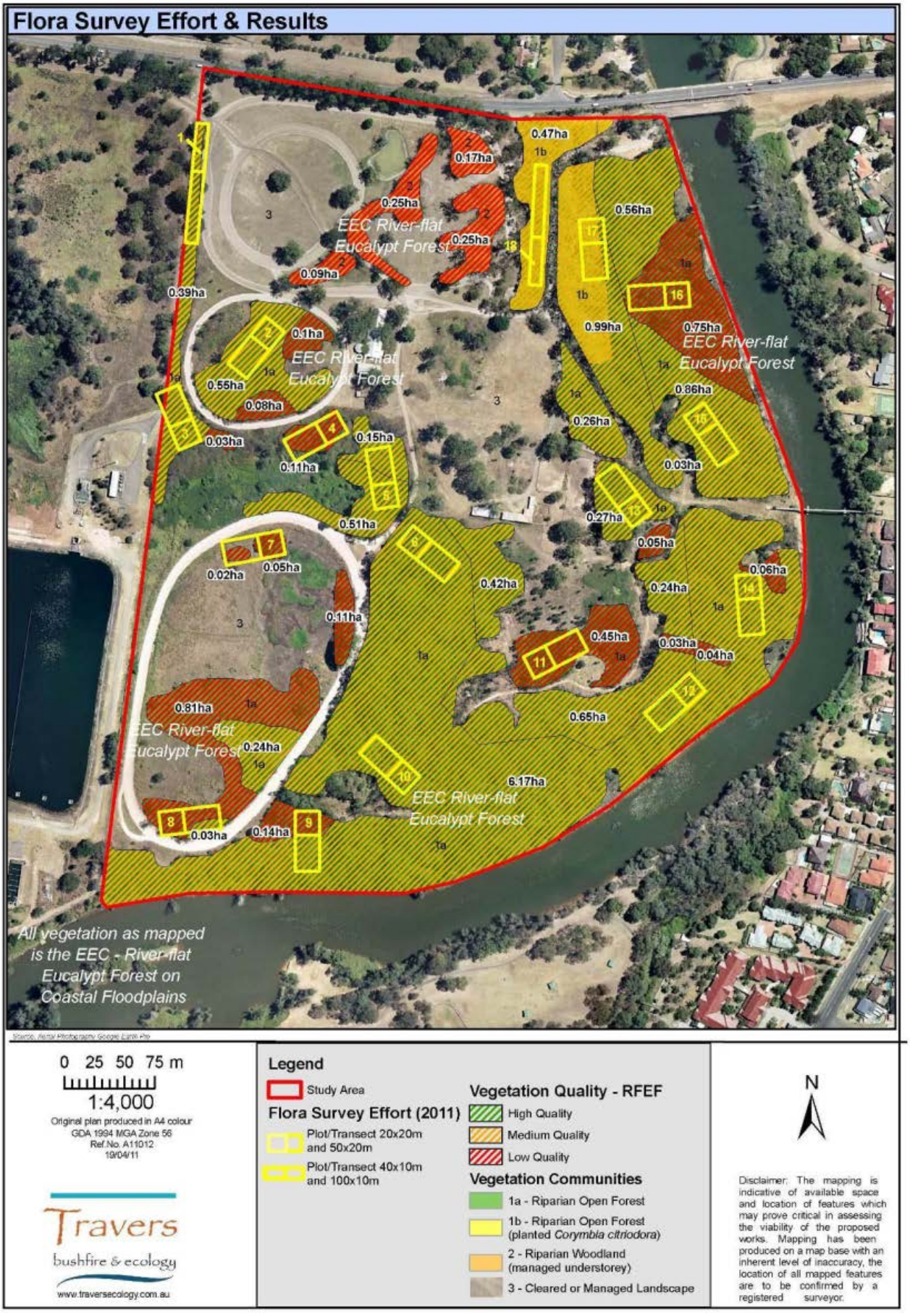


Figure 3 - Flora survey effort & results

2.4 Vegetation condition, connectivity and wildlife corridors

A detailed condition assessment (Figure 3) for offsetting and vegetation management purposes had been prepared by *Travers bushfire & ecology* in accordance with OEH vegetation assessment bio-banking methodology.

Figure 4 – Aerial appraisal showing current habitat connectivity generally associated with watercourses
(Source: Google Earth Pro 16.9.10)

A corridor is used to ensure wildlife can move between vegetation parcels that contain habitat characteristics suitable for each taxa and foraging opportunities for those taxa. In other words they need protection and food. For some wildlife the dispersal (home) range is quite small whilst others migrate over larger areas.

Vegetation connectivity to the subject site from other local remnants are limited to the narrow strips of riparian vegetation along the fringes of the Georges River that continues to the north and south-west – see Figure 4 above.

These narrow linear strips do eventually connect to other larger remnant patches however it may be said that the subject site provides the largest patch of remnant trees within 2km.

This gives obvious value to the subject site as a haven for fauna utilising the riverine corridors. In respect to native fauna species, the riverine corridors would assist movement mainly for waterbirds, forest birds of various sizes, raptors, owls, micro-chiropteran bats, and some small reptiles.

On-ground habitat will be enhanced through restoration of existing native vegetation and the establishment of on-ground and arboreal fauna habitat such as rocks, logs, a variety of foraging vegetation layers, and artificial nest boxes.

For contracting purposes a detailed vegetation condition assessment map will need to be prepared identifying understorey areas for biotic translocation and the preparation of a targeted weed control strategy. The vegetation condition map will also be reassessed on an annual basis to assess the progress of weed control, restoration and bush regeneration works.

2.5 Fauna

Fauna survey was conducted by *Travers bushfire & ecology* in 2011 which found a number of threatened species that consequently required further consideration including Powerful Owl, Varied Sittella, Black-chinned Honeyeater and microchiropteran bat species, such that the proposed zoning needed modification. This VMP has been updated to reflect the findings of target fauna survey and is consistent with the ecological approvals gained by NSW Office of Environmental and Heritage for the proposed rezoning.

The site has approximately 60 hollow bearing trees as surveyed by *Wheelans Insites,* 2008 (Figure 8) within the subject site (additional trees are located on adjoining ATC lands), and hollow dependent species are likely to be affected by the removal of these hollows. The removal of hollow bearing trees is a listed threatening process and mitigation measures are required to minimise impacts on hollow dependent threatened species.

Eight (8) threatened fauna species were recorded within or in close proximity to the subject site. Threatened fauna species recorded included:-

- Powerful Owl (*Ninox strenua*),
- Varied Sittella (*Daphoenositta chrysoptera*),
- Little Lorikeet (*Glossopsitta pusilla*),
- Grey-headed Flying-fox (*Pteropus poliocephalus*),
- Large-footed Myotis (*Myotis macropus*),
- Eastern Bentwing-bat (*Miniopterus orianae oceansis*),
- East-coast Freetail Bat (*Micronomus norfolkensis*) and
- Yellow- bellied Sheathtail-bat (*Saccolaimus flaviventris*).

The Yellow-bellied Sheathtail-bat was recorded only to a 'possible' level of certainty. One (1) additional threatened fauna species - Black-chinned Honeyeater (eastern subspecies - *Melithreptus gularis gularis*) has been previously recorded on the other side of the Georges River as evident from the Atlas of NSW Wildlife Database records (OEH 2011) and likely utilised the subject site on these occasions.

Two (2) protected migratory fauna species listed under the EPBC Act (1999) - Rufous Fantail (*Rhipidura rufifrons*) and Satin Flycatcher (*Myiagra cyanoleuca*) - were recorded within the subject site.

Figure 5 shows the location of the threatened fauna as recorded by *Travers bushfire & ecology,* 2011. It also shows the boundary of the Powerful Owl roosting area to be protected inclusive of the revegetation buffer to further enhance the vegetative buffer present.

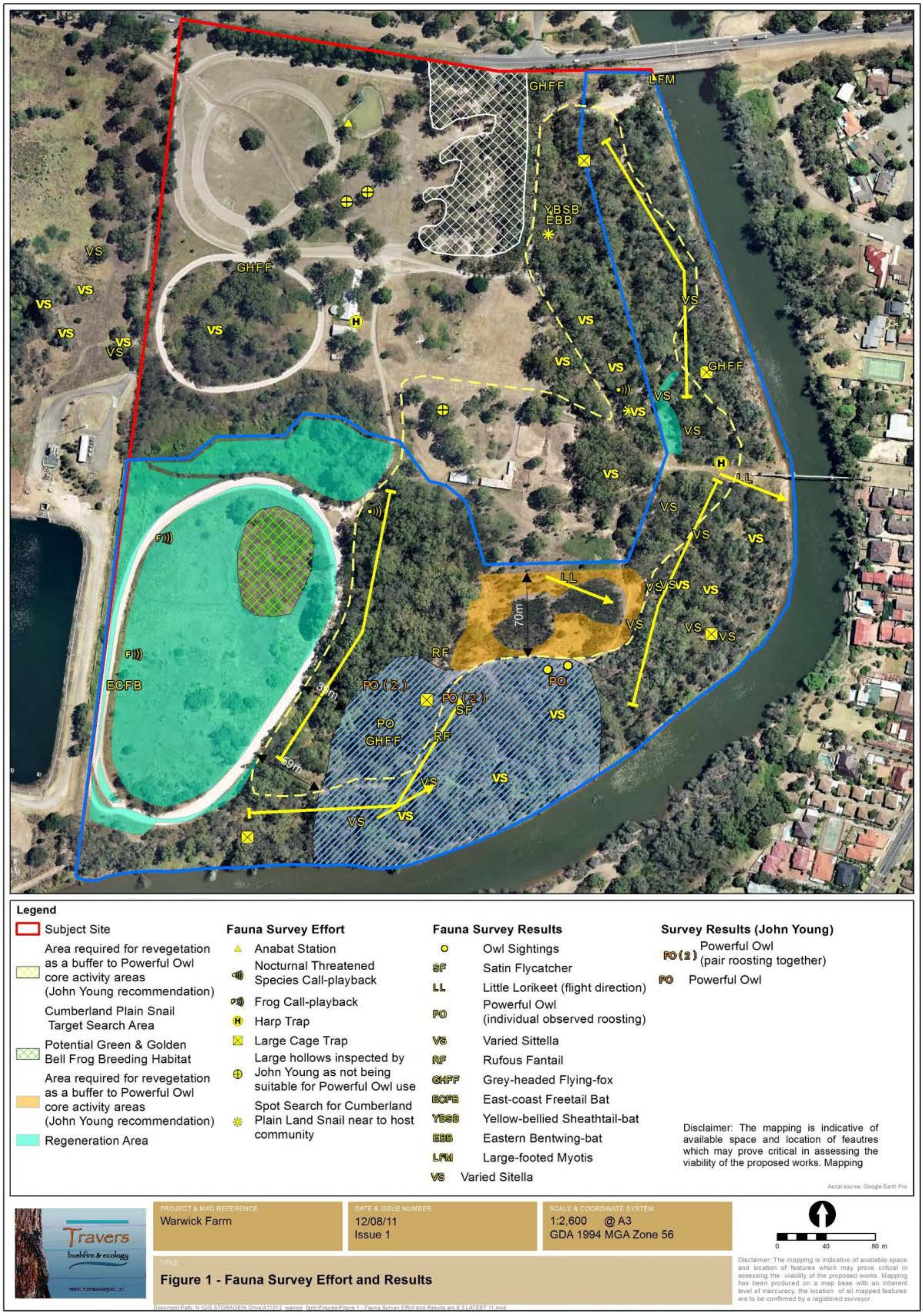


Figure 5 – Fauna survey effort and results

Figure 6 identifies the location of recorded threatened species within the Warwick Farm locality. Of these records, Green and Gold Bell Frog, Varied Sittella, Eastern Bent-wing Bat and Black– chinned Honeyeater have been recorded onsite. The Little Eagle, Little Lorikeet, Regent Honeyeater and Powerful Owl have been previously recorded in the locality.

The Powerful Owl and the Little Lorikeet are hollow dependent species and consequently hollow resources within the industrial development Lots may contain suitable nesting or roosting habitat. Section 2.7 describes the hollow characteristics within Coopers Paddock and section 3.7 identifies the process for removal of hollow bearing trees and the handling of wildlife and the appendices contains nest box design specifications for replacement hollows.

A thorough assessment of hollow bearing trees is to be undertaken prior to removal of trees within the proposed industrial area to allow the reuse of hollows and relocation of any resident fauna.

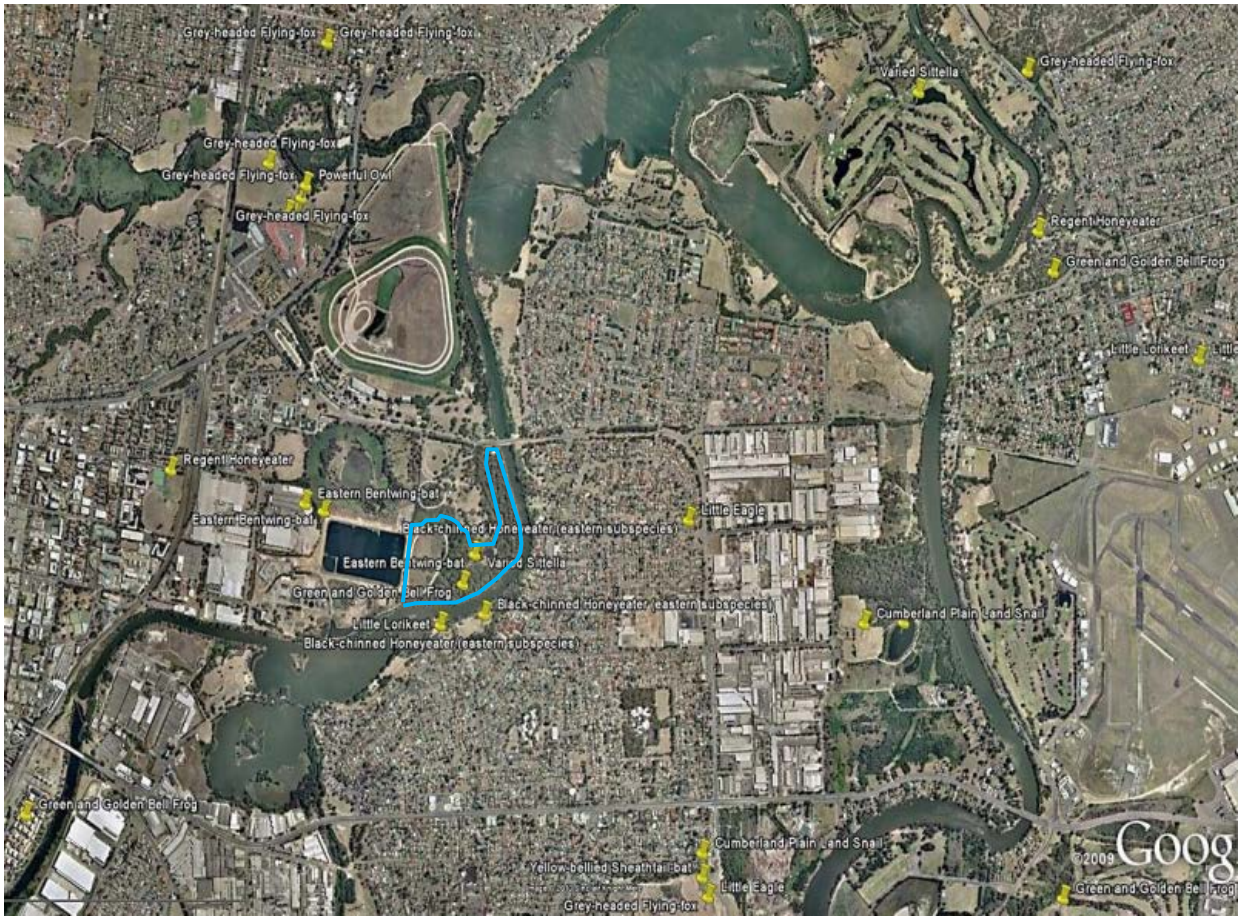


Figure 6 – Threatened species record locations within Warwick Farm locality
(Source: NSW Atlas Database – Penrith Fauna Sheet 2010)

2.6 Bushfire risk

The Bushfire Protection Assessment (*Travers bushfire & ecology* 2010) found that bushfire can potentially affect the proposed rezoning lands from the foreshore forest adjoining Georges River to the south and east of the Coopers Paddock site resulting in possible ember attack, radiant heat and potential flame attack.

The bushfire risk posed to the site however will be reduced to an acceptable risk if

appropriate bushfire protection measures are adopted.

The assessment has concluded that the proposed rezoning can support future development with the potential to provide:

- Defendable space in accordance with *Planning for Bushfire Protection 2006 (PBP 2006)*.
- Construction of the buildings in accordance with *AS 3959 (2009) Construction of buildings in bushfire prone areas.*
- Compliance with access and egress as per Section 4.1.3 of PBP (2006) Bushfire protection measures that are recommended are illustrated on Figure 7 below.

Figure 7 – Industrial Bushfire Setbacks (Travers Bushfire & Ecology 2010)

2.7 Habitat trees

Whelans Insites Pty ltd (2008) mapped 92 hollow bearing trees within Coopers Paddock and within the SE Corner of the Warwick Farm Racecourse lands (Figure 8 and Table 2). The 92 hollow bearing trees contained 28 large hollows, 110 medium sized hollows and 92 small sized hollows. Subject to hollow condition, the existing hollows provide a diverse range of hollow types to support local wildlife. Note that the ground line represents an old reserve boundary line which has been adjusted since 2008.

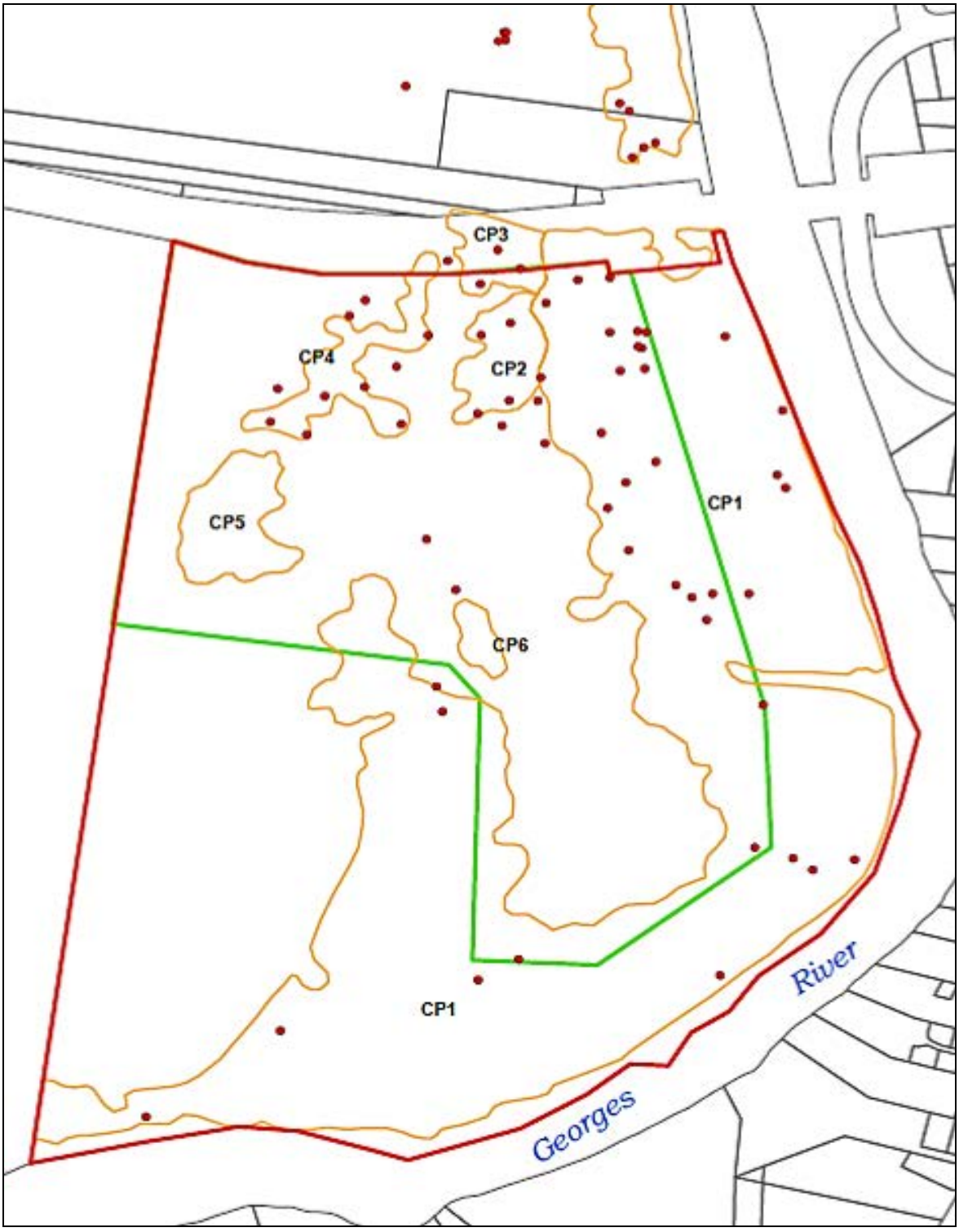


Figure 8 - Hollow bearing trees
(Source: Figure 4 - Whelans Insites 2008)

Note that the ground boundary of the conservation corridor was amended after the figure was produced.

Table 2 – Tree hollows within Coopers Paddock & SE corner of the racecourse land
(Source: Wheelans Insites 2008)

Trees with Hollows			Number of Hollows				
Species	**Common Name**	**Number**	**Small**	**Medium**	**Large**	**Owl**	**Total**
Angophora subvelutina	Broad-leaved Apple	1	0	0	1	0	1
Corymbia citriodora	Lemon-scented Gum	1	1	0	0	0	1
Eucalyptus eugenioides	Thin-leaved Stringybark	32	38	29	6	0	73
Eucalyptus baeuriana	Blue Box	2	1	2	0	0	3
Eucalyptus botryoides	Bangalay	14	9	13	5	0	27
Eucalyptus saligna X botryoides	Blue Gum x Bangalay	13	4	26	2	0	32
Eucalyptus sp. cultivar	Cultivar	5	1	0	5	0	6
Eucalyptus tereticornis	Forest Red Gum	3	1	4	2	1	8
Stag	Stag	21	39	36	7	0	82
	Total	**92**	**94**	**110**	**28**	**1**	**233**

Approximately 18 (20%) of the identified trees will be retained within the proposed Coopers Paddock Foreshore Reserve. Further hollow bearing trees are present within the foreshore reserve which have not been mapped to date. Whilst further habitat trees will be protected within the foreshore reserve, there are likely to be significant hollows removed as a result of the proposed industrial development. Hollow-bearing tree removal guidelines (Section 3.7), have been incorporated into this VMP to minimise the potential impacts on residential fauna.

Restoration Strategy 3

The restoration strategy to be adopted within the site is based on relocation of high quality habitat resources, protection of existing native vegetation within the Foreshore Reserve, restoration of locally occurring native species, extensive weed control works and ongoing maintenance to achieve stipulated performance targets.

In accordance with the approval given by the NSW Office of Environment and Heritage, the following restoration works have been identified (Schedule 1 – Restoration Works).

3.1 Restoration management zones

The Foreshore Reserve contains several management zones (as shown on Schedule 1 &2):

- Areas A – E is the former quarry area requiring targeted weed control and revegetation works
- Areas F, I – L contains remnant bushland areas containing extensive lantana infestations (low resilience understorey with and without native canopy)
- Areas G1, G2 and G3 form part of the Powerful Owl buffer zone (with a restriction on the timing of works) also progressive weed removal and revegetation works (typically having a moderate level of resilience)
- Areas H1 and H2 form the core Powerful Owl Protection Zone (with a restriction on the timing of works) requiring less intense weed clearance and revegetation works (typically has a higher level of resilience).

As shown on Schedules 1 – Restoration Works Plan and Schedule 2 – Weed Clearance plan, works within each management zones are staged over a total period of 3 years from 2015 to 2018. Year 1 is inclusive of the offset works, Years 2-3 are inclusive of all works associated with the management of the designated land over a 2 year period. Ongoing management by Council will be required upon handover by the ATC after the three year VPA period.

The least resilient areas are scheduled to commence as a higher priority to the more resilient areas as evidenced by extensive vine infestations. Therefore the existing degraded areas in the former extraction area and surrounding slopes will be commenced first following by the eastern most Georges River foreshore and finally the Powerful Owl protection area which appears to have a resilient native ground layer in areas of dense canopy.

To facilitate access for regeneration purposes and subsequent works, addition tritter lines have been identified on Schedule 2 – Weed clearance plan. The tritter trails are to be undertaken under the supervision of the project ecologist or project ecologist representative.

Primary weed clearance commences in 2015 and continues over the next 3 years finishing in 2017. Whereas revegetation works commences in 2016 and finishes in 2018.

3.3 Restoration techniques

The Foreshore Reserve will be managed in the following manner:

- The Foreshore Reserve is to be protected for the benefit of Liverpool City Council for ecological protection.

- Except for the proposed cycleway and restoration works, there will be no disturbance to existing trees within the Foreshore Reserve except for the purposes of removing noxious or environmental weeds, restoration works, management of dangerous trees of no habitat value immediately adjoining the foreshore reserve boundary and the installation of pathways (Schedule 2).

- With the exception of the proposed cycleway, boundary fencing and the maintenance access, no further services, vehicle access, garbage bins, permanent fencing, stepping stones is to be erected or installed within the Foreshore Reserve except for that shown on Schedule 1 – Restoration Works Plan and Schedule 2 – Weed Clearance Plan as contained in this vegetation management plan.

- The design and construction of the cycleway is to conserve and protect as many of the mature trees as possible by selecting a route that minimises tree loss. Preference is to be given to removing dangerous or heavily suppressed sub-canopy trees for installation of the pathway and choosing a route through degraded areas. The pathway construction is to also minimise damage to existing root zones of mature and good condition trees.

Given the site's ecological significance, the primary objective is firstly to conserve and restore the locally occurring native vegetation, and secondly to provide a public recreational space.

Bush regeneration is a key component of the proposed restoration works which typically involves weed control, removal of any weed material or waste and revegetation / regeneration of ground and shrub layers typical of RFEF vegetation. In this case the extent and density of weeds is a significant restoration task and will mostly determine the ability to regenerate the locally occurring native vegetation. As indicated on Schedule 2 – Weed Clearance Plan, significant areas of vegetation contains only Lantana and no other native canopy of suppressing vegetation. Vines are also highly prevalent within and immediately surrounding the extraction area and a part treated infestation of Alligator Weed is present within a drainage line on the Western boundary.

Revegetation within the Foreshore Reserve is to provide a high representation of non-eucalypt rough-barked tree species for the Varied Sittella and to mitigate against the further encroachment of Noisy and Bell Miners into quality passerine bird habitat areas. These miner species tend to have higher presence in open woodland and eucalypt dominant areas.

Primary and secondary weed clearance works

- Protection of resilient areas
- Installation of access trails using a forest mulcher to divide the site into manageable weed control units.
- Progressive primary weed removal of all major weed infestations using a forest mulcher followed by targeted weed control and removal within more resilient areas.
- Progressive secondary weed removal targeting regrowth of weeds
- Seeding of native grasses in less resilient areas to resist the regrowth of colonising weed species.
- Ongoing weed control with less resilient areas to ensure the success of revegetation works.

Bush regeneration works

- Collect seed from trees for revegetation purposes and provide local provenance stock for revegetation purposes.

- Install temporary or permanent fencing to control access during restoration.

- In bare areas, direct seed with native grasses, groundcovers and enrichment planting of shrub and canopy layers.

- Regenerate, control weeds and landscape maintenance commencing after practical completion of the primary restoration works (Section 7 – program of works).

- Installation of suitable logs, laying hollows harvested from the industrial subdivision area into the Foreshore Reserve.

- Installation of a minimum 70 artificial nest boxes shall be provided consisting of 30 microbat boxes, 10 small bird boxes, 20 medium boxes and 10 large boxes within the Foreshore Reserve.

- Managed by an experienced and qualified Project Ecologist.

Revegetation works

- Commence pest control including a Pindone baiting program for rabbits and 1080 for foxes. Destroy existing rabbit burrows (deep rip) and continue rabbit baiting every 3 months for a minimum of 3 years.

- Weed control and scalping all weeds from the recipient areas whilst protecting threatened flora, suitable fauna habitat, retaining significant stands of native vegetation or remnant juvenile or mature trees, shrubs and native ground covers.

- Prepare site for planting by deep ripping, removal of waste, installation of protective fencing and access to temporary or permanent water supplies for irrigation purposes. Please note that access to a pumped water supply or large tank onsite is recommended.

- Mass planting of locally occurring native shrub and canopy species where canopy gaps are present. This may be supplemented with brushmatting.

- Direct drilling from collected native seeds is recommended to enhance the regeneration of native plants and reduce the level of potential planting required. Planting of native grasses may be undertaken in addition to the above plantings if advised by the Project Ecologist or contract bush regeneration team.

- Direct seeding is an important strategy in achieving the required species diversity, density and coverage within the restoration areas. The use of grasses from tubestock is too costly and cannot achieve the required outcome within the timeframe of the VMP.

- Mulching to minimise weed infestations in selected locations. Mulching is not to be undertaken in areas that have been direct seeded.

- Weed control and landscape maintenance for a period of 3 years commencing after practical completion of primary restoration works and on an ongoing basis.

- Weed control, seeding and revegetation works is to be undertaken to maintain control over the spread of invasive weed species including Common Couch, Paspalum, African Lovegrass, invasive vines and other common weed species. Regular weed and effective control that meets the performance targets is an auditable process.

- Contingency restoration works are to be proposed subject to the performance of the primary, secondary and maintenance restoration works which may involve target weed control and additional revegetation works in areas that have failed. The minimum plant densities, percent weed cover and species diversity is to be achieved across the entire biotic translocation and revegetation areas.

To ensure a long term and secure conservation outcome it is best practice for the Foreshore Reserve is to be designated as public conservation area with an ecological objective of conserving and restoring the existing native vegetation.

3.4 Biotic translocation of native vegetation and soils

Biotic translocation will only be utilised as a supplementary strategy for achieving performance targets. It may be utilised in localised areas subject to Project Ecologist directions. Given the limited area of native vegetation being removed within the proposed industrial zone and the degree of weed infestation, biotic translocation is likely to only involve the harvesting and relocation of hollow bearing trees, logs or native mulch for regeneration purposes. Mulch from removed trees may also be strategically used to suppress weed growth particularly on the interface within the industrial area or to suppress exotic grass regrowth following weed treatment.

The translocation of biotic material that is native vegetation and the soil upon which it resides is an important biodiversity conservation measure and a very cost effective method(s) of restoring native vegetation areas. Significant savings and a better outcome compared to a traditional revegetation processes can be achieved. Biotic translocation has the advantage that significant native vegetation regrowth can be stimulated through a bulk relocation process integrated with the stripping of vegetation and topsoils from the proposed industrial lands and levelling for the construction of building pads. Excess soil not to use with the development area can be used to reshape the restoration area and provide a suitable landscape outcome.

Whilst weeds are also translocated, the stimulated native regrowth is often significant and significant reduces the cost of revegetating highly disturbed landscapes. In concert with a weed control program and enrichment revegetation of missing native plant species to supplement natural regeneration from the soil seed bank and spread seeds, highly diverse native vegetation can be created in a highly disturbed landscape.

The translocation of soil and vegetation is a two phase process that identifies a “Borrow Area” and a “Recipient Area”, that require different treatment specifications (Appendix A3 – Biotic Translocation Method). This translocation method has been approved for use by OEH for the relocation of specific endangered ecological communities and sufficient trials have been undertaken to prove the method of restoration. The method is designed to minimise the disturbance to the borrow (harvest area) and recipient (restoration area) sites, its vegetation and soil seed bank that can be used to conserve genetic diversity and restore a natural vegetation community. The soil seed bank is a critical resource that is used to provide long term resilience against disturbance whether it be physical, biological or major events such as bushfires.

The adopted process is based on successful soil translocation works for the endangered ecological communities “Duffy’s Forest”, “Blue Gum High Forest” and regeneration trials which have been in process since 2001 (*Kate Low and Associates 2001* & *Travers bushfire & Ecology 2010*). These sites trailed many methods of promoting regeneration from the soil seed bank. The findings of these studies found that the physical disturbance of the soil during translocation, combined with direct drilling of local provenance seed stock, weed control, pest control and provision of protection such as brush matting provided the best possible regeneration outcome without the need for planting of tube stock.

3.5 Burns and fuel reduction within the Foreshore Reserve

Given the size, structure, type and location of the native vegetation onsite and the close proximity of urban areas within and adjacent to the subject site, an ecological burning regime is unlikely to be implemented within the site.

Ecological or Bushfire Hazard Reduction burns require appropriate assessment, planning, permits and execution and are only undertaken with the advice, direction and assistance of the Rural Fire Service or NSW Fire Brigade and Council.

The Foreshore Reserve is not required to be managed for fuel reduction purposes. Ecological burns or pile burns however may be appropriate subject to suitable assessment and issue of a permit under Section 91 of the NPWS Act.

Future management of the reserve may see the need for implementation of Land Management Zones inclusive of ecological burns to promote regeneration of native vegetation and to provide mosaic habitat patterns within the reserve. This however is not proposed under this VMP given the degree of weed management and revegetation works required but may be considered as a future plan of management issue after handover to Council.

3.6 Recreation activities within the Foreshore Reserve

Given the conservation status of the existing vegetation, active recreational pursuits should generally be limited to walking, cycling or running along the provided cycleway within existing vegetated areas and proposed revegetation areas.

As Warwick Farm Racecourse is a heritage feature of the local area, access along the cycleway by horses appears appropriate provided access is limited to the nominated access routes.

To enable this area to be maintained and accessed by the public it is proposed to make allowance for an access road into the open grass area.

3.7 Provision of cycleways, walking trails and maintenance access

In accordance with the Planning Agreement a shared path of a minimum width of 2.5m shall be constructed within the designated land along the foreshore and within the Coopers Paddock site as shown on Schedule 1. The proposed location of the pathway subject to detailed design and route assessment.

Walking trails and bike paths also function as an access route for weed control teams and landscape maintenance crews. Consequently the access needs to be able to provide sufficient width for a 2WD utility (weed control cart) or ‘Alligator” style 6 wheeled vehicles for the carrying of equipment and removal of vegetative waste and litter. The proposed pathway will provide access through the foreshore reserve but temporary access along walking trails will be required to access all weed treatment areas.

Walking trails through the restoration areas are to be closed unless it provides a suitable access trail for weed control or bush regeneration teams. Vehicle access to this track will however need to be restricted to maintenance crews only.

3.8 Management of hollow-bearing trees

All trees to be removed should first be inspected for fauna occupation and identification of potential hollow bearing Trees. The guidelines for the removal of hollow bearing trees are;

I) The fauna ecologist is to inspect all potential habitat trees prior to removal and identify evidence of fauna use. All clearing of habitat trees is to be done under the direct supervision of an immunised fauna ecologist with a valid Scientific Licence under the NPW Act.
II) When fauna are present, the animals are to be removed through section dismantling of the hollows and relocated prior to felling or the tree under the supervision of the fauna ecologist.
III) Trees should be pushed over using an excavator or similar technique only once the tree has been cleared of any wildlife allowing the recovery of high quality hollows that are to be sectionally removed and lowered to the ground before felling.
IV) Any natural hollows removed by the development are to be placed wherever possible as ground hollows within retained bushland under the supervision of the consulting ecologist.
V) All replacement nest boxes are to be secured to trees at a minimum height of four metres above ground level facing the east to northeast direction. Nest boxes and re-erected limbs are not to be placed near locations where public access is planned along reserve areas. All nest boxes and re-erected limbs will be inspected annually and any damaged, or in danger of falling, are to be repaired or replaced.
VI) A fauna ecologist is to locate appropriate trees and locations for installing the nest boxes.
VII) On-ground refugia is to be retained where possible consisting of rocks, logs, and wherever appropriate dense under-storey native vegetation. Felled or damage hollows from the building site are to be used within the restoration area as on ground habitat.

A minimum of 70 artificial nest boxes shall be provided consisting of 30 microbat boxes, 10 small bird boxes, 20 medium boxes and 10 large boxes within the Foreshore Reserve.

Artificial nest boxes are to be built and installed in accordance with the attached nest box design (Appendix 4) and as recommended by an experienced fauna ecologist. A fauna ecologist is to locate appropriate trees, locations, aspect and heights for installing the nest boxes.

On-ground refugia should be relocated or retained where possible consisting of rocks, logs, and wherever appropriate dense under-storey native vegetation. The hollow bearing trees that are to be dismantled are to be placed on the ground within protected areas to be utilised by ground dwelling fauna.

3.8.1 Handling of resident wildlife within vegetation clearance areas

To minimise the impact of tree removal on resident fauna the following procedure is to be implemented during tree removal works.

Pre Clearing

At least one week's notice will be needed prior to the planned date for clearing of any trees.

This is required so as to allow suitable time for inspections of trees for use by fauna and to plan for the safe felling of the tree and removal of fauna if present. A fauna ecologist will inspect the trees for use by fauna. This may include inspection of trees at sunset (stag watching) that allows for the detection of diurnal fauna returning to hollows or nocturnal fauna leaving for the night.

In some cases physical inspections of hollows by climbing trees and insertion of camera probes may be required. This will be carried out by suitably qualified arborists under the direction and supervision of the fauna ecologist.

During Clearing

Where fauna is identified within a hollow and the risk of death or injury as a result of machine felling of the tree is high, the tree may need to be felled in sections. This will involve the removal of hollow limbs or sections by chainsaw with the hollow limb lowered to the ground for removal and relocation of fauna. These works are to be carried out by a suitably qualified arborist under the direction of the fauna ecologist.

In those trees that contain hollows and no fauna has been observed, the tree will be machine felled after recovery of high quality hollows as advised by the fauna ecologist.

The tree will first by inspected by the fauna ecologist and provide instruction on the felling technique which may require sectional dismantling or lowering of trunk sections to the ground for inspection of recovery of wildlife. All hollow limbs will be inspected after felling for occupation by fauna. Any fauna will be removed and relocated to adjoining bushland by the fauna ecologist.

Where young fauna are identified within a hollow whose survival will be at risk as a result of the removal of the hollow or the felling of the tree, then clearing will not be carried out until those young are old enough to leave the hollow and under the care of the parents. It is suggested therefore that clearing is not carried out during breeding times when young are likely to be present within hollows (Spring-early summer).

Where possible, hollow limbs removed from trees will be collected by the fauna ecologist for re-erection/ reuse at a later date. High quality hollows may be used for reinstallation into trees as a replacement for constructed nest boxes of similar size and type. Any fauna injured during clearing will be handed to WIRES for care and rehabilitation.

3.9 Pest fauna management

A critical pest management issue for Coopers Paddock is the control of Bell Miners and Noisy Miners which compete with Varied Sittella for the existing habitat. In accordance with specialist advice, revegetation within the Foreshore Reserve is to provide a high representation of non-eucalypt rough-barked tree species for the Varied Sittella and to mitigate against the further encroachment of Noisy and Bell Miners into quality passerine bird habitat areas. These miner species tend to have higher presence in eucalypt dominant areas.

The following methods are considered appropriate techniques for pest fauna management within the subject site given the nature of the development;

- trapping
- baiting
- fertility control (de-sexing)
- exclusion fencing

- restraint of domestic animals

In the context of this site, baiting for rabbits and exclusion fencing will be undertaken to maximise the potential regeneration outcomes and to maximise the survival of planted native tube stock. The following guidelines are provided for application of the relevant technique.

Trapping has been used successfully to control predators and for commercial purposes. There are numerous types of traps available for the capture of cats, dogs, foxes and rabbits, all with varying success and animal welfare issues. Cage traps are generally preferred over snare traps and jaw traps which can injure or kill both target and non-target species. Consequently, there are legal requirements and strict guidelines for undertaking any trapping exercise. Liaison with the Rural Lands Protection Board, Local Council and the National Parks and Wildlife Service is required before considering any trapping programs.

Baiting involves the use of a variety and bait types, depending on the target species. The most common baiting poison used today for the control of feral dogs, cats, foxes and rabbits is *Sodium mono-fluoroacetate* (1080) – Pindone Bait. These baits are generally target specific; however, accidental poisoning of domestic animals and children can theoretically occur. Consequently, there are legal requirements and strict guidelines for undertaking any baiting exercise. Liaison with the Rural Lands Protection Board, Local Council and National Parks and Wildlife Service is required before considering any baiting programs. Strict adherence to the label instructions, approved baiting methodology, notification and installation of signage must be complied with at all times.

Fertility control involves the reduction or removal of reproductive performance, and hence population densities using administration of anti-fertility agents (hormones), or de-sexing operations. Due to the need for appropriate doses of anti-fertility agents required for the target pest species, anti-fertility treatment is not recommended for use on animals other than those which are domesticated.

Similarly, de-sexing of domesticated species is a viable option for control.

Exclusion fencing involves the erection of fences as a barrier to pest species movements into and out of the subject site. Exclusion fences may be fully enclosing but are not intended to stop the movement of all wildlife. Sediment fences are effective temporary measures to discourage rabbit access to smaller restoration areas which also perform other functions as exclusion of invasive grasses and sediment control.

Pest control will be required for the duration of the works.

3.10 Hydrological, erosion control and sedimentation management

Mitigation measures will need to be put in place to lessen any potential impact on the hydrological environment from the drainage of construction areas on site. Any existing native vegetation or drainage line not being altered by approved stormwater and drainage construction works shall be protected by sediment fences along the top of bank, temporary sand bags used in areas that are eroding or appear to have potential to erode in larger storm events during the course of construction works.

Drainage lines are to be stabilised with open weave jute mesh or geotextile fabric as a temporary measure until the final landform has been achieved. Temporary hale bale and filter fences are to be installed where needed to minimise erosion and sedimentation within protected areas. All temporary sediment and erosion control measures are to be maintained when 40% capacity is reached, and reinstated or removed once the ground

surface is stable. All sediments left behind after removal of the temporary sediment control measures is to be removed and the ground surface “made good” in accordance with the approved landscape plans.

The immediate embankment of the Georges River will be kept stable at all times and any weed rootstock must remain in the ground after poisoning to bind the soil. Where appropriate open weave jute mesh is to be securing laid to minimise surface erosion. All exposed riverbank areas are to be planted immediately after adequate weed control is achieved. Long stem tubestock may be considered for stabilisation purposes.

Additional measures may be required subject to unexpected variations in surface drainage or works. These measures are to be approved by the project ecologist. All sediment and erosion originating from the broader industrial site are to be controlled prior to reaching the Foreshore Reserve.

Within the restoration area, low impact bushland regeneration practices will be adopted to minimise the mobilisation of sediment. These practices include hand removal of weeds as opposed to high impact methods such as machinery and vehicles. Forest mulching lays a surface mulch on the ground and is an acceptable primary weed removal techniques in areas of low resilience and dense weed infestation. Standard sediment and erosion control measures are to be installed where there is potential for sediment to be mobilised.

Erosion and sediment control measures are to be implemented on a needs basis to minimise adverse impacts as a result of increased erosion and sediment loading. These measures include:

- Coordinated work practices aimed at minimising land disturbance.
- Identification of potential erosion areas.
- Control of sediment through construction of permanent or temporary fencing, straw bales, sand bags, rock checks or sediment basin/s if required.
- The minimisation of groundcover disturbance through the dedication of vegetation protection zones.
- Installation and maintenance of flow, erosion, sediment and nutrient control structures.
- Routine site inspections of any sediment control fences and/or structures.
- The safe disposal of all waste products.
- Installation of a high grass lined earth berm to act as a level spreader to allow sheet flow to exit the site.
- Stockpiles of soil should be stabilised if they are to be in place for more than ten (10) days by methods such as hydromulching.

All staff involved in construction works on site shall be inducted on the ecological issues pertaining to the vegetation and habitat on site, and the importance of marked “No Go Areas”.

Hay bale reinforced sediment fences are to be installed around work areas that have the potential to cause erosion and impact upon drainage lines or where runoff can move quickly across the site. These sediment fences are to be regularly checked for any faults and replaced as necessary as part of the site maintenance works. The Project Ecologist shall determine when and if necessary these sediment fences can be removed. They should be in place for a period of at least 18 months after revegetation has been completed.

Mulching is an efficient method to impede the establishment of weed species, soil erosion, compaction and desiccation. Mulching is not to be used in regeneration areas where the

mulch layer is likely to suppress the germination of native plant species.

Mulch or tub grindings generated from the removal or thinning of native trees associated with the development is to be placed at a depth of 75-100mm covering any proposed 'landscape beds' but is not to be placed in direct seeded areas. Areas surrounding the stems/trunks of plants are to be kept free from mulch, thereby reducing the incidence of collar rot on retained or planted flora. Mulch to be used in landscaped and restoration areas is to be certified weed free from tree lopper's mulch, or obtained from the removed vegetation on site if possible.

The drainage line off the Georges River to the east of the wetland will require adequate protection and stabilisation works over the duration of the VMP. As weeds are removed from the drainage line leaving patches of bare earth, these shall be remediated through the placement of open-weave jute mesh and planted with tubestock. Machines (tritter) may be permitted within this area but where the drainage line passes through the Power Owl buffer zone, restrictions may be applied from May – November.

The embankment of the Georges River is to be protected through the provision of a 15m buffer from the approximate normal high tide level where there will be no machine removal of vegetation. Root masses of vegetation proposed for cutting/painting will be retained in situ to limit the potential for erosion and cumulative sedimentation of the river.

3.11 Vegetation protection, tree protection & access into restoration areas

Access to all active regeneration areas (Schedule 1 / Schedule 2) will be controlled by the Site Manager. A permanent boundary fence is to be placed on the Conservation reserve boundary between the industrial site and the river. A 1.2m high five plain wire strand rural fence is the minimum standard required for permanent protection. Alternative fence types are to be approved by the project ecologist.

Plant protection will be provided by the following measures:

- Use of 2L cardboard or equivalent plastic guards around tube stock plants to protect against weather phenomena and grazing animals in the early stages of growth,
- Installation of sediment fences around external or internal weed infestations to protect restoration areas from invasive grass species,
- Placement of mulch around individual plants to minimise soil moisture loss and to slow weed growth (not to be used in translocation areas but in landscaped areas only),
- Laying of course native brush to minimise rabbit grazing (to be used in translocation areas), and
- Pindone and 1080 baiting to eradicate or control existing rabbit and fox populations.

Long-term vegetation protection will require pest fauna management as described in section 3.8. Appropriate signage is to be installed to identify that restoration works are being undertaken and the activities permitted within or adjacent to the remnant bushland areas.

Weed Management 4

The following weed management and maintenance works are to be undertaken within the Foreshore Reserve. No plant species other than those associated with RFEF will be planted or used in revegetation works or established within the Foreshore Reserve.

The objectives of weed management actions are to protect and rehabilitate the RFEF and in doing so to maintain and enhance existing fauna habitat in the medium to long term. This will primarily involve the removal of weed infestations, bush regeneration, enrichment planting of suitable native endemic species for foraging and the ongoing maintenance of remnant vegetation and disturbed areas.

Progressive removal of weeds across the site is required in accordance with the Ecological Constraints Report (2011) and the recommendations of the expert advice contained therein. Weed removal is to be undertaken over an extended period to allow fauna to relocate and establish new breeding sites affected by weed control. In addition weed control is to be avoided in critical breeding areas during the breeding seasons of both Varied Sittella (August to January) and Powerful Owl (between March and November).

Given the size of the site weed control works can be selectively undertaken to avoid works during breeding seasons.

A number of planted shrubs and trees occur across the site, particularly in the northern portion and planted *Corymbia citriodora* species within remnant bushland in the north-east. Whilst these have been given a lower priority for removal (Appendix 2) as they tend to be less invasive, they will are to be removed as part of the works. Removal of *Corymbia citriodora* from the Foreshore Reserve will open up parts of the canopy to allow for natural and assisted regeneration and revegetation of naturally occurring native trees. The specimens occur sporadically within the reserve area but dominate only approximately 0.03 ha along the edge of vegetation along Governor Macquarie Drive. Within the reserve, trees will need to be removed by machinery, and seedlings may be cut / painted.

4.1 Weed management strategy within the Foreshore Reserve

Subject to the resident fuel loads, it is recommended that natural recruitment of the tree, shrub and groundcover layers be encouraged to regenerate within designated protected areas. There is currently a number of bush regeneration techniques used in bushland management for the removal of weeds. The bush regeneration process involves (Buchanan, 1989):

- Minimal soil disturbance during weed removal,
- Clearing and stabilising techniques,
- Selective use of targeted herbicides,
- The use of fire (pile burns),
- Biological controls – such as ‘rusts’ and competitive planting, and
- Use of temporary barriers such as sediment fencing to exclude invasive ground layer species.

Regeneration requires the removal of weeds in phases. Stages of weed removal can be broken into three components:

Primary Weeding

Primary weeding is the initial weeding. It is recommended that primary weeding should be carried out to remove the majority of dominant weeds. This involves removal of weeds through herbicide use and hand removal. It is important to note primary weeding usually initiates new growth of both weeds and native species. The Foreshore Reserve will form the focus of the primary weeding stage of works.

Secondary or Follow-up Weeding

Secondary or follow-up weeding involves intensive weeding in areas that have already received primary work to remove weed regrowth or overlooked weeds. It is recommended that secondary weeding be conducted in the following 3-6 months after primary weeding.

Direct seeding of native grasses is recommended by Dr Ian Chilvers as a means of suppressing annual weed regrowth.

Maintenance Weeding

After primary and secondary weeding and natural regeneration of the bushland, the area should be able to resist most weeds. However, weeds will re-establish on the site from bird, wind, water transport and other seed or propagule dispersal mechanisms within the site. Maintenance weeding should be undertaken 6-12 times a year until such time as the resistance of the bushland to weeds increases, then only requiring hand-weeding on a needs basis. Maintenance weeding is to be conducted for a maximum period of three (3) years within the Foreshore Reserve area, and should be ongoing until the above is achieved.

Weeding works are to be carried out by an appropriately qualified and licensed bushland regeneration company under the direction of a consulting Project Ecologist.

4.1.1 Alligator Weed control

Alligator Weed (*Alternanthera philoxeroides*) has been observed near the western boundary of the site in a swale surrounding part of the on-site wetland (Schedule 2 – Weed Clearance Plan). The contractor and proposed weed control plan is specifically address treatment methods to achieve eradication of Alligator Weed.

Alligator Weed is a weed of national significance and a class 3 noxious weed in the Liverpool LGA. A class 3 noxious weed are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area. The plant must be fully and continuously suppressed and destroyed.

Photo 7 – Alligator Weed

It is very unlikely that immediate eradication will be achieved with herbicides alone; however herbicides are used to help with eradication. Infestations should receive initial herbicide treatments before being subjected to physical removal. This reduces the risks of spreading viable fragments, reduces the bulk of the above-ground biomass, and creates better visual access to the site.

Physical controls (mechanical or manual) are appropriate for small and isolated situations and are useful in removing initial invaders of a catchment if they can be located early enough, all above and below-ground plant material must be removed. Care must be exercised during removal to ensure that broken plant sections are not dispersed on equipment or in downstream flow.

Excavation has successfully eradicated small infestations, but follow-up treatment of regrowth of missed plant material is necessary.

4.2 Herbicide use

The use of herbicides is needed where hand removal of weeds is impractical. The use of Glyphosate based herbicides is recommended in accordance with the manufacturers labels. Within 5m of a drainage line only Roundup Bi-active ® or equivalent formulations can be used.

There are various categories of herbicides currently used (Buchanan, 1989), specifically those that kill on contact (contact herbicides), and those that must move through the tissue of the plant (systemic herbicides). Other herbicides include those that are non-selective and those that are selective. There are also those herbicides that kill all existing plants and those that prevent germination (Buchanan, 1989). The most commonly used herbicides by bush regenerators are Glyphosate 360 ®, Roundup ®, Bi-active ® and Weed Master ®.

Other regularly used herbicides include Garlon ®, Brushoff ®, Brush Killer ® and Starane 200 ®. These non-Glyphosate based herbicides are not to be used adjacent to water bodies.

Grazon DS is not considered to be a very safe chemical to use within high soil moisture zones and that significant off target kill of woody species and aquatic fauna has been

tentatively linked to Grazon DS. If using Grazon DS on site, it should be used with caution in areas of wet soils.

An advantage of herbicide use is the low time taken to spray weeds as compared to physically removing them, particularly for large infestations of weeds, and the consequent reduction in the bulk handling of vegetative material which can decompose onsite. The disadvantage is that no single herbicide is effective on all weed species, thus the herbicide used needs to achieve an effective kill or reapplied over a longer time frame.

In general, *Travers bushfire & ecology* supports that the use of herbicides in non-ecologically sensitive areas under the following circumstances:

- there are small areas of dense weeds with few or no native plants to protect; or
- there are large areas of dominant weed coverage or weeds are growing too rapidly for physical removal; and
- there are no significant threatened plants or protected vegetation.

The potential for destabilising soils and causing erosion on steep slopes as a result of spraying vegetation with herbicide needs to be considered prior to commencement of weed control works.

Only operators with Chemcert or equivalent training must undertake the spraying of weeds. The operator must evaluate the success of each treatment after a set period of time according to the labelled effective treatment of each species for each herbicide. Care must be taken when applying herbicides near water bodies due to the sensitivity of the waterways, and resident flora and fauna to runoff containing these herbicides.

All herbicides must be applied according to the herbicide usage label and provisions of the Protection of the Environmental Operations Act (NSW).

All weeds need to be eradicated and controlled within the Foreshore Reserve and landscape areas, targeting firstly those that are listed under Liverpool City Councils noxious weeds list and invasive environmental weeds typical in RFEF remnants (Appendix 2).

Garden waste, weed propagules (seeds, tubers etc.) need to be periodically collected and disposed of at an approved waste transfer facility, and should not be dumped on adjacent bushland or propagules allowed to be washed into surrounding riparian environments.

All noxious and environmental weeds need to be eradicated and controlled across the entire site. Garden waste, weed propagules (seeds, tubers etc.) need to be periodically collected and disposed of at an approved waste transfer facility, and shall not be dumped on adjacent bushland or allowed to be washed downstream.

The restoration areas are to be managed for conservation purposes and no other plants other than those associated with RFEF are to be planted.

Monitoring & Site Audits

5

Monitoring of the progress of weed removal, plant growth and natural regeneration is to be undertaken every six (6) months, with annual progress reports to be submitted to Liverpool City Council. The Foreshore Reserve will be monitored in terms of vegetation condition, fuel loads and achievement of restoration outcomes. Monitoring activities will include:

1 A photographic record for comparative purposes taken on an annual basis.
2 A minimum of ten (10) biometric flora quadrats are to be undertaken within the bush regeneration zone to assess the achievement of the performance targets.
3 An annual vegetation condition map based on standard bush regeneration vegetation condition assessment methodology.
4 All works within the bushland area are to be documented and submitted to the Project Ecologist for inclusion in the annual audit report.

Monitoring of the site is required to be set up at the commencement of regeneration works within the Foreshore Reserve and continued for the full duration of the maintenance period without a break in the required maintenance or monitoring sessions. This will allow the determination of pre and post condition of the vegetation and its habitat, and may include identification of any areas suffering from disturbance, sedimentation or in need of contingency rehabilitation, weed control, stabilisation or maintenance of rehabilitated or regenerating areas.

The monitoring and review process will focus on the presence / absence of exotic species, floristic diversity of the bushland, structural integrity of the bushland, revegetation progress and success, monitoring of any sediment fencing or protective fencing, monitoring of pest fauna and nest boxes.

Inspections of the site by the consulting Project Ecologist should be undertaken prior to, during and post-operations to ensure that vegetated areas designated for retention and exclusion zones are adequately marked and that other appropriate protection procedures are being maintained.

The Project Ecologist will be required to supervise critical stages of the restoration process, to maintain photographic records and audit all outcomes against the stipulated performance targets.

Monitoring of the Foreshore Reserve is to be undertaken by the appointed Project Ecologist on a minimum 6 monthly basis during the three year VPA term and a further year after handover and the outcomes are to be reported in the annual monitoring report to Liverpool City Council. The Foreshore Reserve is to be generally maintained to a high standard, with no future encroachments of landscaping works, tree removal, installed or repaired services, driveways, fences or buildings except for that shown on the *Schedule 1 - Restoration Works.* The Foreshore Reserve is to be maintained as an indigenous native bushland area with a focus on enhancing habitat values and re-instating the River-flat Eucalypt Forest to a high quality condition.

An inspection is to be undertaken by the Project Ecologist every 3 months during primary restoration works, with the submission of one compliance certificate at the completion of

each major phase of work. An annual site audit report is to be submitted to Council detailing the restoration works completed and achievement of the following restoration performance targets (Section 6). All reports are to be submitted to the Liverpool City Council on an annual basis for the three year VPA term and a further year after handover for a (4) year minimum.

The Project Ecologist is to determine whether any additional contingency works are required to satisfactorily achieve the performance targets at any stage of the restoration works. These works are to be managed under the supervision of the Project Ecologist.

Compliance certificates will be issued by the Project Ecologist for the following items:

- Engagement of a bush regeneration company and independent Project Ecologist,
- Installation of all protective fencing and sediment and erosion control measures,
- Completion of primary & secondary weed control works
- Completion of restoration works including planting of tree and shrub species at the required densities and removal of waste from site,
- Completion of all required primary restoration, maintenance and contingency tasks including successful translocation and regeneration of the recipient site, and
- Achievement of all remaining restoration performance targets as stipulated within Section 6 and mirrored on Schedule 1 and 2.

Contractor duties include:

- Six (6) monthly site inspection and review progress with the Project Ecologist,
- Provide recommendations regarding upcoming restoration techniques, and
- Provide monthly progress reports and invoices to Project Ecologist.

The submission of the progress reporting will assist in the preparation of reporting that will be submitted to Council by the Project Ecologist.

Submission of invoices without a progress report will result in the invoice being rejected by the Project Ecologist.

Contractor progress reports are to include:

- Relevant site photos and recommendations
- Work zone maps
- Description of works completed and breakdown of work effort into tasks.
- A full list of planted species and numbers as installed.
- Estimate of revegetation losses at 3, 6 and 12 months after planting.

Nest box monitoring is to be undertaken by a fauna ecologist. When the nest boxes are installed they are to be identified by a number and their location fixed by GPS. During the third year of works, the fauna ecologist is to inspect all installed nest boxes and confirm:

- Status – do they require replacement or fixing, and are they still there (not been vandalised)
- Advise if there is any visual evidence of fauna use

These works are to be undertaken prior to the final compliance certificate such that arrangements can be made for boxes to be fixed or replaced as part of the supplementary works.

Performance Targets 6

Restoration Performance targets apply to the Foreshore Reserve. Site audits are to be undertaken on an annual basis to assess the achievement of the following performance targets:

1 The presence, abundance and cover of noxious and environmental weed species is to be progressively reduced over 3 years (1 year establishment and 2 years of restoration, revegetation and maintenance). A maximum of 5 % noxious weed and invasive vine cover is to be present at the end of year 3 and a maximum of 10% exotic grass and wood weed cover (lantana) to be present at the end of year 3.

2 Stabilised soils in all localities and establishment of native vegetation to provide long term ground cover.

3 Achievement of a natural vegetation structure and composition using species that naturally occur within River-flat Eucalypt Forest vegetation, ridgeline plantings may also include species from the vegetation community Cumberland Plain Woodland.

4 A total of 10.7 ha of River-flat Eucalypt Forest vegetation will be protected and regenerated with a fully structured and diverse vegetation community. Within revegetation and translocation areas, a minimum of 30 endemic native species are to be established consisting of a broad mix of groundcover, shrub, vine, sub-canopy and canopy species. 6.76 ha of disturbed landscapes will be restored with fully structured River-flat Eucalypt Forest. A total of 17.4 ha will be protected and restored.

5 All vegetation within the Powerful Owl Protection Zone is to be protected and progressively regenerated. There is to be no activity including bush regeneration works within the Powerful Owl Protection Zone during the breeding season which includes March and November or any time the owls are observed present. Progressive weed control and native regeneration should be undertaken with patchwork mowing over 3 years which should continue post handover.

6 There is an existing horse trail which runs through the Powerful Owl Protection Zone is to be closed immediately and an alternative route provided.

7 All dead trees and dead wood are to be retained on trees within the conservation area to allow for hollow retention, roosting and foraging sites for the Powerful Owl, Varied Sittella, Grey-headed Flying-fox and recorded microbat species.

8 A minimum of 50% of all planted canopy species are to be rough barked trees to provide foraging habitat for Varied Sittella and discourage occupation by Bell Miners. Canopy plants are to be accompanied by dense plantings of sub-canopy, and shrub layers. Grasses to be direct drilled and revegetated where appropriate.

9 Target 90% native vegetation cover at the end of year 3. Native vegetation cover is to be monitored every six (6) months.

10 Improved density and diversity of understorey vegetation for fauna species habitat.

11 The effectiveness and appropriateness of weed control and fuel reduction methods.

12 The effective control and removal of waste and litter from the Riparian Corridor.

13 Installation of artificial 70 mixed artificial nest boxes of varying sizes (to be advised by the project ecologist) suited to general bird, arboreal mammal and microbat species.

14 All stormwater outlets within the riparian zone, drainage lines and Georges River bank are to be fully stabilised with a minimum of 4 endemic native plants per m^2 with no identifiable bed or bank erosion, inclusive of open weave jute mesh.

15 The boundaries of the conservation area is to be protected with at a minimum a 5 wire strand with dog exclusion fencing or open timber boundary fence and may include the use of solid colour bond fences. At the rear of all industrial lots the fences are to be a minimum of 1.8 m high to prevent the disposal of refuse in the conservation area. A 2-3 m wide grassed access route is to be provided adjoining the protective fence within the conservation zone for maintenance purposes. The access may be provided in the form of the cycleway or open grass zone stabilised within locally occurring native species.

16 The felling of all hollow-bearing trees is to be undertaken under the supervision of a fauna ecologist to allow the removal and management of any resident fauna. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse. Re-used hollows or those with likely occupation are to be relocated to natural areas within the conservation zone.

17 Native vegetation on the remnant side of the conservation zone boundary is to be regenerated and planted densely to out-compete invasive weed species. In this case the outer 20 m of the EEC buffer is to be densely planted or regenerated with acacias and other similar sub-canopy species to suppress weed regrowth.

18 Surface drainage is to be collected and directed away from the conservation zone using a swale system within the development lots so as to minimise the potential for weed invasion.

Program of Works 7

The *Program of Works* (Table 3 below) is aimed at providing a management framework for enacting relevant rehabilitation, maintenance, monitoring and review works reasonably required for the conservation of the riparian corridor. Site rehabilitation including weed control works is to be undertaken in accordance with the layout on Schedule 1 – Restoration Works.

7.1 Voluntary Planning Agreement (VPA)

The voluntary planning agreement requires the completion of the following works as follows:-

1. Offset Works - carry out offset works within the designated land in accordance with the 'Ecological Constraints report proposed rezoning Lot 1 DP 581034 Coopers Paddock Governor Macquarie Drive Warwick Farm (TBE 2011) and accepted by the NSW office of Environment and Heritage and in the Vegetation Management Plan to be approved by the Council, prior to the first to occur of (i) issue of a subdivision certificate and (ii) the issue of the occupation certificate (estimated at October 2015).
2. Management of the designated land - carry out the program of works as specified in the Vegetation Management Plan to be completed within 3 years from the dedication of the designated land to Council.

Accordingly the minimum time period for completion of all works is approximately 3 years. 3

The management of the designated lands comprises of all works to be completed by the appointed restoration contractor. Please note that lead time is required for the sourcing and propagation of local provenance seed for revegetation purposes which will occur within year 1.

7.1.1 Offset works

For the purposes of defining the completion of works under the VPA, 'Offset Works' include:-

- Establishment of the Foreshore Reserve through the installation of a permanent protective fence
- Installation of the cycleway
- Completion of any tree hollow inspection, supervision, hollow and fauna relocation works within the approved industrial subdivision area
- Relocation of any biotic resources such as mulch and logs into the foreshore reserve for later use, and
- Supply and installation of nest boxes within the Foreshore Reserve

Offset works are to be implemented under the direction of the appointed Project Ecologist.

Offset Works include any items to effectively establish the foreshore reserve prior to the issue of an occupation certificate of the industrial lands. The offset works will be completed as part of the release and development of the industrial lands.

Offset works effectively enable the foreshore reserve to be established and the industrial

area to be released for development.

7.1.2 Management of the designated land

Management of the designated land includes all habitat enhancements, weed control revegetation, regeneration and maintenance works in accordance with the approved Vegetation Management Plan within the foreshore reserve area. They form the key works required to enable the land to be handed over to Liverpool City Council is a condition to allow ongoing maintenance and public access.

'Management of the designated land' includes:

- Completion of primary and secondary weed control.
- Completion of revegetation works
- Completion of 3 years of maintenance works

Management of the designated land tasks are to be implemented by the Australian Turf Club and appointed contractors under the direction of the appointed Project Ecologist.

7.2 Program of works

For the purposes of the Program of Works, the listed tasks are divided into the following category of works.

Pre-Construction Works

Pre-construction works refers to all site preparation activities such as seed collection, site fencing and access tracks for restoration purposes (generally prior to the commencement of construction works), supply and installation of nest boxes and generally excludes any landscaping, cycle ways construction and planting works.

Construction Works – Staged over 3 years

Construction works refers to the period during which construction of buildings, roads and other facilities are being installed. It is during this period, the protection of remnant vegetation is critical to minimising accidental loss of trees or associated vegetation. It is also during this phase that Primary Restoration Works are completed.

"Primary Restoration Works" as defined under this VMP include the completion of primary and secondary weed control, protective fencing, pathways, mulching, biotic translocation works and revegetation works. Practical completion of the primary restoration phase is determined by the Project Ecologist at which point all primary restoration actions need to have been completed and the installed plants are well established and only requiring periodic maintenance or watering. Should there be a delay in the completion of works, for any reason, then contingency restoration works may be required by the project ecologist.

Post Construction Works – Staged over 3 years

Post construction works is essentially maintenance activities unless further contingency works are identified by the Project Ecologist for auditing purposes. Maintenance will be undertaken by a fully qualified bush regeneration crew over a total period of approximately 3 years from commencement of primary restoration works and are to continue post-handover to Council.

All bush regeneration or landscape crews working within the Foreshore Reserve are required to have at a minimum TAFE Certificate Level II Bush regeneration qualifications

or equivalent to work within the bush regeneration zone. All staff is to be supervised by a qualified bush regeneration supervisor with a minimum 5 years full time experience and a minimum TAFE Certificate Level II Bush regeneration qualifications and or a degree in Natural Areas Management or equivalent.

Table 3 – Program of works

Action	Responsibility
Stage 1 – Preconstruction Works	
• Formation of site management team & establish supervision and consultation processes – minimum Project Ecologist, and Site Manager	• Site Project Manager
• Identification and erection of erosion control fencing and installation of temporary exclusion fencing.	• Site Manager / Restoration Ecologist
• Installation of sediment basins and nutrient filter devices (if necessary)	• Contractor with advice of Project Manager
• Commencement of primary weed control	• Suitably qualified Bushland Regenerator
• Installation or protective border or fence or pathway surrounding the bush regeneration zone	• Project Manager / Project Ecologist
• Commencement of primary restoration works, and initiation of brush, seed collection and propagation contracts	• Bushland Regenerator / Project Ecologist
• Hollows to be relocated as advised by the Project Ecologist and/or Fauna Ecologist	• Contractor with advice of Project Ecologist
• Set up tritter lines and marking of Powerful Owl protection area	• Contractor with advice of Project Ecologist
• Supply and installation of 70 nest boxes	• Project Ecologist
• Provide certificates of compliance	• Project Ecologist

***Stage 2 – Construction Works** (Staged over 3 Years)*	
• Supervision of hollow bearing tree removal or selective removal of limbs as required for the tree removal & management works	• Site Project Manager in association with the Project Ecologist
• Supervision of vegetation clearance and hollow relocation Works	• Site Project Manager in association with the Project Ecologist
• Monitor erosion control measures (monthly – especially after heavy rain) and replace if required	• Contractor with advice of Project Manager
• Waste removal & soil amelioration works in accordance with the Vegetation Management Plan	• Earthworks Contractor / suitably qualified Bushland Regenerator
• Continuation of primary and commencement of secondary weed control and maintenance weed control	• Contractor / Project Manager
• Maintenance of fencing and signage around protected vegetation	• Contractor / suitably qualified Bushland Regenerator
• Continuation of primary restoration and revegetation works	• Project Ecologist
• Provide certificates of compliance	• Project Ecologist
***Stage 3 – Post Construction Works** (Staged over 3 Years)*	
• Contingency or enrichment planting within revegetation areas.	• Contractor with advice of Project Manager
• Continuation of regeneration, target weed control and revegetation maintenance.	• Contractor with advice of Project Manager
• Monitoring of retained vegetation at 6 months, 12 months and annually until achievement of restoration performance targets.	• Project Ecologist
• Handover of Foreshore reserve to Council	• ATC based on satisfactory audit of restoration works by Project Ecologist

Schedule 1 identifies the location of the staged restoration works and revegetated areas in relation to the proposed development. Schedule 2 identifies the staged Weed Clearance Plan.

Recommended Revegetation Species A1

A minimum of selection of 30 of the following listed species are to be established within the Foreshore Reserve Corridor within all revegetation areas (Schedule 1 – Restoration Works). Enrichment planting within existing native vegetation areas is to select species which are lacking in any of the vegetative strata. Further species will also be suitable provided that they are recognised as being typical or common species known or demonstrated to occur within Cumberland Plain Woodland or River-flat Eucalypt Forest on Coastal Floodplains.

Table A1.1 - Flora species to be used for revegetation within the site

Family	Scientific Name	Common Name
TREES		
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Myrtaceae	*Angophora subvelutina*	Broad-leaved Apple
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Myrtaceae	*Corymbia maculata*	Spotted Gum
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark
Myrtaceae	*Eucalyptus punctata*	Grey Gum
Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum
Myrtaceae	*Eucalyptus sclerophylla*	Scribbly Gum
Myrtaceae	*Eucalyptus amplifolia ssp. amplifolia*	Cabbage Gum
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Eucalyptus umbra*	Bastard White Mahogany
Myrtaceae	*Eucalyptus bauerana*	Blue Box
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Melaleuca decora*	
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark
SHRUBS		
Epacridaeae	*Leucopogon juniperinus*	Leucopogon
Mimosaceae	*Acacia implexa*	Hickory
Mimosaceae	*Acacia decurrens*	Black Wattle
Mimosaceae	*Acacia falcata*	
Mimosaceae	*Acacia falciformis*	Broad leaved Hickory
Mimosaceae	*Acacia parramattensis*	Parramatta Wattle
Proteaceae	*Banksia integrifolia ssp. integrifolia*	Coast Banksia
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Blackthorn
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea
Fabaceae	*Dillwynia sieberi*	Prickly Parrot-pea

Sapinadeae	*Dodonea triquetra*	Hopbush
Fabaceae	*Indigofera australis*	Native Indigo
Myrtaceae	*Kunzea ambigua*	Tick Bush
Myrtaceae	*Melaleuca nodosa*	Ball Honey Myrtle
Rubiaceae	*Opercularia aspera*	Common Stinkweed
GROUNDCOVERS		
Convolvulaceae	*Dichondra repens*	Kidney Weed
Hypoxidaceae	*Hypoxis hygrometrica var. hydrometrica*	Golden Weather-Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Poaceae	*Austrodanthonia racemosa*	Wallaby Grass
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass
Apiaceae	*Centella asiatica*	Swamp Pennywort
Commelinaceae	*Commelina cyanea*	Scurvy Weed
Sinopteridaceae	*Chelianthes sieberi ssp sieberi*	Chelianthes
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Phormiaceae	*Dianella caerulea* var. *caerulea*	Flax Lily
Phormiaceae	*Dianella longifolia*	-
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass
Poaceae	*Echinopogon caespitosus* var. *caespitosus*	Tufted Hedgehog Grass
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower
Dilleniaceae	*Hibbertia diffusa*	-
Lamaceae	*Plectranthus parviflorus*	Plectranthra
Loganiaceae	*Logaria pusilla*	Logaria
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass
Poaceae	*Paspalidium distans*	-
Poaceae	*Poa labillardieri* var. *labillardieri*	Tussock Grass
Dennstaedtiaceae	*Pteridium esculentum*	*Brackern*
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Poaceae	*Themeda australis*	Kangaroo Grass
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell
VINES		
Fabaceae	*Glycine clandestina*	Forest Clematis
Fabaceae	*Hardenbergia violacea*	False Sarsparilla

Target Weed Species

A2

The following weed species were recorded onsite and are to be targeted on a priority basis subject to their respective level of invasive and implications for regeneration of native flora.

Table A2.1 - Target weed species for the site

Scientific Name	Common Name	Priority
TREES		
*Acacia baileyana**	Cootamundra Wattle	Medium
Acer sp. (cultivar)*	Maple	Low
*Cinnamomum camphora**	Camphor Laurel	High
*Corymbia citriodora**	Lemon-scented Gum	Low
*Erythrina sykesii**	Coral Tree	High
Olea europaea subsp. *cuspidata**	African Olive	High
*Phoenix canariensis**	Canary Island Date Palm	Low
*Pinus sp.** (Cultivar)	-	Low
*Plantanus x acerifolia**	Sycamore	Low
*Populus alba**	White Poplar	Low
*Quercus robur**	English Oak	Low
*Salix babylonica**	Weeping Willow	High
SHRUBS & MID-STOREY		
*Acacia podalyriifolia**	Queensland Silver Wattle	Medium
*Acacia saligna**	Orange Wattle	Medium
Camellia sp. (cultivar)*	Camellia	Low
*Cestrum parqui**	Chilean Cestrum	Very high
Chrysanthemoides monilifera subsp. *monilifera**	Boneseed	Very high
*Cotoneaster pannosus**	Cotoneaster (cultivar)	Medium
*Lantana camara**	Lantana	Very high
*Ligustrum lucidum**	Large-leaved Privet	Very high
*Ligustrum sinense**	Small-leaved Privet	Very high
*Lycium ferocissimum**	African Boxthorn	Very high
*Nerium oleander**	Oleander Bush	Low
*Ochna serrulata**	Mickey Mouse Plant	Medium
*Phytolacca octandra**	Inkweed	Medium
*Plumbago sp.**	-	Low
*Ricinus communis**	Castor Oil Plant	Very high
Rubus fruticosus sp. agg.*	Blackberry Complex	Very high
Senna pendula var. *glabrata**	-	Medium
*Solanum mauritianum**	Wild Tobacco	Medium
GROUNDCOVERS		
*Ageratina adenophora**	Crofton Weed	High
*Alternanthera philoxeroides**	Alligator Weed	Very high
*Amaranthus viridis**	Green Amaranth	Low
*Anagallis arvensis**	Scarlet Pimpernel	Low

*Andropogon virginicus**	Whisky Grass	Medium
*Arundo donax**	Giant Reed	Very high
*Asparagus aethiopicus**	Asparagus Fern	High
*Asphodelus fistulosus**	Onion Weed	Low
*Avena sativa**	Oats	Low
*Axonopus fissifolius**	Narrow-leaf Carpet Grass	Low
*Bidens pilosa**	Cobbler's Pegs	Medium
*Brassica juncea**	Indian Mustard	Medium
*Brassica rapa**	Wild Turnip	Medium
*Bromus cartharticus**	Prairie Grass	Medium
*Bryophyllum delagoense**	Mother of Millions	High
*Capsella bursa-pastoris**	Shepherds purse	Low
*Centaurium erythraea**	Pink Stars	Low
*Centaurium tenuiflorum**	Branched Century	Low
*Chenopodium album**	Fat Hen	Low
*Chloris virgata**	Feathertop Rhodes Grass	Low
*Cirsium vulgare**	Spear Thistle	Medium
*Conyza bonariensis**	Flax-leaf Fleabane	Low
*Conyza canadensis**	Tall Fleabane	Low
*Cortaderia selloana**	Pampas Grass	Very high
*Crocosmia X crocosmiiflora**	Montbretia	Medium
*Cyclospermum leptophyllum**	Slender Celery	Low
*Cyperus congestus**	-	Medium
*Cyperus eragrostis**	Umbrella Sedge	Medium
*Ehrharta erecta**	Panic Veldtgrass	Low
*Eleusine indica**	Crowsfoot Grass	Medium
*Eragrostis curvula**	African Lovegrass	High
*Foeniculum vulgare**	Fennel	High
*Galium aparine**	Cleavers	Low
*Gamochaeta spicata**	Cudweed	Low
*Hedychium gardnerianum**	Ginger Lily	medium
*Hypochaeris radicata**	Flatweed	Low
*Lepidium africanum**	Common Peppercress	Low
*Malva parviflora**	Small-flowered Mallow	Low
*Modiola caroliniana**	Red-flowered Mallow	Low
*Oenothera stricta**	Evening Primrose	Low
Opuntia sp. (cultivar)*	Prickly Pear	High
*Oxalis corniculata**	Yellow Wood Sorrel	Low
*Oxalis debilis**	-	Low
*Oxalis pes-caprae**	Soursob	Low
*Paspalum dilatatum**	Paspalum	Medium
*Paspalum quadrifarium**	Tussock Paspalum	High
*Paspalum urvillei**	Vasey Grass	Medium
*Pennisetum clandestinum**	Kikuyu	Medium
*Plantago lanceolata**	Ribwort	Low
*Richardia brasiliensis**	White Eye	Low
*Richardia stellaris**	-	Low
*Rumex crispus**	Curled Dock	Low
*Senecio madagascariensis**	Fireweed	Medium
*Setaria parviflora**	-	Low
*Sida rhombifolia**	Paddy's Lucerne	Medium
*Solanum nigrum**	Black Nightshade	Low
*Sonchus oleraceus**	Common Sow-thistle	Low
*Sporobolus africanus**	Parramatta Grass	Medium
*Stellaria media**	Common Chickweed	Low

*Tagetes minuta**	Stinking Roger	Medium
*Taraxacum officinale**	Dandelion	Low
*Tradescantia albiflora**	Wandering Jew	High
*Trifolium repens**	White Clover	Medium
*Verbena bonariensis**	Purpletop	Medium
*Verbena officinalis**	Common Verbena	Medium
*Verbena rigida**	Veined Verbena	Medium
*Xanthium occidentale**	Noogoora Burr	High
VINES		
*Acetosa saggitata**	Turkey Rhubarb	Very high
*Anredera cordifolia**	Madiera Vine	Very high
*Araujia sericifera**	Mothvine	Very high
*Asparagus asparagoides**	Bridal Creeper	Very high
*Cardiospermum grandiflorum**	Balloon Vine, Love in a Puff	Very high
*Ipomoea cairica**	Blue Morning Glory	Very high
*Lonicera japonica**	Japanese Honeysuckle	Very high
*Passiflora edulis**	Common Passionfruit	Medium
*Wisteria sinensis**	Wisteria	Medium

The most significant of these weeds that have the most invasive properties include Alligator Weed, Balloon Vine, Blackberry, Bitou Bush, African Lovegrass, Kikuyu, Asparagus Fern, Small and Large Leaved Privet, Common Passionfruit, Mother of Millions, and Rhodes Grass. With the exception of invasive species all other low priority species can be suppressed by competitive planting or tree and shrub species and creating a dense canopy and shading.

Noxious needs that commonly occur within Liverpool City Council need to be targeted if found onsite in accordance with their respective noxious weed category and the 'best practice' methods identified for that noxious weed. Noxious Weed species are listed at a state and local government level. Please refer to Liverpool City Council for a current noxious weed species list.

Biotic Translocation Method

A3

The following method is supplied in the event that the appointed contractors propose to undertake biotic translocation of any soil and vegetation as part of the restoration process. The current program of works does not involve biotic translocation with exception to the relocation of hollows and fauna from the industrial area into the foreshore reserve. This appendix is therefore only supplied for information purposes and the implementation of any translocation works is subject to confirmation of restoration strategy and costs.

The translocation of soil and vegetation is a two phase process that identifies a “Borrow Area” and a “Recipient Area”, that require different treatment specifications. These specifications are designed to minimise the disturbance to the borrow and recipient sites, its vegetation and soil seed bank that can be used to conserve genetic diversity and restore a natural vegetation community. The soil seed bank is a critical resource that is used to provide long term resilience against disturbance whether it be physical, biological or major events such as bushfires.

The adopted process is based on successful soil translocation works for the endangered ecological communities “Duffy’s Forest”, “Blue Gum High Forest” and regeneration trials which have been in process since 2001 (Kate Low and Associates 2001 & Travers bushfire & Ecology 2010). These sites trailed many methods of promoting regeneration from the soil seed bank.

The findings of these studies found that the physical disturbance of the soil during translocation, combined with direct drilling of local provenance seed stock and provision of protection such as brush matting provided the best possible regeneration outcome without the need for planting of tube stock. Similar processes can be used for the restoration of Cumberland Plain Woodland and any community with a modicum of natural resilience. In combination with direct seeding, even low condition sites can be effectively restored using bulk earth movement works, direct drilling and supplementary planting.

The use of methods such as burning stimulated rapid seed bank germination of fire resistant species but there was no difference detected between the control and fire plots after five years (Kate Lowe and Associates 2001). Burning is suspected of depleting the soil seed bank too quickly and may reduce the sites resilience to extreme events such as drought. The application of “smoke water” and other seed treatments were not found to be effective and did not result in any significant regeneration advantage.

(Photo 1) Niangala Close, Belrose – Soil translocation of subsoil and topsoil – Duffy's Forest. Prior to seeding and brush matting (Conacher Travers 2005)

Photo 2 – Seeded & Brush matted Translocated soils – Niangala Close – Duffy's Forest (Conacher Travers 2005).

The above studies have identified that the provision of a friable and crumbly topsoil to promote seed germination, "direct drilling " of the copious quantities of seed into the soil surface (as distinct from spray seeding), spreading of cones and fruits, brush matting and protection from grazing were the most important factors. Both soil translocation studies have reported high germination results and very good native vegetation cover

Photo 3 – Niangala Close, Belrose - 0.5 to 1m regeneration – Duffy's Forest (Travers Environmental 2008).

Ongoing and well managed weed control; top-ups to brush matting when thin have been critical factors in the success of soil translocation projects. A minimum of 5 years maintenance is required for the site to become reasonably self-sufficient.

Preparation of the recipient site

These works are to be undertaken prior to the clearing of vegetation and the translocation of soil from the borrow area. The following works are to be undertaken under the direction of an appointed Project Ecologist.

Task Description	Responsibility Centre
1. Eradicate weeds from the recipient area by a combination of scalping, selective spot spraying with systemic and knockdown herbicides and removal of all weed waste.	Bush Regeneration Contractor
2. Prepare soil in recipient area which may include the removal of rubbish, levelling, light ripping	Bush Regeneration Contractor & Earth works Contractor
3. Erect exclusion fencing to exclude public and non-essential personnel	Site Superintendent, Fencing Contractor
4. Install sediment and erosion control fences in accordance with Schedule 1 – Restoration Works Plan and additional measures as instructed by the Project Ecologist or by Council. Sediment control measures are to be cleaned out and damage rectified when 40% capacity is reached.	Bush Regeneration Contractor
5. All machinery entering the Borrow Area are to be cleaned prior to entry and checked by the Project Ecologist for soil or plant debris	Project Ecologist
6. Apply subsoil material to a maximum depth of 200 mm. Only light machinery to be used.	Earthworks Contractor

7. Apply topsoil to a maximum of depth of 100mm. Only light machinery to be used.	Earthworks Contractor
8. Light ripping of the translocated topsoil and harrowing to create a friable seed bed.	Bush regeneration contractor using hand operated machinery or dingo equivalent
9. Install brush matting to achieve a full cover of 100mm thickness consisting of mainly light twigs and branches of between 2mm and 10 mm in diameter. Brush is to be sourced from within the site and may use native plant material to be removed within the development area.	Bush regeneration Contractor
10. Ensure all erosion control devices are installed and working properly, fix up tears and re-erect fallen sections. Replace the fence if required. There are to be no breaks or fallen sections that will enable entry by rabbits external to the site.	Bush Regeneration Contractor
11. Rabbit baiting is to be installed within the site by a registered contractor using Pindone baits	Pest Control Contractor
12. Water in translocated material – minimum 10 consecutive days. Top ups as instructed by the Project Ecologist	Bush Regeneration contractor
13. Weed and control and supplementary planting undertaken at the direction of the Project Ecologist.	Bush regeneration contractor for the entire 3 year maintenance period
14. Contingency Works as instructed by the Project Ecologist to achieve stipulated performance Criteria	Bush regeneration contractor for the entire 3 year maintenance period

Removal Biotic Material from the Borrow Site

These works are to be undertaken prior to the commencement of civil or bulk earthworks in the area denoted as the “Borrow Area”. The Borrow area is to be fenced and protected from construction works until released by the Project Ecologist to the Site Superintendent. The following works are to be undertaken under the direction of an appointed Project Ecologist.

Task Description	Responsibility Centre
1. Eradicate weeds from the borrow area by a combination of scalping, selective spot spraying with systemic and knockdown herbicides and removal of all weed waste. Weed seed propagules are to be removed and disposed at a waste facility.	Bush Regeneration Contractor
2. Prepare soil in recipient area prior to translocation of soil from the borrow area	Bush Regeneration Contractor & Earth works Contractor
3. All machinery entering the Borrow Area are to be cleaned prior to entry and checked by the Project Ecologist for soil or plant debris	Project Ecologist
4. Erect exclusion fencing to exclude public and non-essential personnel	Site Superintendent, Fencing Contractor

5. Install sediment and erosion control fences as instructed by the Project Ecologist	Bush Regeneration Contractor
6. Harvest all plant and seed material to be transplanted into the recipient area.	Bush Regeneration Contractor
7. Strip topsoil and any remain organic matter after weeds removed to the existing	Earthworks Contractor
8. Strip subsoil to maximum of 200 mm depth and relocate to the recipient area.	Earthworks Contractor
9. Move stockpiled topsoil to recipient site once subsoil is spread	Earthworks Contractor
10. Rectify and tidy up borrow area in accordance with Project Ecologist	Earthworks Contractor
11. Remove Protective Fencing from the Borrow area and relocate fencing to the	Fencing Contractor under direction of Project Ecologist
12. Issue compliance certificate for the soil translocation works to Council	Project Ecologist
13. Release borrow area to Site Superintendent.	Project Ecologist

To assist in the regeneration process the collection of native brush from native trees and shrubs to be removed in the site is to be stockpiled for use within the Recipient Area.

Nest Box Design Guidelines

A4

The following specifications are separated into two parts. Part 1 provides specifications for nest boxes for use by arboreal mammals, diurnal birds and microbats and Part 2 provides specifications for large forest owl nest boxes.

Part 1 - Nest boxes for use by arboreal mammals, diurnal birds and microbats

The following nest box designs are provided by *Travers bushfire & ecology* as a guide for construction of nest boxes for arboreal mammals, diurnal birds and microbats. It is based on a variety of information sources and current project experience in the construction and installation of nest boxes.

The following design parameters are important to ensure the design is robust, the attachment to trees remains secure and use by wildlife is appropriate all for the long-term. These specifications will incur subsequent additional costs to ensure the longevity of the box, this expense will be more cost effective in the long-term as boxes (if built correctly) can be built to last for more than three times longer.

Minimum design requirements

The nest boxes are to be built in the following manner:-

- Timber is to be of high grade marine ply 15 mm thick – MDF, particle board and low grade ply are not acceptable.
- The lid is to be hinged at the rear side of the box that is affixed to the tree to allow internal inspections from the front side. Lids are to be well sloped to the front to allow runoff by rain. Hinges are to be robust (not small) and made of brass, stainless steel or galvanised. Lids are to be larger than the overall cross sectional size of the box and placed so that a small eave exists on all sides to prevent entry of rain.
- Two vertical timber supports (approximately 30x30mm timber strips 150 mm apart) are to be attached down the rear face of the box so that there are two points of attachment to the trunk on a curved surface and the box does not rock in the wind. This will also provide easy attachment points to the trees without having to screw through the inside of the box. These are to be made of treated pine and any screws into this (for hinges etc) should be treated pine or stainless. Holes at both ends of both supports are to be predrilled for easy attachment to trees. Timber supports should not be placed directly onto the box but with small timber spacers so that an eave is permissible along this side of the roof.
- Boxes to be constructed for a target species. Recommended dimensions of nest boxes for select fauna species are supplied in Table 1 below. Entry holes are best placed in the front for birds or the sides for arboreal mammals.

- For bird boxes, an anti-myna baffle (illustrated below) or steeply sloped roof with side excluders should be placed to prevent direct front access to the entry hole. This is to prevent use and dominance by the exotic Common Myna or Starlings.
- Bird boxes should allow the wall to be climbed from the entry hole down to the base. This may be achieved by depth controlled saw cuts, robust matting or a ladder. Boxes with anti-myna baffle may require the same placed below the hole on the external front.
- Joints are to be glued and screwed for strength. Glue should be labelled as non-toxic wood glue.
- All fasteners used are to be weather resistant stainless steel, galvanised or other. Screws into the treated pine supports are to be stainless steel or treated pine screws.
- All fasteners for tree attachment are to be supplied (stainless steel or treated pine coach screws). These are to be a suitable gauge depending the size of bow and suitable length to pass through the vertical timber supports, through the bark and cambium, and into a sufficient extent of heartwood. Heartwood penetration will depend on the size of the box. Screws for small boxes should extend a minimum of 20mm into the heartwood of hardwood eucalypts and medium boxes ~40mm. All boxes are to be screwed so that a small distance for growth exists between the timber supports and the trunk. This can be achieved with a small stainless sleeve over the screw.
- 5 mm drainage holes are to be drilled in each corner at the base.
- Exterior of the boxes (including treated pine supports) are to be painted with a primer and then a minimum of two coats of external non-alcohol based acrylic paint. The colour selected should be consistent with the colour of the recipient trunk and therefore recipient trees should ideally be prior selected.

Note: Different methods of attachment to the tree are available. *Travers bushfire & ecology* generally recommends that the boxes should be fixed with robust stainless steel or treated pine coach screws that penetrate through the cambium and into the heartwood of the tree to ensure a very secure attachment. Provided that any cambium damage to a tree is not left as an open wound then the chance of fungal infection or insect attack is significantly reduced and the tree will grow around the screw. Any other method of attachment selected should also ensure the box is secured to prevent movement or fall and allows for the future growth of the tree without any cambium constriction over the complete life of the box.

<u>Nest box placement requirements</u>

- The larger and more mature the recipient tree are to be selected where available. This will comparatively reduce the weighted stress on the tree, make the box less visible and result in less change in growth ratio affecting the selected attachment method.
- Nest box is preferably to be placed on the trunk for structural stability and protection from falling branches.
- Place nest boxes are high as physically possible within a tree preferably using a cherry picker or tree climber. This is certainly the case for birds (including owls) but no so much necessary for gliders. Microbat species vary but generally the higher the better for consideration to most species.
- Place nest boxes away from continual direct mid-day summer sun (on the edge of clearings) and preferably on the southern side of the trunk.

- Place nest boxes with large entry holes away from any prevailing winds when close to open water-bodies. E.g. protect from strong southerly winds close to the ocean and contrastingly cool-hot westerly winds in different seasons.
- Attached nest boxes securely so that they do not shift or shake in response to strong winds or being knocked by the movements of heavier animals, eg. possums and goannas.
- To ensure nest boxes are inaccessible to cats and rats or to also assist target species by exclusion of possums, the base of trunk or branches may also installation of tree guards or exclusion collars.
- Nest boxes should ideally be placed accessible for management but concealed from interference.

Management of installed boxes

- Deterring Mynas and Starlings from re-nesting is not easy; these pests are very persistent, and constant vigilance is necessary. This also means that you must have convenient regular access to the nest-box, and that you must be aware of what creatures are using it for what purposes.
- Nest boxes found to be utilised by threatened or otherwise significant fauna may be prioritised for ongoing management to ensure their longevity and replicate their design/placement characteristics.

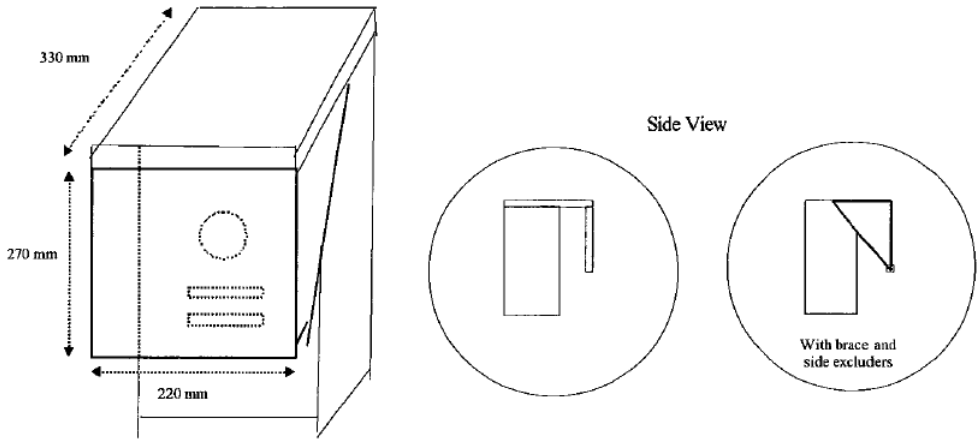
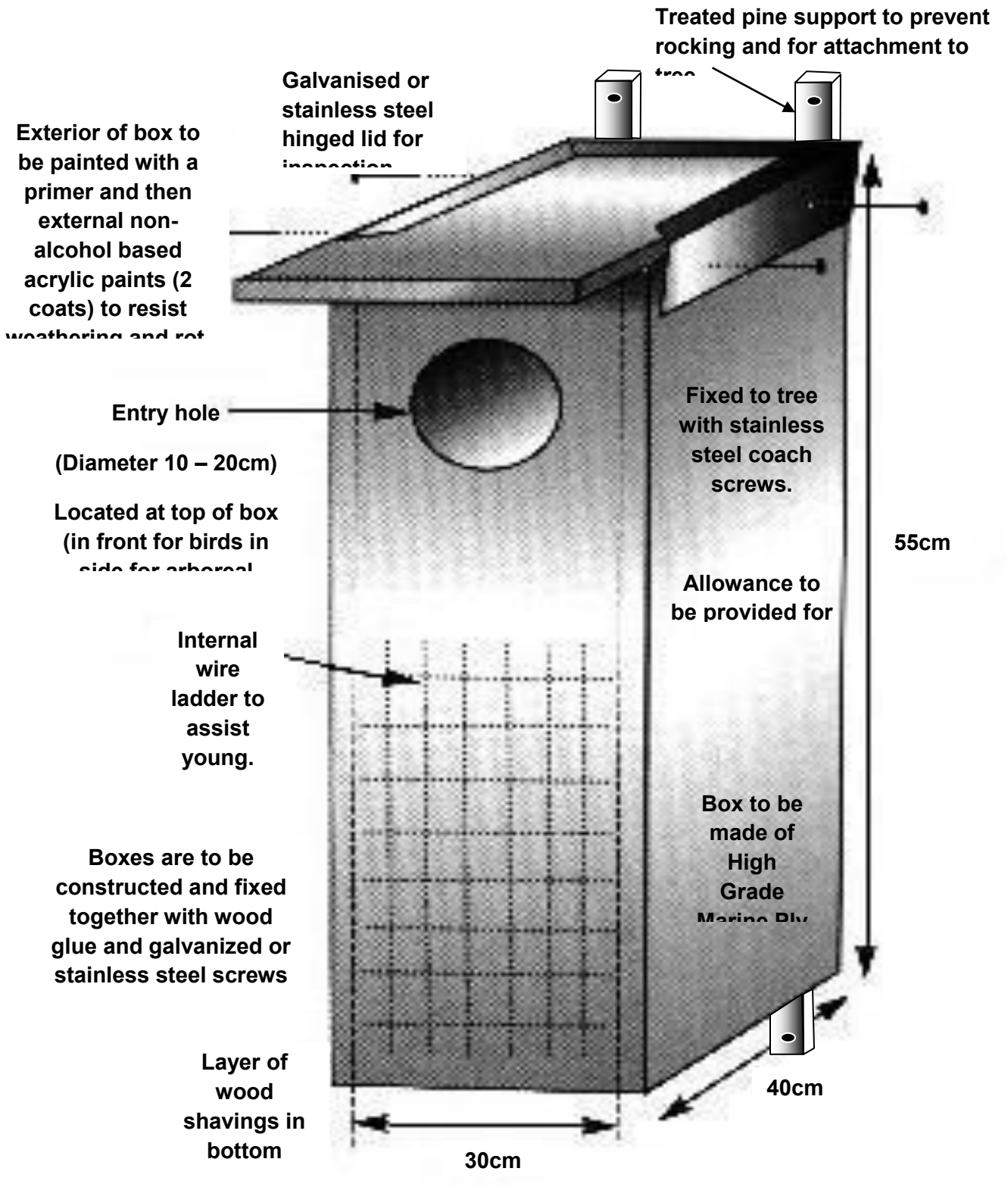


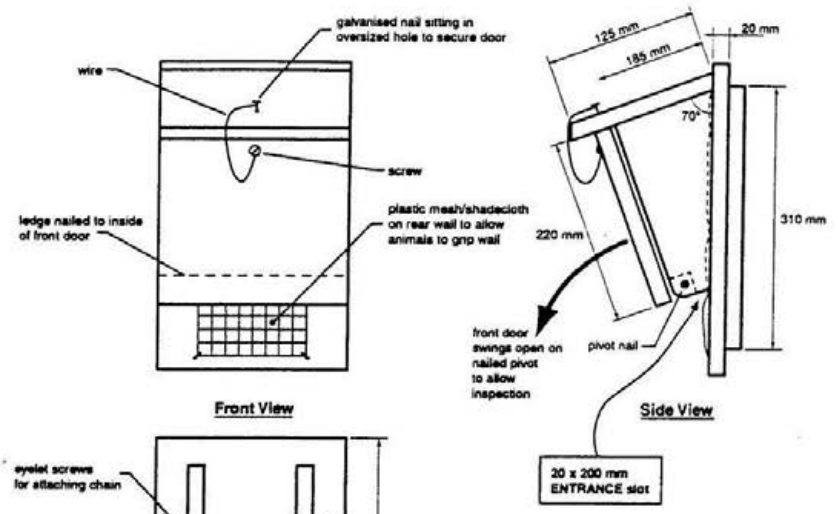
Diagram 1 - Anti-Myna Baffle

(Sourced from Birds Australia Information Sheet No.5 – 30 July 2001).



DESIGN 1 - PARROT & ARBOREAL MAMMAL NEST BOX DETAIL

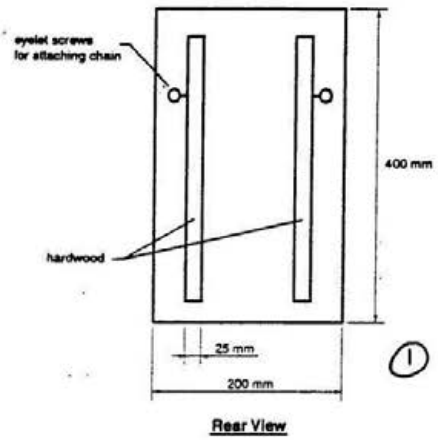
Note: For dimensions of other target species see Table 1.
(Size dimensions applied for a Large Parrot Box)



Fixed to tree with stainless steel coach screws.

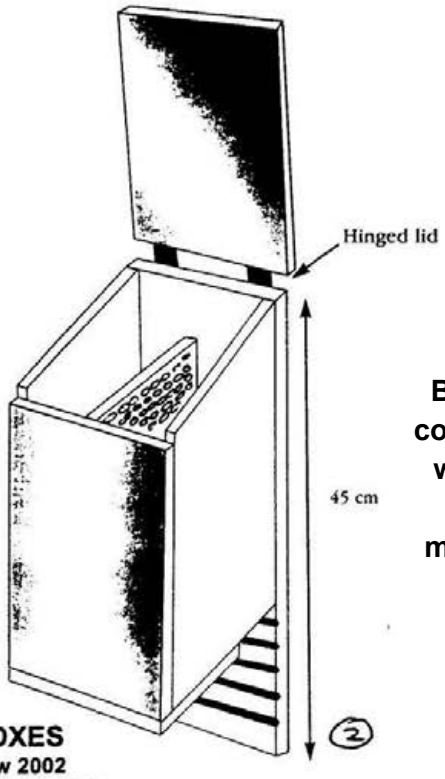
Allowance to be provided

OPTION 1



Exterior of box to be painted with a primer and then 2 coats of external non-alcohol based acrylic paint to resist weathering and

OPTION 2



Box to be constructed with high grade marine ply

BAT ROOSTING BOXES
1. From Smith and Agnew 2002
2. From Gould League of Victoria 1997

DESIGN 2 - MICROBAT NEST BOX DETAIL (Option 1 & 2)

Note: Alternative designs available for alternative mounts

Photo 1 - Example of microbat design. Note: these boxes are not painted or appropriately affixed to the tree.

Table 1 - Recommended Nest Box Dimensions for typical fauna
(Source: Birds Australia Supplement No. 5 – Nest Boxes for Natives)

The following internal and external dimensions are recommended for the list of species. In choosing the ideal size boxes and openings the advice of an experienced Restoration Ecologist is to be sought.

SPECIES	INT DIAM	DEPTH/LENGTH	ENT DIAM	VERT/HOR	HEIGHT	SEASON	REF
Antechinus, Yellow-footed	-	-	20-25 mm	-	-	-	Trainor (1995)
Bat sp.	70-100 x 150-240 mm	200-250 mm	15-20 mm slit	v	-	-	BFNC (n.d.)
Bat, Chocolate Wattled	-	-	10 mm slit	-	-	-	Trainor (1995)
Bat, Gould's Wattled	-	-	10 mm slit	-	-	-	Trainor (1995)
Bat, Lesser Long-eared	-	-	10 mm slit	-	-	-	Trainor (1995)
Black-Cockatoo, Glossy	300 mm	870-1000 mm	160 x 200 mm	v	-	-	Pedler (1996)
Boobook, Southern	-	-	150 mm	h	-	-	Trainor (1995)
Brushtail-Possum sp.	320 mm	400 mm	120-150 mm	v	4-8 m	Autumn	MZES (n.d.)
Brushtail-Possum sp.	210 x 240 mm	380 mm	c.120 mm	v	-	-	RSPCA (n.d.)
Brushtail-Possum sp.	-	-	90 mm	-	-	-	Trainor (1995)
Cockatoo, Sulphur-crested	-	-	150 mm	v	-	-	Trainor (1995)
Corella, Little	-	-	150 mm	-	-	-	Trainor (1995)
Corella, Long-billed	-	-	150 mm	-	-	-	Trainor (1995)
Duck, Australian Wood	200 mm	500 mm	120 mm	v	-	-	Trainor (1995)
Duck, Pacific Black	450 x 300 mm	-	120 mm	-	-	-	Elliot (1994)
Duck, Pacific Black	-	-	120 mm	h	-	-	Trainor (1995)
Duck, Pink-eared	-	-	-	-	-	-	Elliot (1994)
Galah	200 mm	650 mm	120 mm	v	6 m	Aug-Nov	Adams (1980)
Galah	200 mm	650 mm	120 mm	v	6 m	Sep-Jan	MZES (n.d.)
Galah	-	-	150 mm	-	-	-	Trainor (1995)
Glider, Feather-tailed	-	-	20-25 mm	-	-	-	Trainor (1995)
Glider, Squirrel	-	-	60 mm	-	-	-	Trainor (1995)
Glider, Sugar	250 mm	300 mm	50 mm	v	4-8 m	Jun-Dec	MZES (n.d.)
Glider, Sugar	200 mm	450 mm	35-40 mm	v	-	-	BFNC (n.d.)
Glider, Sugar	-	-	25-30 mm	-	-	-	Trainor (1995)
Kestrel, Nankeen	400 mm	750 mm	100 mm	v	5 m	Aug-Nov	Adams (1980)
Kingfisher, Sacred	130 mm	600-900 mm	75 mm	h	5-10 m	Sep-Mar	Adams (1980)
Kookaburra sp.	300 mm	500 mm	>130 mm	h	5-10 m	Sep-Jan	Adams (1980)
Kookaburra sp.	400 mm	-	130 mm	h	5-10 m	Sep-Jan	MZES (n.d.)
Kookaburra sp.	300 x 150-200 mm	600 mm	open	h	-	-	BFNC (n.d.)
Kookaburra, Laughing	150-300 mm	>400 mm	80-120 mm	h	-	-	Elliot (1994)
Kookaburra, Laughing	-	-	120 mm	h	-	-	Trainor (1995)
Lorikeet sp.	120 mm	600 mm	60 mm	h	5 m	Aug-Jan	Adams (1980)
Lorikeet, Little	-	-	25-30 mm	-	-	-	Trainor (1995)
Lorikeet, Musk	-	-	25-30 mm	-	-	-	Trainor (1995)
Lorikeet, Purple-crowned	-	-	25-30 mm	-	-	-	Trainor (1995)
Owl, Barn	400 mm	750 mm	open	h	5 m	Aut-Spr	Adams (1980)
Owl, Barn	-	-	150 mm	h	-	-	Trainor (1995)
Owlet-nightjar, Australian	100-150 mm	300-350 mm	60-80 mm	v	5 m	Sep-Dec	Adams (1980)
Owlet-nightjar, Australian	150 mm	>150 mm	70-120 mm	v	-	-	Elliot (1994)
Owlet-nightjar, Australian	150 mm	400 mm	50 mm	v	-	Sep-Dec	BFNC (n.d.)
Owlet-nightjar, Australian	-	-	40 mm	-	>5 m	-	Trainor (1995)
Owlet-nightjar, Australian	-	-	25-30 mm	-	-	-	Trainor (1995)
Pardalote sp.	120 mm	400-500 mm	30-45 mm	h	5 m	Jul-Jan	Adams (1980)
Pardalote sp.	120 mm	450 mm	30-45 mm	h	5 m	Jul-Jan	MZES (n.d.)
Pardalote, Striated	200 x 120-150 mm		25-35 mm	v/h	-	-	Elliot (1994)
Pardalote, Striated	90 x 120-140 mm	200 mm	30 mm	h	-	Aug-Feb	BFNC (n.d.)
Parrot, Red-rumped	100 mm	600 mm	75 mm	v/h	5 m	Aug-Jan	Adams (1980)
Parrot, Red-rumped	100-150 mm	400 mm	70-120 mm	h	-	-	Elliot (1994)
Parrot, Red-rumped	200-240 mm	400 mm	60-70 mm	v	-	-	BFNC (n.d.)
Parrot, Red-rumped	-	-	25-30 mm	-	-	-	Trainor (1995)
Phascogale, Brush-tailed	-	-	25-30 mm	-	-	-	Trainor (1995)
Ringtail-Possum sp.	250 mm	350 mm	80 mm	v	4-8 m	Apr-Nov	MZES (n.d.)
Ringtail-Possum sp.	250 mm	400 mm	60-80 mm	v	-	Mar-Nov	BFNC (n.d.)
Ringtail-Possum sp.	-	-	90 mm	-	-	-	Trainor (1995)
Rosella sp.	120-150 mm	>400 mm	70-120 mm	-	-	-	Elliot (1994)
Rosella sp.	150-200 mm	350-800 mm	75-100 mm	v/h	5 m	Aug-Jan	MZES (n.d.)
Rosella sp.	c.130 x 180 mm	c.400 mm	80 mm	v	-	-	Morrison (1996)
Rosella, Crimson	150-200 mm	350-800 mm	75-100 mm	v/h	5-6 m	Sep-Jan	Adams (1980)
Rosella, Eastern	135-150 mm	350-800 mm	75-100 mm	v/h	5-6 m	Aug-Jan	Adams (1980)
Rosella, Eastern	240 mm	400 mm	70 mm	v	-	-	BFNC (n.d.)
Rosella, Eastern	-	>500 mm	60 mm	-	>5 m	-	Trainor (1995)
Shrike-thrush, Grey	150-200 mm	200-300 mm	150 mm	-	-	-	Elliot (1994)
Shrike-thrush, Grey	150-200 x 200-300 mm	150-200 mm	open	h	-	-	BFNC (n.d.)
Swallow, Welcome	130 mm	-	open	h	3 m	Aug-Dec	Adams (1980)
Teal, Chestnut	200-400 mm	450-750 mm	100-120 mm	v	1.5 m	Sep-Dec	Adams (1980)
Teal, Chestnut	450 x 300 mm	-	80-100 mm	-	-	-	Elliot (1994)
Teal, Grey	200-400 mm	450-750 mm	100-120 mm	v	1.5 m	All year	Adams (1980)
Teal, Grey	450 x 300 mm	-	80-100 mm	-	-	-	Elliot (1994)
Teal, Grey	-	-	90 mm	-	-	-	Trainor (1995)
Treecreeper sp.	90-150 mm	100-150 mm	50-80 mm	v	-	-	Elliot (1994)
Treecreeper sp.	150 mm	400 mm	50 mm	v	-	-	BFNC (n.d.)
Treecreeper, White-throated	75-100 mm	300-400 mm	50-70 mm	v	5 m	Aug-Jan	Adams (1980)

Part 2 - Nest boxes for use by Large Forest Owl

The following nest box criteria have been prepared in collaboration with owl behaviour expert, John Young of *John Young Wildlife Enterprises*. The criteria address the need to replicate a large forest owl (eg Powerful Owl) nest hollow with a nest box in the wild.

Where a nesting hollow is required to be provided for a large forest owl (Powerful Owl, Masked Owl or Sooty Owl) the following advice should be considered.

A. In the consideration of a nesting hollow/s for the Large Forest Owls, it is preferable to retain natural hollows insitu for Owls, as opposed to relocating or constructing any new artificial hollow/s.
B. When there is no alternative and the construction of an artificial hollow is required, the design guidelines below should be used.
C. In all cases, formal approval must be gained from the appropriate consent authority before any attempt at hollow resource movement is undertaken. The Large Forest Owls is a threatened species listed under the *NSW Threatened Species Conservation Act* and any *likely impact* upon this species must be fully considered through scientific significance assessment under Part 5 of the *EPA Act.* Failure to undertake that assessment and protocol may result in severe penalties.
D. Where possible high quality hollows are to be relocated in preference to artificial nest boxes due to the preference of hollow dependent species to use natural over artificial hollows.

<u>Specific Design Criteria to of nest boxes for large forest owls</u>

1. The design of artificial nesting boxes for Large Forest Owls should replicate the natural hollow tree shape, design and size to enable a natural amenity for nesting owls.
    - The cross-sectional shape should be octagonal or circular (and not square) depending on construction materials, to prevent hatchlings being pinned into the corner (Figure 1).
    - Internal size dimensions should be 500mm in diameter and 1500mm in height.
    - The entry hole should be on the side at the top end. The opening should be 200mm wide and 300mm high.
    - A landing perch should be placed directly out from the base of the entry hole on the nest box exterior. This perch should a roughened round rod approximately 30mm diameter and 300mm long.
    - An awning over the entry hole to minimise rain entry into the nest box. This should be no larger than 100mm to permit easy approach to the perch.
    - An observation hole or mounting for cameras is not recommended where there will be any movement or light disturbance as seen from within the nest chamber.
    - A maintenance hatch is to be provided to remove any undesirable pests. The maintenance hatch is to remain closed at all times unless accessed for maintenance purposes.
    - Dry termite mud should be placed inside the box at the base as a bedding material for nesting. This should be 150mm thick. This provides good egg incubation properties and drainage.
    - Small holes should be drilled into the base of the nest box to permit water drainage.

- Roughened round horizontal timber rods approximately 30mm in diameter should be attached directly against the internal wall of the box in a ladder type fashion. The rods should be placed approximately 80mm apart from the base of the box to the entry hole, only on the entry side of the box.
- Additional external insulation materials would be beneficial to simulate the cambium properties of a living hollow and the exterior of the box should, where possible, take on a natural appearance to suit the host tree species.
- Construction materials are to mimic natural conditions such as typically dense hard dead timber which provides a level of structural security for long term occupation. Materials should not leak water at joints. Ideally, materials should be constructed using a minimum of 18mm structural grade ply or marine ply.
- Due to the size and subsequent weight of the box, all timber joints should be sealed to prevent cracking, glued and screwed to ensure impact resilience.
- All fasteners are to be suitable for external use. (e.g. galvanised, stainless steel, brass fixing etc.)
- The fixing method should not cause stress to the host tree such as open wounds or strapping tightly around the cambium restricting nutrient flow.

2. The fabrication of the boxes should be sufficiently robust to withstand impacts from fire, wind, rain and vandalism.
   - The structure of the nesting box, as well as the fixing technique to the host tree, should be resilient to falling or swinging branches. The structural integrity can be tested by dropping the box onto a hard surface from above 1m in height without altering the shape. The fixing can be tested by having the full weight of the tree climbing installer on the box without it being dislodged from the tree.
   - External materials should be resilient to excessive heat such as that from a low fire in the understorey.
   - The roof of the nest box should be sloped to prevent pooling of water.
   - A strong lining around the entry hole will reduce potential for Cockatoo damage but should not result in a slippery surface.
   - Boxes must be installed away from existing tracks and roads so as to deter human contact.
   - Boxes should be installed at a height of at least 10m, and preferably 15m above ground level.
   - External materials should be resilient to impacts from projected debris such as rocks.

3. The location of boxes should reflect specific natural conditions whilst the fixing to a host tree should be substantially secure to withstand movement for long term occupation.
   - Boxes should be placed onto stable trees with a DBH of greater than 400mm.
   - The location of nest box placement is best determined by an Owl specialist or suitably experienced ecologist. The location of Large Forest Owls nest boxes should

consider nearby roosting opportunity for the male and proximity to identified habitat features unique to the locality.

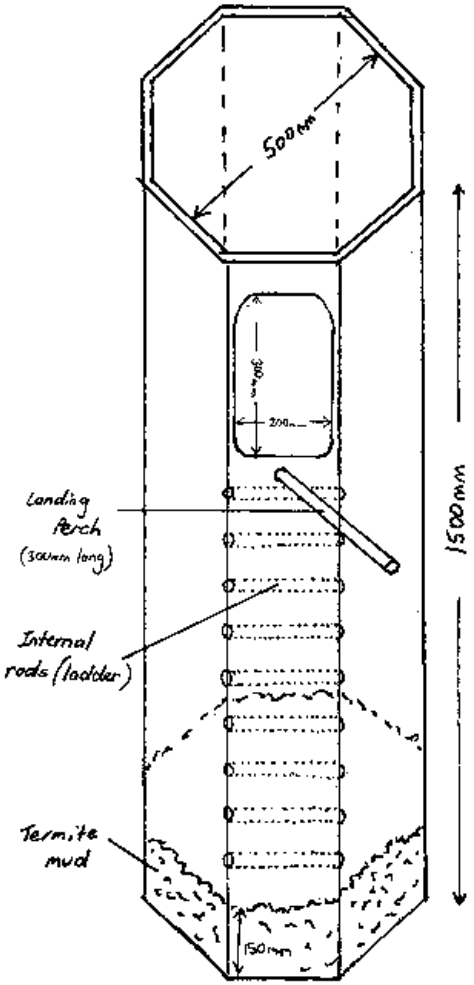
- Trees should be selected so that they are not likely to be subject to falling trees and / or substantial branches.
- The box should be placed directly against the trunk and preferably rested on a branch for added structural integrity. Methods of placement to mimic the natural features of the host tree may be investigated further.
- The host tree selected should be of suitable size and condition such that stress would not result from the placement of the nesting box.
- cement of nest boxes before the end of February will allow the Powerful Owls to familiarise themselves with the presence of the nest box prior to the following breeding season which begins in May.
- Boxes should be marked with a reference number for documenting monitoring and reference purposes. The location of the box is to be fixed by GPS and located on a topographic figure for monitoring purposes.

Exterior Materials:

Exterior insulation is to be provided that replicates the look and thermal properties of a trunk. This may consist of natural timber offcuts and / or a combination of thermal insulation products.

Exterior needs to be camouflaged to reflect a natural tree preferably using natural bark and timber offcuts e.g. a rough barked species.

Artificial means of camouflage may be used subject to replicating the bark type of the host tree e.g. smooth barked trees.



DESIGN 3 - LARGE FOREST OWL BOX

(Internal Construction design)

Construction materials & external design

These specifications stipulate the construction materials and external design used to meet the above specific design criteria.

Positive Design Aspects:

- This design is made of easily obtainable materials and thus may be replicated.
- Collection of natural coverings would be far more time costly.
- The internal design addresses size and shape specifications provided by John Young of *John Young Wildlife Enterprises*.
- The external robust design addresses strength and resilience specifications set by *Travers bushfire & ecology* against UV radiation, vandalism, weather and excessive heat.
- Insulation aims to replicate thermal properties of a living hollow trunk.
- Other current Large Forest Owls nest box designs have not been proven very effective.
- The colour and shape mimics a smooth-barked tree trunk. In this case, Spotted Gum is the intended recipient tree.
- This same design could also be used for rough barked recipient trees (e.g. Ironbark, Stringybark), which would only require the additional affixing of bark samples of Ironbark / Stringybark to the rounded exterior.
- The nest box is significantly less weight than relocating a natural hollow and does not require the use of a crane to install.

Negative Design Aspects:

- External materials selected to replicate a smooth-barked tree (eg. Spotted Gum) are not natural.
- When attached it takes the appearance of one trunk section (nest box) attached to another trunk (recipient tree) rather than a single tree section. The flat lid and eave also do not mimic natural shape.
- Increased cost over a standard nest box.
- The nest box is moderately heavy and is best installed using a small crane to enable effective placement on a strong branch.

Following the construction of the internal octagonal box, the nest box will be provided with extra insulation by wrapping in *Anti-con* roofing insulation. This is to replicate the insulation properties of a thick walled tree with water that provides a cooling / insulation effect. This product is normally placed below a standard *Colorbond* roof and is made of fibreglass sponge and lined with a heavy duty foil sarking on one side. The foil sarking will be placed on the outside and pulled tightly around the box, then taped secure. The sarking will provide increased waterproofing to the fibreglass foam.

The natural smooth look of a Spotted Gum and strong weather-resistant finish is then achieved by wrapping the box exterior with flat *Colorbond* sheeting.

Colorbond is durable, weather resistant, has good resistance to fire and is able to be painted for a natural finished look and therefore both products will suit specifications outlined by *Travers bushfire & ecology*.

Colorbond sheeting has the added benefit for fastening using roofing screws and rivets, and it comes in a range of grey colours that may be matched to a Spotted Gum. Both options will require two sheets lapped around the middle due to the size of sheets available. The bottom

sheet will be wrapped first and then the top sheet so that a water resistant lapping will result. Rivets will secure the lapped join. The lapped join of both sheets will be sealed at the rear of the box with a piece of treated pine timber which will protrude higher and lower than the box and used to fasten the box against the tree trunk using bugle screws. A pre-drilled hole in the top of this timber will be used to pull the box up the tree by rope.

A photo of the recipient tree is taken to colour-match the *Colorbond* base as well as the paint used to mimic bark spots and peels.

The roof of the box will be made of plywood on a slope as required and then lined on top with *Colorbond* sheeting to prevent possum entry into the box. Possums will not be able to grapple the smooth surface all around.

The two flat faces of the hexagonal plywood interior on either side of the entry hole face will run longer and protrude below the box. This is so that the box may rest more securely on a branch.

Photos 2 & 3 - Examples of large forest owl nest box design and placement at Wadalba

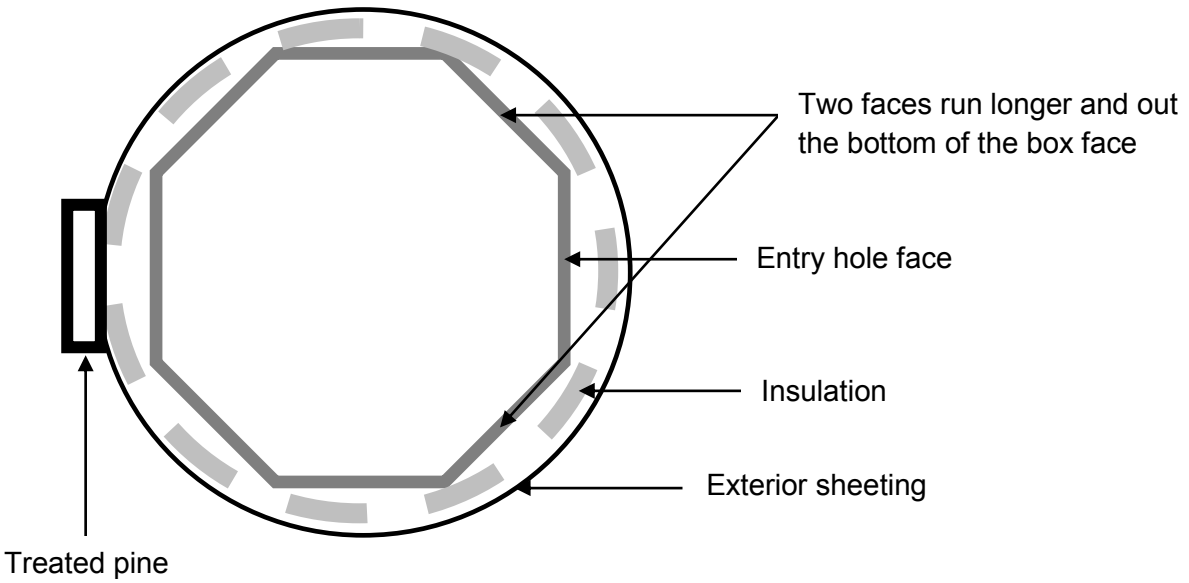


Diagram 2: Cross-section

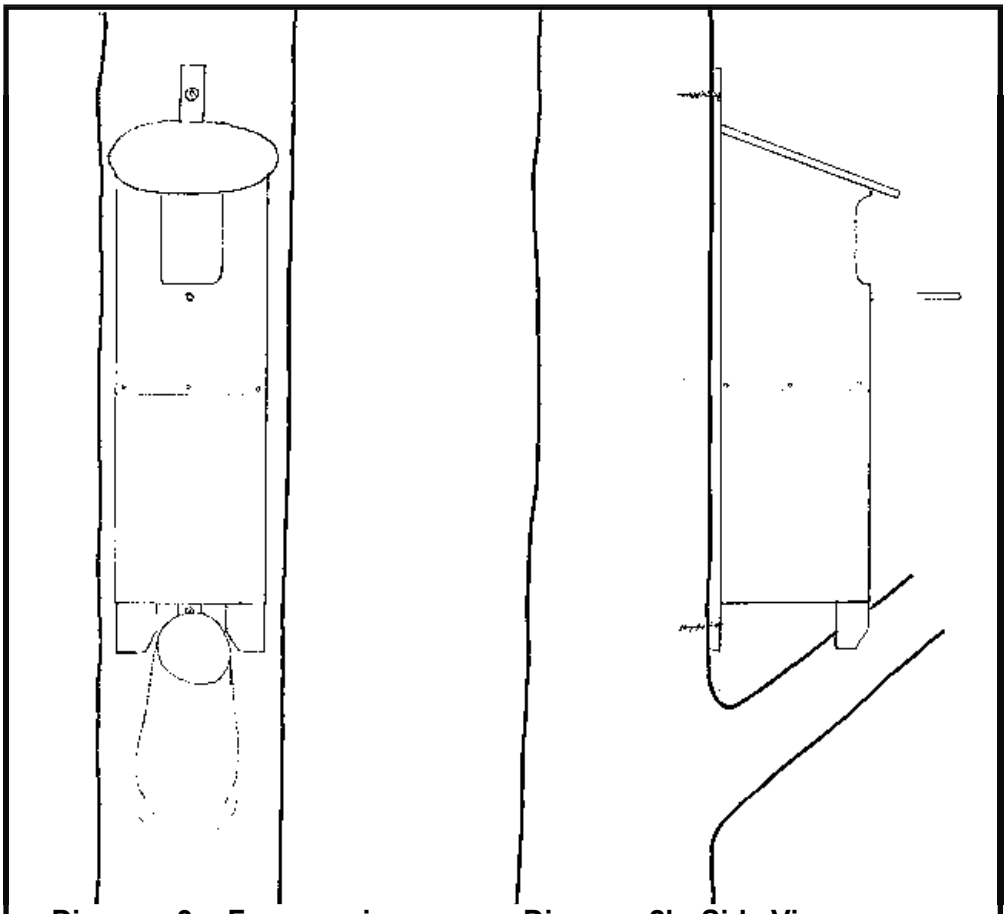


Diagram 3a: Face on view **Diagram 2b: Side View**

Restoration Timeline A5

ID	Task Name	Duration	Year 1- Primary Restoration Works												Year 2												Year 3											
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	STAGE 1 - PRECOMMENCEMENT																																					
1.0	**PROJECT INITIATION**	1 month																																				
1.1	Confirm funding	1 month																																				
1.2	Preparation of contract schedules	1 month																																				
1.3	Submission of fee proposals	1 month																																				
1.4	Contractor approvals & engagement of project ecologist	2 weeks																																				
2.0	**SITE PREPARATION AND PROPAGATION**																																					
2.1	Veg condition assessment & installation of monitoring plots	2 weeks																																				
2.3	Plant propagation (initial & contingency)	6-8 months																																				
2.4	Protective fencing	2 weeks																																				
2.5	Install sediment and erosion control measures	2 weeks																																				
2.6	Commence pest control - Pindone baiting	1 week																																				
	STAGE 2 DURING CONSTRUCTION WORKS																																					
3.0	**WEED CONTROL**																																					
3.1	Primary weed control Year 1	1-6 months																																				
3.1.1	Year 1	1 year																																				
3.1.2	Year 2	1 year																																				
3.1.3	Year 3	1 year																																				
3.2	Secondary weed control - Year 2	1 year																																				
3.2.1	Year 3	1 year																																				
4.0	**REVEGETATION ESTABLISHMENT**																																					
4.1	Site preparation - initial treatment, removal of waste	2 weeks																																				
4.2	Construction works within conservation area - regrading and stormwater outlet works	ongoing																																				
4.3	Installation of irrigation system (as appropriate to site)																																					
4.4	Direct Seeding - native grasses	3-4 months																																				
4.5	Regeneration works	ongoing																																				
4.6	Revegetation Works	6 months																																				
4.7	Initial watering & maintenance	ongoing																																				
4.8	Installation of nest boxes	1 month																																				
4.9	Remove redundant guards and sediment fencing	as required																																				
	STAGE 3 - POST CONSTRUCTION WORKS																																					
5.0	**BUSH REGENERATION & REVEGETATION**																																					
5.1	Watering, maintenance weed control and repairs	3 years																																				
5.2	Pest control - Pindone baiting	3 years																																				
5.3	Ongoing bushland Regeneration of existin bushland areas	3 years																																				
6.0	**MANAGEMENT AUDITING AND MONITORING**																																					
6.1	Contractor supervision / monitoring	12 months																																				
6.2	Ongoing supervision/auditing/monitoring	2 years																																				
6.3	Submission of annual reporting	3 years																																				
6.4	Nest box monitoring	2 weeks																																				
7.0	**CONTINGENCY WORKS (Subject to Audits)**																																					
7.1	Target noxious weeds	2 weeks																																				
7.2	Replacement planting	1 month																																				
7.3	Watering & maintenance	3-6 months																																				
7.4	Medium term maintenance	6 months																			Contingency												Contingency					
7.5	Submission of compliance certification																																					

Direct Seeding Specification

A6

Native Seeds Pty Ltd

ABN 18 051 485 710

27 October 2014

Mr. M. Sheather-Reid
Travers bushfire and ecology
38A The Avenue,
Mount Penang Parklands
Central Coast Highway
Kariong NSW 2250

Dear Michael,

Report on Coopers Paddock Restoration

At your request I visited the Cooper Paddock part of the Warwick farm racecourse to evaluate what works need to be undertaken to restore habitat.

Attached is my report as discussed.

If you need further information or explanation please let me know,

Yours sincerely,

Ian Chivers

CEO

PO Box 133
Sandringham Victoria 3191
Australia

Telephone (03) 9555 1722
Fax (03) 9555 1799

Website:
www.nativeseeds.com.au
Email: enquiries@nativeseeds.com.au

Warwick Farm – Coopers Paddock site restoration

Overview

The site can be seen as having three different vegetation mixes:

1. Varying content of lantana under mature trees – the content varying from very dense to moderately dense and vines being present or absent
2. Cleared spaces with mostly introduced grassy plants, many of which are difficult weeds
3. Groundcover areas in what was previously a quarry

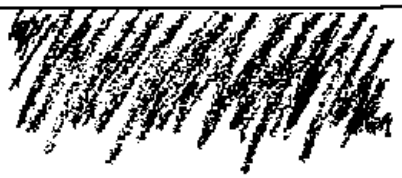
There were very few naturally occurring native grasses – only Microlaena stipoides, Themeda australis and Entolasia stricta.

The main emphasis of the conservation efforts on this site are to providing better habitat for the abundant birdlife that is already present on the site by removing the weed burden, particularly that of the Lantana and replacing with native shrub and subcanopy species.

The plans suggested for each area are set out below. The choice of plan will depend upon the vegetation that is encountered in each location.

The intention is not to attempt to do the entire revegetation in one event, rather to mulch strips through the area, to establish a dense groundcover layer in that strip, then to progress to adjoining areas. It is expected that all lantana will be removed with 3 years allowing another two years to consolidate any remaining target weed control and revegetation works. The existing riparian bank being a natural berm will prevent any erosion into the adjoining George's River .This approach aims to prevent soil erosion and to continue to provide habitat for native animals. It does run the risk of seed coming into the strips from the remaining vegetation, and of issues of practicality of broadscale weed control in the interim stage, however, on balance the methodology should provide a good result as long as the operators are diligent.

There is a four to five year time frame and an adequate budget to help achieve a satisfactory result from this work. This allows time for weed control operations to be undertaken over a series of seasons and gives a far greater chance of success than would be obtainable from a more contracted time frame.



General Approach to Site Rehabilitation

The general approach being recommended is to restore to a diverse understory through a series of stages commencing with a simple monoculture of a key grass species and developing greater complexity through revegetation of shrub layers and canopy layers, and regeneration over the subsequent years. This approach allows for the use of a one or two species in each treatment area that are well adapted to the site and for which a high degree of knowledge is available in relation to weed control and herbicide tolerances. Choosing a monoculture seeding stage permits easier management of the weeds on the site.

Given that the most prolific weed is lantana, it can be expected that there will be a massive seed load of this species in the soil which will lead to massive lantana germination soon after removal of the lantana canopy. This germination wave will need immediate control. Sowing a complex seed mixture into this soil make control of these seedlings more difficult as it will require some specific herbicide knowledge. The use of complex seed mixtures will not permit the use of the most appropriate herbicide because of the varying herbicide tolerances between species.

The key species recommended are Kangaroo grass (Themeda australis) and Weeping grass (Microlaena stipoides). These are both found on site, hence they are locally adapted, and have been produced in monocultures for many years, hence good herbicide knowledge is available.

Once a monoculture of these species is developed it will be possible to increase the diversity within the sward by either over-sowing or by inter-planting. The decision as to the most appropriate species to sow or plant can be left for that future time. The most important stage to achieve is that of having a full cover of the desired groundcover species as this will allow control of weeds in an efficient manner.

Vegetation Mix 1a – Dense Lantana and Vines under mature canopy (Areas A, G1, E, F)

In this case it is expected that there will be a profusion of weed types germinating once the existing shrub and vine layer is removed. There will also be a significant re-sprouting of the Lantana and the vines from fallen-but-not-dead stems.

In this case it will be best to leave the area without any seeding for at least 3 to 4 months. The mulched areas will resprout with rainfall and the correct temperatures. This can be expected to occur several times over the following season. Each time, the new weed crop can be either sprayed off or the areas mulched again. Repeating this approach will progressively reduce the weed seed burden of the soil and will swing the seed numbers in favour of a sown grass.

Vegetation Mix 1b – Moderately dense Lantana under mature canopy (Areas G3, H1, H2, I, J, K, L)

In these areas there are likely to be fewer resprouting stems and the chance of a successful establishment from seed is far higher than in the previous class of vegetation.

In this case the approach will be to sow heavily a cover of the appropriate native grass species and to allow the seedlings to achieve at least a 3 to 5 leaf stage, after which time they can be sprayed with a broadleaf selective herbicide without suffering unduly. This regime of broadleaf weed control will need to be maintained for at least 12 to 18 months so as to help to deplete the seedbank in the soil.

Sowing in November to January / February would best be undertaken using Themeda seed, while in April to August it should be Microlaena seed.

The minimum sowing rates recommended to be used are:

- Themeda (pelletised seed) 0.3 kg per 100 sq.m., or
- Themeda (florets) 2 kg per 100 sq.m.
- Microlaena (florets) 1 kg per 100 sq.m.

Vegetation mix 2 – Cleared areas with cover of introduced grasses (Areas D, G2)

There are several, relatively small areas that have a grass cover rather than one of lantana. On these areas there were swards of African Lovegrass (Eragrostis curvula), Kikuyu (Pennisetum clandestinum), Quacking grass (Briza maxima) and Perennial Veldt grass (Ehrharta erecta).

These are all weeds with a great capacity to invade the nearby cleared areas and will be important to control.

In each case they should be killed off with a repeated series of glyphosate sprays. This will probably require a period of 6 months to achieve reasonable control. After that time it would be possible to sow the area with the grass of choice for the season of sowing.

Once the new grass cover is established it will be possible to prevent new weeds emerging by using selective pre-emergent herbicides for the seeded types (Eragrostis and Ehrharta) and spot spraying for the vegetative type (Pennisetum).

Vegetation mix 3 – Old Quarry area, previously cleared (Area B)

In this area there is a moderate cover of Carex appressa, accounting for around 30% of the total groundcover. Apart from this desirable species there are a number of undesirable introduced species such as Kikuyu (Pennisetum clandestinum) and Giant Brome (Bromus catharticus).

There was a large body of grassy thatch over the entire area. This will have accumulated over the last decades when there has been no grazing or fire across the area. The thatch layer will need to be removed so as to create space for the weeds to be controlled and more Carex introduced. Removal can be either by burning or by mulching and removal of the clippings. My preference is for burning as it is more effective at removing the material and allowing for creation of a suitable seedbed, however I can understand if this is not supported by the local fire management group.

Some earthworks will be necessary in this area to remove the spillover soil along the edge of the horse training track, and this can happen more efficiently once the excess thatch is removed.

Once the excess thatch is removed and the edge removed, revegetation can be achieved by planting of mature Carex appressa plants by tubes. I expect that around 500 plants will be sufficient to give a sufficiently high density of planting over this area.

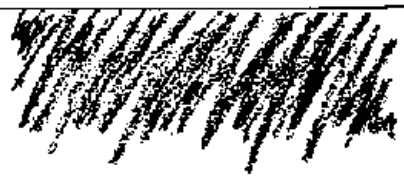
Likely prices of seeds

I expect the likely prices per kilogram of seed (ex GST) will be as follows:

- Themeda pelletised seed - $600 – 800 per kg
- Themeda florets - $85 – 140 per kg (Price varies with the seed content)
- Microlaena stipoides - $150 to 250 per kg

Pre-emergent herbicides to use

For both Themeda and Microlaena sowing operations it is possible to use either Spinnaker at 300 ml/ha or Glean at 25 g/ha to give selective control of weeds. These herbicides are to be applied immediately following seeding according to the method on the label and will help to give 6 to 8 weeks of protection against weed germination. Whilst it will slightly reduce the numbers of desired plants that will germinate, it will substantially reduce the weed numbers that will germinate within this period of protection.



Post-Emergent Herbicides with potential to use

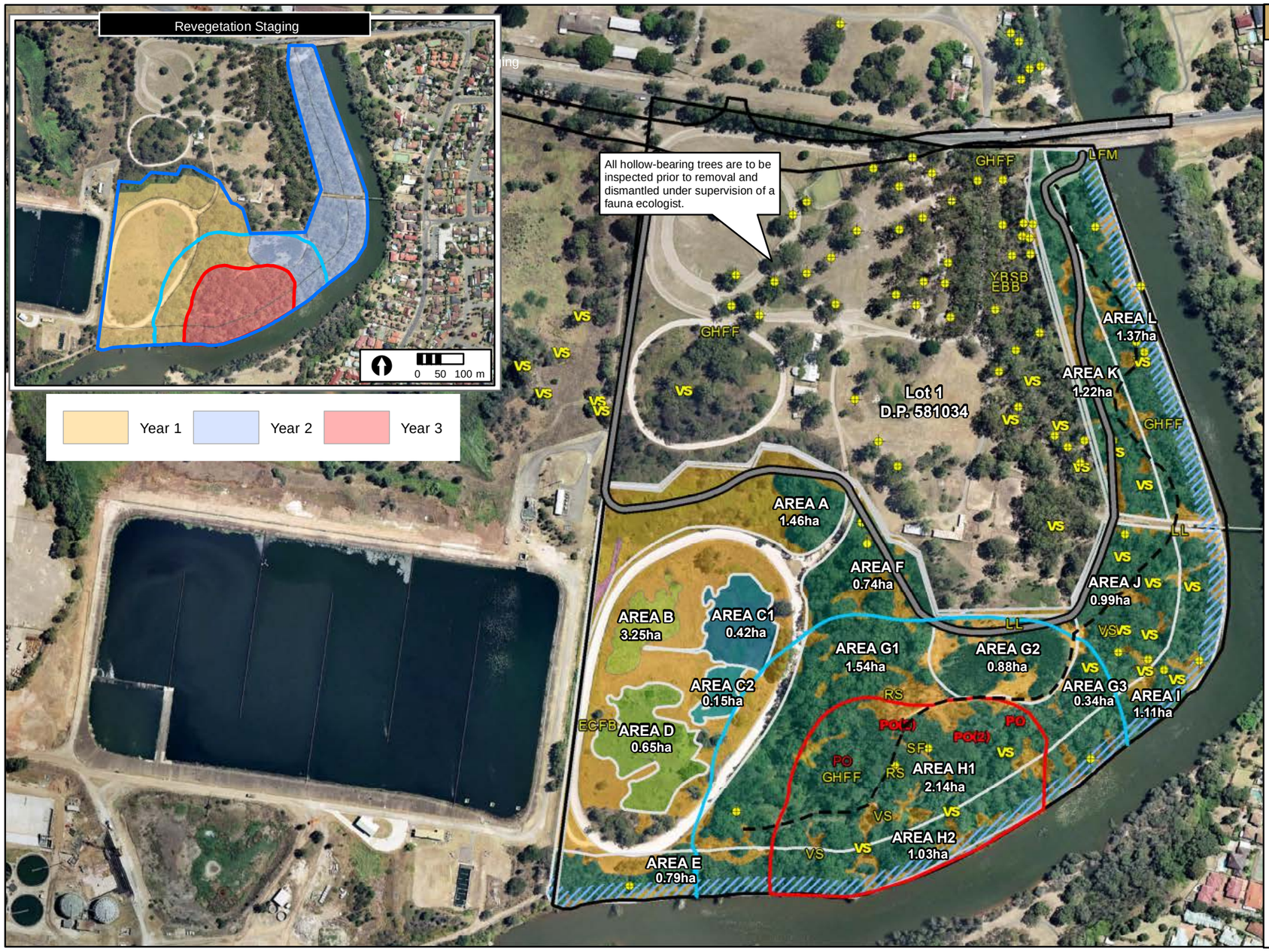
Within Themeda sowings it is possible to use Fusilade for the control of Ehrharta and Briza as long as the rate chosen is the lowest applicable and care is not taken to have spray overlaps. There may be some effect on Kikuyu with the use of Fusilade however it is less reliable on this weed.

Within Microlaena it is possible to use Glean as a post-emergent spray for the control of those same weeds.

African Lovegrass is difficult to control. Some success has occurred with Flupropanate however this herbicide is a long-term soil residual herbicide and I have seen significant problems with its use. I do not recommend its use. Instead my view is that it is best controlled by spot-spraying with glyphosate.

Restoration Works Plan

S1



Restoration Performance Targets – Coppers Paddock Foreshore Reserve

Restoration Performance targets apply to the Foreshore Reserve. Site audits are to be undertaken on an annual basis to assess the achievement of the following performance targets

1. The presence, abundance and cover of noxious and environmental weed species is to be progressively reduced over 4 years (1 year establishment and 3 years of restoration, revegetation and maintenance). A maximum of 5% noxious weed and invasive vine cover is to be present at the end of year 3 and a maximum of 10% grass and wood weed cover to be present at the end of year 4.
2. Stabilised soils in all localities and establishment of native vegetation to provide long term ground cover.
3. Achievement of a natural vegetation structure and composition using species that naturally occur within River-flat Eucalypt Forest vegetation, ridgeline plantings may also include species from the vegetation community Cumberland Plain Woodland. To be determined by comparison of retained areas against onsite benchmarks and assessed using the biometric methodology.
4. A total of 10.7 ha of River-flat Eucalypt Forest vegetation will be protected and regenerated with a fully structured and diverse vegetation community. Within revegetation and translocation areas, a minimum of 30 endemic native species are to be established consisting of a broad mix of groundcover, shrub, vine, sub-canopy and canopy species. 6.76 ha of disturbed landscapes will be restored with fully structured River-flat Eucalypt Forest. A total of 17.4 ha will be protected and restored.
5. All vegetation within the Powerful Owl Protection Zone is to be protected and progressively regenerated. There is to be no activity including bush regeneration works within the Powerful Owl Protection Zone during the breeding season which includes March and November or any time the owls are observed present. Progressive weed control and native regeneration should be undertaken with patchwork mowing over 4 years.
6. There is an existing horse trail which runs through the Powerful Owl Protection Zone is to be closed immediately and an alternative route provided.
7. All dead trees and dead wood are to be retained on trees within the conservation area to allow for hollow retention, roosting and foraging sites for the Powerful Owl, Varied Sittella, Grey-headed Flying-fox and recorded microbat species.
8. A minimum of 50% of all planted canopy species are to be rough barked trees to provide foraging habitat for Varied Sittella and discourage occupation by Bell Miners. Canopy plants are to be accompanied by dense plantings of sub-canopy, and shrub layers. Grasses to be direct drilled and revegetated where appropriate.
9. Target 90% native vegetation cover at the end of year 4. Native vegetation cover is to be monitored every six (6) months.
10. Improved density and diversity of understorey vegetation for fauna species habitat.
11. The effectiveness and appropriateness of weed control and fuel reduction methods.
12. The effective control and removal of waste and litter from the Riparian Corridor.
13. Installation of artificial 70 mixed artificial nest boxes of varying sizes (to be advised by the project ecologist) suited to general bird, arboreal mammal and microbat species.
14. All stormwater outlets within the riparian zone, drainage lines and Georges River bank are to be fully stabilised with a minimum of 4 endemic native plants per m^2 with no identifiable bed or bank erosion, inclusive of open weave jute mesh.
15. The boundaries of the conservation area is to be protected with at a minimum a 5 wire strand with dog exclusion fencing or open timber boundary fence and may include the use of solid colour bond fences. At the rear of all industrial lots the fences are to be a minimum of 1.8 m high to prevent the disposal of refuse in the conservation area. A 2-3 m wide grassed access route is to be provided adjoining the protective fence within the conservation zone for maintenance purposes. The access may be provided in the form of the cycleway or open grass zone stabilised within locally occurring native species.
16. The felling of all hollow-bearing trees is to be undertaken under the supervision of a fauna ecologist to allow the removal and management of any resident fauna. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse. Re-used hollows or those with likely occupation are to be relocated to natural areas within the conservation zone.
17. Native vegetation on the remnant side of the conservation zone boundary is to be regenerated and planted densely to out-compete invasive weed species. In this case the outer 20 m of the EEC buffer is to be densely planted or regenerated with acacias and other similar sub-canopy species to suppress weed regrowth.
18. Surface drainage is to be collected and directed away from the conservation zone using a swale system within the development lots so as to minimise the potential for weed invasion.

Areas of Managed Zones					
Area A	1.46ha	**Area F**	0.74ha	**Area I**	1.11ha
Area B	2.68ha	**Area G1**	1.54ha	**Area J**	0.99ha
Area C1	0.42ha	**Area G2**	0.88ha	**Area K**	1.22ha
Area C2	0.15ha	**Area G3**	0.34ha	**Area L**	1.37ha
Area D	0.71ha	**Area H1**	2.40ha		
Area E	0.79ha	**Area H2**	1.03ha		

Legend

- Powerful Owl Protection Zone - Roosting Area
- Powerful Owl 70m buffer
- Cycleway (2.5m wide)
- Existing Trail (to be closed & restored)
- Georges river Buffer (15m)

Vegetation Management Zone

- Existing Native Vegetation (Regeneration)
- Aligator weed (Target noxious weed control - canopy planting)
- Canopy and shrub revegetation with seedlings (Direct seeding of grasses)
- Canopy planting only
- Carex Sedgeland (Canopy and shrub planting only)
- Existing wetland (Targeted weed control)
- Wetland inlet (Enrichment planting of SOF)

- Habitat Trees

Fauna Survey Results

- SF — Satin Flycatcher
- LL — Little Lorikeet (flight direction)
- VS — Varied Sittella
- RS — Rufous Fantail
- GHFF — Grey-headed Flying-fox
- ECFB — East-coast Freetail Bat
- YBSB — Yellow-bellied Sheathtail-bat
- EBB — Eastern Bentwing-bat
- LFM — Large-footed Myotis
- PO — Powerful Owl (individual observed roosting)
- PO(2) — Powerful Owl (pair roosting together)

0 50 100 150 200 m

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

Travers bushfire & ecology

PROJECT	REFERENCE
Coopers Paddock Development, Warwick Farm	A14149_Schedule 1 - Restoration Works Plan
SCALE	**DATE (ISSUE)**	**TITLE**
1:4,000 @ A3	07.09.2015 (Issue 3)	**Schedule 1 - Restoration Works Plan**

Weed Clearance Plan

S2

Table 1 – Vegetation cover calculations

Management Zone	Total Area (ha)	No canopy cover	Existing canopy (ha)
Area A	1.46	1.25	0.204
Area B	2.68	1.95	1.21
Area C1	0.42	-	0.42
Area C2	0.15	-	0.15
Area D	0.71	0.71	-
Area E	0.79	0.218	0.572
Area F	0.74	0.163	0.577
Area G1	1.54	0.28	1.26
Area G2	0.88	0.33	0.847
Area G3	0.34	0.035	0.305
Area H1	2.4	0.385	2.015
Area H2	1.03	0.215	0.815
Area I	1.11	0.541	0.569
Area J	0.99	0.089	0.1
Area K	1.22	0.596	0.624
Area L	1.37	0.404	0.966
TOTAL	**17.77**	**7.15**	**10.63**
			17.7

Legend

- Powerful Owl Protection Zone - Roosting Area
- Powerful Owl 70m buffer
- Drainage Line
- Cycleway (2.5m wide)
- Existing forest mulcher tracks
- New forest mulcher tracks
- Existing Trail
- Access Ramp
- Habitat Trees
- Georges river Buffer (15m)

Vegetation Zone Management

- Existing Native Vegetation (regeneration)
- Aligator Weed (target noxious weed control - canopy planting)
- Canopy and Shrub Revegetation with Seedlings (direct seeding of grasses)
- Canopy Planting Only
- Carex Sedgeland (canopy and shrub planting only)
- Existing Wetland (targeted weed control)
- Wetland Inlet (enrichment planting of Swamp Oak Forest)

Aerial source: *Google Earth Pro*

0 50 100 m

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE
Coopers Paddock Development, Warwick Farm
A14149_W001

DATE & ISSUE NUMBER
7/09/2015
Issue 1

SCALE & COORDINATE SYSTEM
1:2,750 @A3
GDA 1994 MGA Zone 56

TITLE

Schedule 2 - Weed Clearance Plan

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