



ANNE CLEMENTS & ASSOCIATES PTY. LIMITED
(ABN 41 077 242 365, ACN 077-160-939)
Environmental and Botanical Consultants
Office 2, 3 Harbourview Crescent, Milsons Point 2060
PO Box 1623, North Sydney 2059
Phone: (02) 9955 9733, Mobile: 0427553362
Email: mail@acabotanic.com

9 May 2024



Vegetation Management Plan for Conservation Areas associated with the proposed Augusta Street warehouse and distribution centre in Huntingwood

Prepared by:

Dr AnneMarie Clements
Dr Anne Baumann
Tony Rodd
Tim Harding

Prepared for:

The Trustee for Huntingwood Property Trust

Document Control

Version	Date	Author	Details
1	25 March 2024	Dr AnneMarie Clements, Dr Anne Baumann, Tony Rodd, Tim Harding	VMP prepared as requested by Blacktown City Council.
2	9 May 2024	Dr AnneMarie Clements, Dr Anne Baumann, Tony Rodd, Tim Harding	VMP revised in response to Blacktown City Council's comments

Photograph on front cover: Culvert under the M4 Motorway. Taken by Kane Durrant on 27 February 2024.

Table of Contents

Glossary and Definitions.....	5
1.0 Introduction.....	7
2.0 VMP Guidelines and national standards.....	8
3.0 Site description.....	9
3.1 Landform.....	9
3.2 Drainage and hydrology.....	10
3.2.1 Flooding.....	11
3.3 Geology and soils.....	11
3.4 Land use.....	11
3.5 Climate.....	12
3.6 Native vegetation.....	12
3.6.1 Onsite surveys.....	13
3.6.2 Observations within the Conservation Areas.....	14
3.7 Weeds.....	15
3.8 Habitat values.....	15
3.9 Key threats to biodiversity and management issues.....	16
3.9.1 Known threats to Cumberland Plain Woodland.....	18
3.10 Conservation assets.....	19
4.0 The Vegetation Management Plan.....	20
4.1 Land to which the VMP applies.....	20
4.2 Aims of the VMP.....	20
4.3 Objectives of the VMP.....	20
4.3.1 Management Objective 1 – Protection of the VMP areas.....	21
4.3.2 Management Objective 2 – Increase community awareness of the benefits of canopy vegetation to minimise heat island effects.....	22
4.3.3 Management Objective 3 – Feral pest control and relocation of native species prior to works.....	22
4.3.4 Management Objective 4 – Enhancement of the local native vegetation utilising the conservation assets.....	22
4.3.5 Management Objective 5 – Remove existing dumpings and weed control.....	24
Control of dense weed growth.....	24
4.3.6 Management Objective 6 – Re-establish the landform and associated hydrology.....	28
4.3.7 Management Objective 7 – Habitat enhancement for native fauna species.....	29
4.3.8 Management Objective 8 – Enhancing water quality in bioretention and reconstructing wetlands using local native species.....	36
4.3.9 Management Objective 9 – Monitoring and maintenance.....	38
References.....	39

Figures

Site location

- 1a. Site boundary and mapped watercourses overlaid on the Nearmap aerial photograph dated 21 August 2022
- 1b. Site boundary overlaid on the E-topo Prospect topographic map sheet 9030-2N
- 1c. Site boundary overlaid on the Penrith 1 Metre DEM LiDAR dated June 2019 (Spatial Services, ELVIS) - close up
- 1d. Site boundary overlaid on Huntingwood Precinct Development Framework (from Figure 4, page 7 of the Huntingwood Precinct DCP)

- 1e. 1% AEP pre-development flood levels and depth (Costin Roe Consulting Pty Ltd, Drawing No. C013904.03-F001. Issue A. Dated 23.06.23)

Conservation Areas

- 2a. Conservation Areas A, B and C overlaid on the Masterplan (PACE Architects, Dwg no. 220207-DA-001, Issue E, Dated 20.02.24)
- 2b. Conservation Areas A, B, C overlaid on the Landscape Strategy (Habit8 - Project No. H8-22032, Rev. M, Dated 14.03. 2024)

Sampling and observations

- 3a. Sampling locations overlaid on the vegetation map
- 3b. Native canopy trees from Canopy Consulting overlaid on the Nearmap aerial photograph dated 21 August 2022

Engineering works within the Conservation Areas

- 4a. Location of Conservation Areas A, B, C overlaid on Costin Roe Drawing No. C013904.03-SSDA550, Issue B, dated 13.03.24
- 4b-1. Costin Roe Drawings No. C013904.03-SSDA415, Issue F, dated 13.03.24
- 4b-2. Costin Roe Drawings No. C013904.03-SSDA410, Issue F, dated 13.03.24
- 4b-3. Costin Roe Drawings No. C013904.03-SSDA551, Issue B, dated 13.03.24
- 4b-4. Costin Roe Drawings No. C013904.03-SSDA552, Issue B, dated 13.03.24
- 4b-5. Costin Roe Drawings No. C013904.03-SSDA553, Issue B, dated 13.03.24

Tables

1. Cover of species recorded in the Conservation Areas
2. Maximum height and number of individuals per 10 m x 10 m subquadrat for species present ≥ 2 m in the Conservation Areas
3. Target Table for implementing the Vegetation Management Plan.
4. Timeline / Schedule of activities.
5. Costing estimates.

Appendices

1. Examples of major projects designed and implemented by Anne Clements & Associates.
2. Seed availability for native species recorded onsite or nearby.
3. Sheet 12 of Blacktown City Council's Water Sensitive Urban Design Standard Drawings.
4. Figures 13 and 14 from the Huntingwood Precinct DCP.
5. Huntingwood frog survey outcomes and habitat suitability for microbats with recommendations for habitat restoration for threatened fauna (Grant Webster and Jayden Walsh 2022).
6. Additional microbat survey on 27 February 2024 (Kane Durrant Wild Conservation 2024).
7. PCT 3319 Profile.
8. Photographic record for plots in the Conservation Areas.

Details and experience of author/s and contributors

Name	Position	Tasks performed include	Relevant qualifications
Dr AnneMarie Clements	Restoration ecologist	- report preparation - review of species lists	MSc, PhD, Ecology Specialists Certified Environmental Practitioner under the EIANZ: CEnvP Registration Number E200001.
Dr Anne Baumann	Ecologist	- report preparation - document review - checking figures	PhD, BScAg, Cert III Conservation and Land Management. Dip. Arboriculture.
Tony Rodd	Botanist	- reviewing species lists	BSc, Specialist botanist with many years of experience
Tim Harding	Ecologist	- preparing figures	BSc with ecology major.

Glossary and Definitions

BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BC Act	Biodiversity Conservation Act 2016 (NSW)
BCC DCP	Blacktown City Council Development Control Plan 2015
BDAR	Biodiversity Development Assessment Report
CEEC	critically endangered ecological community
CM	Construction Manager
DBH	diameter at breast height (over bark)
DCP	Development Control Plan
EM	Environmental manager
HTW	High Threat Weed
IBRA	Interim Biogeographic Regionalisation for Australia
NRAR	Natural Resources Access Regulator
NSW	New South Wales
PCT	plant community type
RAP	Remediation Action Plan
VMP	Vegetation Management Plan

Additional Key definitions in the Blacktown City Council 2019 VMP Guidelines

Adaptive management	A sophisticated form of 'trial and error', using the best currently available knowledge, skills and technology. An action is implemented and outcomes recorded including success, failures and potential for improvement. These learnings form the basis of the next round of decision making and trialling in a process of continuous improvement.
Assisted	The practice of fostering natural regeneration and re-colonisation after actively

regeneration	removing ecological impediments (e.g. invasive species, fish barriers) and reinstating appropriate abiotic and biotic states (e.g. environmental flows, fire regimes).
Ecological restoration	The process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. (Note: Single species restoration can be considered complementary and an important component of ecological restoration.)
Hollow-bearing Tree	A living or dead tree that has at least one hollow. Trees must be examined from all angles. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 metre above the ground.
Natural regeneration	The recovery or recruitment of species from a germination or re-sprouting event. A 'natural regeneration' approach to restoration relies on spontaneous or unassisted natural regeneration as distinct from an 'assisted natural regeneration' approach that depends upon active intervention.
Reconstruction	A restoration approach where the appropriate biota need to be entirely or almost entirely reintroduced as they cannot regenerate or re-colonise within feasible timeframes, even after expert assisted regeneration interventions.
Rehabilitation	The process of reinstating a level of ecosystem functionality on degraded sites where ecological restoration is not the aspiration, as a means of enabling ongoing provision of ecosystem goods and services.
Resilience	Resilience the capacity of a system to absorb disturbance and reorganise while still retaining similar function, structure, and feedbacks. Highly dependent on the long adapted resilience of the species within the ecosystem.
Revegetation	Re-establishment, by any means, of plants on sites (including terrestrial, freshwater and marine areas) that may or may not involve local or indigenous species
Secondary treatment	Repeated follow-up treatments, e.g. to control weed, required during the restoration phase after primary treatment has triggered an ecological response.
Structure (ecosystem)	The physical organisation of an ecological system both within communities and at a larger scale (e.g. density, stratification, and distribution of species-populations, habitat size and complexity, canopy structure, pattern of habitat patches).
Threat	A factor potentially or already causing degradation, damage or destruction.
Trittering	The use of large mulcher to remove weed trees, creating a layer of mulch

1.0 Introduction

This Vegetation Management Plan (VMP) is prepared at the request of The Trustee for Huntingwood Property Trust for the Conservation Areas within the State Significant Development (SSD -36138263).

Location: Augusta Street, Huntingwood in the Blacktown Local Government Area. An approximately 260 m wide, 26.642 ha site, bounded by (Figures 1a, 1b):

- two major east-west roads: the Great Western Highway in the north and the Western Motorway (M4) in the south;
- Prospect Highway in the east; and
- Flushcombe Road to the west.

Development: SSD for the Augusta Road warehouse and distribution centre, and associated protection, enhancement and management of riparian corridors.

The proposal has been designed to address the controls within the Blacktown City Council Development Control Plan 2015 (BCC DCP) and Huntingwood Precinct Development Control Plan 2011 (HP DCP) (as amended May 2020), especially:

- mechanism for enduring protection and maintenance of conservation areas and riparian corridors under private ownership;
- management tasks to maintain or improve biodiversity values (with reference to
- Recovering Bushland on the Cumberland Plain - Best Practice Guidelines for the Management and Restoration of Bushland, Department of Environment and Climate Change 2005), now the Cumberland Plain Conservation Plan (DPE 2022).

Note: Control (i) of the HP DCP (page 40) refers to buffers from the top of bank and the allowance of stormwater management works including detention basins within the specified buffer areas. The location of the Top of Bank was found by the surveyor to be related to the location of culverts under the M4 Motorway (see Section 3.1 of this VMP, survey plans in Appendix 3 from the BDAR).

The VMP applies to the approximately 3.8 ha land, identified as 'Category 2' Riparian Corridors in the Huntingwood Precinct DCP (Figures 1d, 2a, 2b, Appendix 4). This area consists of:

Conservation Area	Area (ha)	Located
A.	0.32	North of Augusta Street in a drainage swale
B.	0.68	South of Augusta Street in a drainage swale
C.	2.79	Along Blacktown Creek
Total	3.79	

In addition, the VMP also provides direction for the conservation areas shown on the Landscape Strategy Plan (Figure 2b).

Consequently, this proposal results in the ecological restoration of 8.74 ha for conservation, that is a 370% increase from 2.37 ha of the existing native vegetation onsite. Ecological

restoration is particularly important for a fragmented landscape such as the Cumberland Plain Conservation Plan Area and for over-cleared vegetation types such *Cumberland Plain Woodland* (DPE 2022).

2.0 VMP Guidelines and national standards

This VMP has been prepared in accordance with the Blacktown City Council's VMP guidelines 2019 and associated template. The Guidelines provide the key definitions to be used in the VMP (see Glossary).

The *National Standards for the Practice of Ecological Restoration in Australia* (Standards Reference Group SERA 2021) provide a set of principles and standards that can be followed to ensure the best possible outcome for a restoration project. These have been considered in the VMP.

SERA principle	Applied to the updated VMP
1. An appropriate local native reference ecosystem that is the target of the restoration project.	<u>Reference site:</u> Benson and Howell (1990, page 70) point out that <i>the largest area of surviving native vegetation</i> [CPW] <i>was on Water Board land surrounding Prospect Reservoir</i> . Prospect Nature Reserve is located approximately 500 m south of the site. The current benchmarks for CPW (PCT 3319) are on the Bionet Vegetation Classification database (Appendix 7).
2. Restoration inputs will be dictated by existing level of resilience and degradation.	The Vegetation Integrity Scores provide an objective measure of resilience potential of the native component (details in Section 3.6.1).
3. Recovery of ecosystem attributes is facilitated by identifying clear targets, goals and objectives	The VMP has been prepared in accordance with the ISO Standard 14001 with clear aims, objectives and targets.
4. The goal of ecological restoration is full recovery, insofar as possible ...	The VMP is directed to reduce the existing threats and manage ongoing threats, such as feral pests, dumping and weed spread.
5. Restoration science and practice are synergistic	The VMP has adopted successful methods applied for grassy woodland (such as Cuneo <i>et al.</i> 2018, Gibson-Roy <i>et al.</i> 2010, Gibson-Roy (2018, 2022), Windsor <i>et al.</i> 2000).
6. Social aspects are critical to successful ecological restoration	Yes. Addressed in VMP in Objective 2. Prior to occupancy, interpretive signage will be provided as part of the landscape design.

The *Cumberland Plain Conservation Plan* (DPE 2022) and *Recovering Bushland on the Cumberland Plain - Best Practice Guidelines for the Management and Restoration of Bushland* by Department of Environment and Climate Change (2005) have also been referred to for this VMP.

The VMP has:

- clear aims and objectives;
- realistic targets associated with each objective; and
- monitoring and reporting for the enduring protection and maintenance of conservation areas and riparian corridors under private ownership.

The VMP has been prepared by restoration ecologists with experience working with large onsite machinery. Examples of major restoration projects are provided in Appendix 1.

It should be noted in the VMP that the term “weed” refers to all exotic and non-local native species.

3.0 Site description

The site is located approximately 34 km west of the Sydney CBD and approximately 3.3 km south of the Blacktown commercial centre in the Blacktown Local Government Area (LGA).

In terms of nearby conservation areas, the site is located approximately 500 m north of Prospect Nature Reserve and separated from Timbertop Reserve to the north by the Great Western Highway (Figure 1b).

The site is abandoned productive farmland dating back to early European settlement. Its relatively fertile soils support vigorous rambling Blackberry and weedy pastures.

In Conservation Areas A and B (the western drainage swales), there are emergent native canopy trees growing amongst dumping and suppressed by a dense weedy understorey.

The site is crossed by drainage lines (Figure 1a), namely:

- Blacktown Creek through Conservation Area C - classified by NRAR as a 1st order watercourse under the *Water Management Act* 2000; and
- a drainage line through Conservation Areas A and B.

Both the areas adjoining these drainage lines are classified as ‘Category 2’ Riparian Corridors – terrestrial and aquatic habitat in the Huntingwood Precinct DCP (Figure 1d). The DCP (page 38) describes the drainage lines in the riparian corridors as “*generally small (less than 1.5 m wide), ephemeral, and flow in a northerly direction*”.

Culverts under the M4 Motorway direct stormwater road runoff to the drainage lines. These wide culverts under the major roads (>1.2 diameter) provide potential bat roosting habitat (Goreski 2020) and provide connectivity with Prospect Nature Reserve to the south and Timbertop Reserve to the north (Figure 1b).

Currently, the Conservation Areas and the culverts provide habitat for a population of feral cats, foxes and rats (details in Durrant 2024 in Appendix 6).

3.1 Landform

The landform of the site consists of gently undulating rises, with elevation ranging from approximately 85 m AHD on the top of the hill west of Blacktown Creek and approximately 90 m AHD on the eastern boundary, to less than 70 m AHD along Blacktown Creek close to the northern boundary (Figures 1c).

The landform on the site has been modified, including for agricultural activities and dumpings.

3.1.1 Top of Bank associated with the drainage lines

The top of bank was assessed by Greg Oxley of LandPartners Surveyors and Planners (2020) (Appendix 3 of the BDAR), with:

- *in the west of the site, the bank is “identifiable”. Within the M4 Motorway corridor, there is a large culvert (pipe diameter 1800 mm) that discharges into this drainage swale. The width of the top of bank appears to be affected by the drainage pipe diameter, for example the width of top of bank is narrower north of the drainage pipe under Augusta Street than south of Augusta Street; and*
- *in the east of the site, there is no defined bank and some of it has been affected by filling / dumping of materials over the years.*

It was found by the surveyor Greg Oxley (email dated 5 December 2023) that:

The plan that Council refers to from the DCP is very misleading because it is clear that it has not been validated by ground truthing. The Council plan is not spatially correct. ... It is more like a “wish list” of where a waterway should go.

3.2 Drainage and hydrology

Sources of the water flowing to the two drainage lines onsite are mainly stormwater runoff from the non-porous M4 Motorway road surfaces (details in Costin Roe 2024), with:

- collection ponds from the road runoff south of the M4 Motorway;
- collected runoff directed to the site via culverts under the M4 Motorway;
- flow through the site in a south to north direction; and
- exits the site via culverts under the Greater Western Highway.

The drainage line in the swale in the west is not a mapped watercourse under the NRAR guidelines associated with NSW *Water Management Act 2000*, but an open stormwater drainage line from the M4 Motorway. It lacks a natural top of bank and the flow location of the drainage water is dependent on the location of constructed culverts.

Blacktown Creek in the east is a 1st Order watercourse with its headwaters on the Raging Waters Sydney site (formerly known as Wet ‘n’ Wild). The water leaves the Wet ‘n’ Wild site from a storage dam containing Wet ‘n’ Wild’s treated water and enters Blacktown Creek via a culvert under the M4 Motorway. Some native biological life was detected immediately downstream of the treated water inflow (Clark 2022).

Stormwater from the M4 Motorway pond is also piped in a second culvert under the Motorway to Blacktown Creek. Blacktown Creek flows northward through the site to a channelised creek in Timbertop Reserve via a culvert under the Great Western Highway.

Within the proposed Conservation Areas A, B, C, the offsite stormwater infrastructure provides potential bat habitat (see 2024 Costin Roe Drawing set), namely:

Existing stormwater flow in the Conservation Areas A to C	Potential roosting habitat for bats in proposed culverts (>1.2 m)
Conservation Area A - Drainage swale north of Augusta Street	
Flows from Conservation B under Augusta Street	Culvert - 1.2 m diameter

Existing stormwater flow in the Conservation Areas A to C	Potential roosting habitat for bats in proposed culverts (>1.2 m)
Discharges to the north under the Great Western Highway.	Culvert - 3 x 900 mm blockouts to reduce existing 3 x 1150 mm diameter pipes.
Conservation Area B. Drainage swale south of Augusta Street	
From M4 stormwater basin to the south of the Motorway	Culvert - 1.8 mm diameter
Conservation Area C. Blacktown Creek	
Two entry points from under the M4 Motorway:	
1. From a storage dam containing Wet 'n' Wild's treated water and stormwater runoff; and	Culvert -1.8 m diameter
2. From M4 road runoff stormwater basin.	Culvert -1.8 m diameter
One exit point in the north under the Great Western Highway.	Culvert - 3 x 900 mm blockouts to reduce existing 3 x 1150 mm diameter pipes.

3.2.1 Flooding

The pre-development risk of 1:100 year flooding is shown on Figure 1e. There appears to be no existing flood risk to the proposed development areas, but flood risk to Conservation Areas A, B and C.

From stormwater flowing under the Great Western Highway, there is flood risk to the land north of Conservation Area A, but not to the land adjoining Timbertop Reserve north of Conservation Area C. In Timbertop Reserve, stormwater appears to be confined to the drainage channel.

3.3 Geology and soils

The soils onsite are clays derived from the Bringelly Shale formation of the Wianamatta Group and form part of the Blacktown Soil Landscape described by Bannerman and Hazelton (1990).

3.4 Land use

The 26.64 ha site was once part of a productive farm on the clay soils widely used for agriculture to feed the early colony of Sydney (Benson and Howell 1990, Hazelton and Clements 2011).

Vegetation in all parts of the site has been greatly modified and disturbed by the historic agricultural use, including former house sites and their surrounding gardens, and by spreading of soil and dumpings (which in some parts forms large mounds), with building rubble probably from the house clearing recorded in the swale to the west.

Conservation Area C is a treeless sediment-filled depression with some dumping, overgrown with native and exotic vegetation leaving little open water habitat for native fauna such as the specialist trawling bat Southern Myotis (see vegetation description below).

3.5 Climate

In planning ecosystem restoration, it should be considered that climate influences:

- the quality and quantity of local native seed availability;
- the timing of seed collection and planting; and
- the survival rate of plantings;
- the need for additional watering during plant establishment phases; and
- the potential erosion risk from high rainfall events.

The monthly rainfall data from the meteorological stations (from BOM climate data online) within approximately 10 km of the site (including Erskine Park Reservoir (Station 67066, opened 2013), Horsley Park Equestrian Centre AWS (Station 67119, opened 1997), Prospect Reservoir (Station 67019, opened 1887) and Seven Hills (Station 67110, opened 1994), indicate:

- The monthly rainfall variation from the mean, with the greatest variation being for the Prospect Reservoir station with its more than 100 years of records.

Monthly rainfall summary from Prospect Reservoir opened 1887

Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	95	99	103	76	69	76	58	50	46	60	73	76	879
Lowest	4	3	5	2	1	1	0	0	0	0	1	0	394
Highest	427	519	513	425	556	531	356	458	186	269	391	338	1900

2022 was a wet year with above average annual rainfall (approximate total of 1742 mm and long term mean of 879 mm).

Monthly rainfall recorded in 2022

Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean for Prospect	95	99	103	76	69	76	58	50	46	60	73	76	879
Erskine Park	119	203	507	91	65	2	358	20	75	-	44	8	-
Horsley Park	97	273	-	124	88	3	402	12	85	151	41	15	-
Prospect Reservoir	-	-	513	132	69	1	356	29	84	187	37	14	-
Seven Hills	116	230	-	190	65	3	277	28	72	158	44	20	-
Approx. trend	100	250	500	150	70	2	350	25	80	160	40	15	1742

Hence, in any one year, there may be periods of low monthly rainfall (as low as 0 mm) and high monthly rainfall (as high as >500 mm). For application of the VMP, such large variations are expected and need to be planned for.

3.6 Native vegetation

3.6.1 Onsite surveys

Clements et al. (2021) recorded a total of 102 (34 native, 68 exotic and non-local natives) species in one BAM Plot and 11 patches in October 2021 as part of a due diligence survey. The species recorded reflected its past history as productive farm land.

Canopy Consulting (2023) assessed a total of 565 trees or groups of trees onsite, with the most frequently recorded being the local native species *Eucalyptus moluccana* (178 trees) and *E. tereticornis* (203 trees), followed by non-local native *Grevillea robusta* (Silky Oak) (39 trees) (distribution of native trees on Figure 3b).

Clements et al. (2024) recorded data from nine BAM Plots (1 to 9) on 26 October 2021, 10, 30 March 2022, 20 January 2023 and 14 June 2023 (Tables 1, 2). It was considered likely that the original vegetation on these undulating hills was *PCT 3319 Cumberland Shale Hills Woodland* prior to European settlement.

It was found that vegetation in all parts of the site had been greatly modified and disturbed by historic agricultural land use, including in the mapped Huntingwood Precinct DCP Riparian Corridors of:

- the swale in the west with emergent eucalypts suppressed by dense exotic weeds and dumpings; and
- Blacktown Creek in the east being treeless and swampy with the creek water concealed beneath a broad swathe of wetland plants. The plants were both exotic and native-cosmopolitan species and adjoined by rambling blackberries.

Consequently, approximately 90% (24.27 ha) of the 26.64 ha site was mapped as “Predominantly exotic vegetation or hardstand” (Figure 3a), with:

- 20.58 ha as predominantly exotic grassland; and
- 3.69 ha associated with the industrial buildings west of the drainage swale.

The predominantly exotic grassland had a low Vegetation Integrity Score (VIS) (see details in the BDAR), namely:

Vegetation Zones	Area on site (ha)	Sampled	Cover by exotic species	Native canopy cover recorded	VIS
PCT 3319 (PCT 0) Predominantly exotic grassland	20.58	ACA Plots 1, 3 and 6	10% (Plot 6) to 97.5% (Plot 3)	0% (Plots 1, 6) to 20% (Plot 3)	7.6

The remaining less than 10% of the site supported two native vegetation zones of *PCT 3319 - Cumberland Shale Hills Woodland* – ‘Degraded’ and ‘Less degraded’ (Figure 3a), with the following VIS scores.

Vegetation Zones	Area on site	Sampled	Cover by exotic species recorded	Native canopy cover recorded	VIS
PCT 3319 - Degraded	2.03	Plots 4, 5, 8, 9 in and close to the drainage swale in the west.	30% (Plot 8) to 79% (Plot 5)	9% (Plot 9) to 29% (Plot 4)	27.1
PCT 3319 –	0.34	Plots 2 mainly offsite to	22% (Plot 2) to	26% (Plot 2) to	59.6

Vegetation Zones	Area on site	Sampled	Cover by exotic species recorded	Native canopy cover recorded	VIS
Less degraded		the east, Plot 7 roadside vegetation in NW adjoining Flushcombe Road	47% (Plot 7)	50% (Plot 7)	

Conservation Areas A, B and C occur in the following vegetation zones (Figures 2a, 2b, 3a):

Conservation Area	Vegetation Zone
A and B along the drainage swale	PCT 3319 - Degraded
C along Blacktown Creek	Predominantly exotic vegetation or hardstand.

3.6.2 Observations within the Conservation Areas

There was native vegetation in Conservation Areas A and B, along the drainage swale in the west of the site, which included dumpings of building materials and general dumpings (see photographs in Appendix 8).

Conservation Area A (sampled in Plot 8) PCT 3319 - Degraded

There were old chain fences and the ground was greatly disturbed, with ground-hollows and low mounds, some containing rubble that appeared to originate from demolition of a brick house.

The vegetation was dominated by quite tall eucalypts, with several mature *Eucalyptus moluccana* up to about 25 m tall and up to 0.8 m trunk diameter. Most trees of *E. teretifolia* appeared to be much younger and concentrated in the lower flat area on both sides of the fenceline.

Beneath the canopy trees there was very little native understorey, with no native subcanopy trees or shrubs. Only 5 native groundlayer species were recorded with the only appreciable cover being by the grass *Oplismenus aemulus* and the forb *Dichondra repens*.

Exotic plants dominated the understorey. The subcanopy layer was dominated by *Olea europaea* subsp. *cuspidata* and the privets *Ligustrum lucidum* and *L. sinense*, all 3–4 m tall. Conspicuous among these were several plants of the tree prickly pear cactus *Opuntia monacantha* up to 3 m tall. *Lantana camara* and *Senna pendula* were also quite abundant and there was one clump of the tall invasive grass *Cortaderia selloana*. The climber *Anredera cordifolia* was abundant along the fenceline and on some smaller trees. In the groundlayer the weed grasses *Cenchrus clandestinus*, *Chloris gayana* and *Ehrharta erecta* contributed most of the cover. There were a few common dicot weeds, the most abundant being *Bidens pilosa*.

Conservation Area B (sampled in Plot 5) PCT 3319 - Degraded

There was sluggish drainage that flows from south to north. The creek was heavily shaded by trees, with tall eucalypts emergent above a dense subcanopy of exotics. *Eucalyptus moluccana* predominated, up to 25 m tall, with *E. tereticornis* uncommon and smaller (at least within the floristic quadrat).

The dominant exotic tree in the subcanopy was *Erythrina crista-galli*, at up to 13 m tall; additional exotic small trees were *Ligustrum lucidum*, *L. sinense* and *Olea europaea* subsp. *cuspidata* – all of them abundant.

There was also a native palm *Livistona australis*, though only as a few young plants (doubtfully a local native in western Sydney and probably spread from cultivation). The native shrub *Bursaria spinosa* was present but rare in the plot, with a few weak specimens; it is intolerant of deep shade. The only native groundlayer plant was the grass *Microlaena stipoides*, though sparse.

Apart from the exotic trees already mentioned, exotic climbers and scrambling shrubs were common, *Lantana camara* the most abundant but *Anredera cordifolia* and *Cardiospermum grandiflorum* both quite frequent. The shade tolerant exotic grass *Ehrharta erecta* and the exotic forb *Tradescantia fluminensis* were among the very few groundlayer plants recorded.

Conservation Area C (sampled in Plot 6) Predominantly exotic vegetation

Plot 6 sampled the swampy bed and banks of Blacktown Creek in the treeless central depression. The vegetation structure and floristics were very simple. Dominating most of the centre was the tall native aquatic *Typha domingensis*, with cover up to 90%. Towards the margins there were narrower belts of the aquatic sedge *Bolboschoenus caldwellii*. The exotic rush *Juncus acutus* was also prominent, forming rows of large spiny tussocks along the margins. The common blackberry *Rubus anglocandicans* grew in large patches along banks of the swamp, with some patches extending well into the swamp.

3.7 Weeds

In the VMP, the term “weed” refers to all exotic and non-local native species.

In addition to the onsite recorded Priority weeds listed under the NSW *Biosecurity Act 2015* and High Threat Weeds (HTW) under the *BC Act*, there are environmental weeds such as the non-local native *Grevillea robusta* (Weeds of Australia (https://keyserver.lucidcentral.org/weeds/data/media/Html/grevillea_robusta.htm, accessed 18 March 2024):

Silky oak (Grevillea robusta) is currently of particular concern throughout the wider Sydney and Blue Mountains region in central New South Wales. For example, it is mentioned as a common environmental weed at Hunts Creek in western Sydney and has become naturalised in Lane Cove National Park in northern Sydney. ...

[Note: Hunts Creek Reserve is located approximately 10 km to the north-east of the site in Parramatta Local Government Area (LGA)].

Onsite, the colonisation by *Grevillea robusta* from garden plantings was observed during the ACA surveys and also recorded by Canopy Consulting (2023) as height classes of <5 m, 5-10 m.

3.8 Habitat values

From the snail survey conducted onsite (Clark 2022 in Appendix 8 of the BDAR), Clark found little or no likely habitat for Cumberland Plain Land Snail onsite, however within 40-50 m downstream of the inflow of the treated water from Wet'n'Wild in Conservation Area C, there were:

.. four species of freshwater snails, two species of small terrestrial snails, ... The presence of the freshwater snail *Posticobia*, plus other aquatic insects such as caddis flies and diving beetles suggests the aquatic macroinvertebrate biodiversity is reasonable considering the streams location in western Sydney.

From the frog survey, there was no evidence of Green and Golden Bell Frog nor any suitable breeding habitat in the form of open or pooling water. There are historic Green and Golden Bell Frog BioNET records in the nearby Prospect Reserve from the 1960s (Appendix 5).

Microbats, there are numerous nearby records of the Southern Myotis, particularly around waterbodies including Prospect Reservoir to the south and along Eastern Creek to the north-west, as well as nearby records of Eastern Coastal Free-tailed Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Little Bent-winged Bat and Large Bent-winged Bat on BioNET. Three of these microbat species were recorded within and near the site. Microbat flyovers are considered very likely.

To confirm if there is current utilisation of the site including culverts as roosting habitat, searches of the Riparian Corridors and the entire length of the culverts were undertaken on 27 February 2024 by Kane Durrant. No evidence of past nor present bat roosting activities were recorded (Appendix 6).

Hollow-bearing trees, there was only one hollow-bearing tree recorded on the site (in Plot 3, approximately 200 m east of Blacktown Creek). From the arborist's height class data (Canopy Consulting 2023) 76% of the 381 local native canopy trees are more than 10 m tall, hence there may be additional hollow-bearing trees onsite. Fauna spotter and catcher will be required at time of development.

Threatened flora, there were none recorded, including no *Pimelea spicata* recorded in targeted searches of potentially suitable habitat (around bases of trees and along fence lines), nor expected as the soils of the paddocks had been repeatedly disturbed, nor in drainage lines affected by dumping and dense weeds (Clements *et al.*, 2024).

In conclusion:

- water quality appears to positively affect the likelihood of native biota with native fauna recorded in the water flowing from the Wet'n'Wild treated stormwater ponds;
- large mature trees are sparse based on the historic aerial photographs and site observations;
- only one hollow bearing tree was recorded approximately 200 m east of Blacktown Creek, but additional hollow-bearing trees may occur onsite;
- the depauperate degraded vegetation onsite provided little or no suitable habitat for threatened species; and
- neither the large culverts nor the Riparian Corridors were occupied by microbats.

3.9 Key threats to biodiversity and management issues

From onsite environmental surveys, the threats to onsite conservation include:

- change in climate with extended periods of low rainfall and the high erosion risk during the brief intense rainfall events;

- extensive dumping and soil disturbances;
- likely absence of soil seed bank;
- the existing contaminated waste emplacement to the NW of Conservation Area A;
- the emergent eucalypt canopy trees being smothered by dense weeds in Conservation Areas A and B;
- widespread and abundant occurrence of feral predators including cats, rats and foxes [Note: rats eat snails, and cats eat anything that moves]; and
- erosion and contamination risk from concentrated piped stormwater runoff from the M4 Motorway to Conservation Areas A, B and C.

The following Key Threatening Processes under the *Biodiversity Conservation Act 2016* currently apply to the Conservation Areas, namely:

Key Threatening Processes	Applied to the Conservation Areas
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Water flow to the site is via culverts. Water volume and quality impacted by road runoff from the M4 Motorway. Drainage lines onsite blocked by dumping and dense weed growth.
Anthropogenic climate change	Changes in rainfall pattern to months of low rainfall separated by extreme rainfall events, increase plant stress and risk of erosion.
Clearing of native vegetation	Clearing has repeatedly occurred as part of its historic land use.
Competition and grazing by the feral European rabbit, <i>Oryctolagus cuniculus</i>	Possible, but the cats and foxes likely control feral European rabbit.
Forest eucalypt dieback associated with over-abundant psyllids and bell miners	Not observed onsite, but a risk.
Infection of native plants by <i>Phytophthora cinnamomi</i>	Not observed onsite, but a risk to be managed by hygiene procedures and nursery protocols.
Introduction and establishment of exotic rust fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Air-borne risk to be managed by hygiene procedures and nursery protocols.
Invasion and establishment of exotic vines and scramblers	Abundant exotic vines and scramblers recorded in Conservation Areas A and B. Blackberry abundant throughout.
Invasion of native plant communities by African olive, <i>Olea europaea</i> subsp. <i>cuspidata</i>	Widespread on site.
Invasion of native plant communities by exotic perennial grasses	Dominate former paddock and widespread.
Invasion, establishment and spread of Lantana, <i>Lantana camara</i>	<i>Lantana camara</i> recorded in Conservation Area A.
Loss and degradation of native plant and animal habitat by invasion of escaped garden	Escaped garden plants recorded onsite, including <i>Grevillea robusta</i> in Conservation Area A.

Key Threatening Processes	Applied to the Conservation Areas
plants, including aquatic plants	
Loss of hollow-bearing trees	One hollow-bearing tree recorded onsite to be removed for the proposal, not within the VMP area.
Predation by <i>Gambusia holbrooki</i> (plague minnow or mosquito fish)	Potential risk of exotic predator fish <i>Gambusia holbrooki</i> in proposed constructed ponds in Conservation Area C.
Predation by the feral cat, <i>Felis catus</i>	Feral cats recorded onsite (details in Appendix 6).
Removal of dead wood and dead tree	Dead wood and dead tree recorded in Conservation Areas A and B.

3.9.1 Known threats to Cumberland Plain Woodland

The native vegetation on site is a degraded example of *Cumberland Plain Woodland in the Sydney Basin Bioregion* (CPW). The VMP is directed to reducing the existing threats to the native vegetation onsite, as well as establishing and constructing native flora and fauna habitat.

The known threats to CPW are listed in the Final Determination (<http://www.environment.nsw.gov.au>, accessed 13 October 2023), namely:

Paragraph 19

Weed invasion also poses a major threat to Cumberland Plain Woodland. While very large numbers of weed species have invaded many different areas of the community,...

Several of these species, particularly grasses, form a dense ground layer capable of smothering indigenous plants, reducing both reproduction and survival, and inhibiting emergence and establishment of their seedlings ... The invasion and establishment of exotic weeds is resulting in a very large reduction in the ecological function of Cumberland Plain Woodland. '**Invasion of exotic perennial grasses**' and '**Invasion and establishment of exotic vines and scramblers**' are listed as Key Threatening Processes under the Threatened Species Conservation Act 1995.

Paragraph 21 refers to agricultural land use, dumping in relation to chemical and structural modification to soils, namely:

The soils of Cumberland Plain Woodland have undergone chemical and structural modification associated with agricultural land uses. Trampling by livestock has resulted in localised areas of soil compaction, primarily around watering points [such as the dam]. Research carried out at the University of Western Sydney found that mean soil inorganic nitrogen levels were two to three times higher in areas of former agricultural land use than in remnant woodland, but was unable to detect differences in other soil properties (E. C. Morris in litt. June 2007). Addition of carbon and burning reduced soil inorganic nitrogen and reduced growth of exotic ground layer species relative to native species, suggesting that elevated soil inorganic nitrogen could favour exotics to the detriment of natives in Cumberland Plain Woodland (E. C. Morris in litt. June 2007). Hill et al. (2005) found elevated levels of phosphorus and conductivity in former agricultural areas compared to remnant woodland, but did not examine soil nitrogen. The sources of nutrient addition to soils of Cumberland Plain Woodland include addition of fertilisers during previous agricultural land use, deposition of livestock dung, **rubbish dumping** and stormwater runoff from urban areas. ... Disruption of ecological processes and degradation of habitat associated with nutrient enrichment contributes to a very large reduction in ecological function of the community.

3.10 Conservation assets

As part of the environmentally sustainable development of the site, the existing conservation assets have been assessed for their use / re-use (See Objective 8). These conservation assets are limited to:

- seed sources for direct seeding and propagation;
- native tree biomass, especially seed bearing upper eucalypt branches:
 - for carbon sources;
 - to increase surface cover to suppress weed growth;
 - to provide habitat for ground dwelling species; and
 - to minimise erosion risks.
- abundant woody weeds in the drainage swale:
 - for rafting into windrows either as rows of timber and /or as mulch along contour lines as erosion control and returning carbon to the soil.
- extensive non-woody weeds and weedy topsoil:
 - for construction of plastic covered windrows along contours for erosion control;
 - returning carbon and nutrients to the scalped soils of the conservation areas.

The potential of a native seed bank in the onsite topsoil is very limited due to the intense agricultural land use and associated high weed seed bank. The most widespread species recorded onsite were the exotic pasture grasses *Paspalum dilatatum* (Paspalum), *Cenchrus clandestinus* (Kikuyu Grass) and *Lolium perenne* (Perennial Ryegrass). With the January, February 2024 rain, growth of the weed *Eragrostis curvula* has been vigorous, especially on the former paddocks and on the central vehicle track.

In terms of the proposed infrastructure (details in Stormwater Management Plan by Costin Roe 2024, see Figures 4a, 4b-1 to 4b-5), assets include:

- **Stormwater entering the Conservation Areas** provides potential habitat for aquatic species in constructed habitat ponds. This water enters via culverts and from the proposed onsite stormwater storage tanks, ponds and bioretention basins.
- **Drainage culverts** for bat roost habitat and connectivity between the site and native vegetation south of the M4 Motorway, including Prospect Nature Reserve and north of the Great Western Highway, including in Timbertop Reserve. Control of feral pests currently occupying the culverts is essential.
- **Volume of water** entering the Conservation Areas, which is affected by the catchment of the stormwater storage ponds south of the M4 Motorway, as well as from the onsite developed areas.
- **High quality water** flowing to Conservation Area C, which is enhanced by the proposed onsite bioretention basins and by the existing Wet'n'Wild treatment pond south of the M4 Motorway.

4.0 The Vegetation Management Plan

4.1 Land to which the VMP applies

The VMP applies to the mapped 'Category 2' Riparian Corridor in the Huntingwood Precinct DCP (HP DCP). These areas are identified on the Masterplan as Conservation Areas A, B and C (Figures 2a, and 4a, 4b-1 to 4b-6 from Costin Roe 2024 Drawing set), namely:

Conservation Area	Area (ha)	Location	Description
A.	0.32	Extends approximately 100 m from Augusta Street in the south to the drainage culvert under the Great Western Highway in the north.	Bounded by an existing contaminated waste emplacement area and proposed underground water tanks and proposed hardstand to the west and the future Telstra site to the east.
B.	0.68	Extends approximately 200 m from the culvert under the M4 motorway in the south to Augusta Street in the north.	Bounded by proposed hardstand with underground water storage tanks to the east and the west.
C.	2.79	Approximately 300 m stretch along Blacktown Creek. It includes two proposed bioretention ponds parallel to the drainage line.	It includes two proposed bioretention ponds parallel to the drainage line. Ephemeral and permanently constructed frog ponds and wetlands.
Total	3.79		

The additional conservation areas are shown on the landscape strategy (Figure 2b).

4.2 Aims of the VMP

The aims of the VMP are to protect, enhance and manage the riparian corridors to provide terrestrial and aquatic habitat expected for a Category 2 drainage line classified in the Huntingwood Precinct DCP.

In addition, local native vegetation is to be re-established in the other conservation areas.

4.3 Objectives of the VMP

The following management objectives have been set:

1. Protection of the VMP areas;
2. Increase community awareness of the benefits of canopy vegetation to minimise heat island effects;
3. Feral pest control and relocation of native fauna species;
4. Enhancement of the local native vegetation utilising the conservation assets;
5. Remove existing dumpings and weed control;
6. Re-establish the landform and associated hydrology;
7. Habitat enhancement for native fauna species;
8. Enhancing water quality in bioretention and reconstructing wetlands using local native species;
9. Monitoring and Maintenance.

The satisfaction of each management objective will be contingent on meeting specific targets.

The specific targets associated with each management objective as well as the outline of the Vegetation Management Plan (VMP) are presented in the Target Table (Table 3), with time frames for completion of the tasks required to achieve each management objective.

Timeline and cost estimates are provided in Tables 4 and 5.

4.3.1 Management Objective 1 – Protection of the VMP areas

The VMP Management Areas (Conservation Areas A, B and C) are to be protected from deliberate or accidental encroachment by persons or vehicles and from sediment and runoff from the works site, prior to, during, and after construction.

Prior to any works onsite the following are required:

- the site owner / the project manager is to appoint an Environmental Manager (EM), who is to be a responsible person with at least 5 years experience of supervising the restoration of degraded native ecosystems, experience with onsite equipment and with at least a university degree in natural sciences to supervise, co-ordinate and document conservation works;
- the EM is to meet with the Site Manager / Construction Manager (CM) about appropriate fencing, vehicle cleanliness and site induction;
- VMP areas are to be clearly identified on plans and marked on the site as “no-go” areas to construction workers;
- areas of planned landform changes in the VMP areas are to be clearly identified on the site and on plans to minimise risk of double handling of materials and spread of weeds;
- to avoid any confusion, the Construction Area is to be fenced to clearly demarcate the limits of the construction activities;
- fencing is to be maintained in good condition during the life of the project until specified by the EM in consultation with the Construction Manager, at which point it can be carefully removed; and
- in areas with extensive exposed soil in and adjoining the VMP area, erosion control is to be installed and other erosion control measures installed, as specified by the EM in consultation with the CM.

Prior to and during works

- as many as possible of the local native trees are to be protected in the VMP areas;
- the native vegetation to be cleared in the development areas is to be harvested for re-use on the VMP areas (seeds and biomass); and
- to minimise risk of pathogen introduction to the VMP areas:
 - the nurseries to be used for plant sourcing / propagation must have cleanliness and hygiene protocols and procedures in place;
 - bush regenerators are to adhere to hygiene protocols; and
 - any machinery is to be clean / free of dirt prior to entry into VMP areas and will be inspected and photographed, as required by the EM (details are to be included in Monitoring Report 1 (Month 1)).

4.3.2 Management Objective 2 – Increase community awareness of the benefits of canopy vegetation to minimise heat island effects

During the works

Increasing conservation awareness is an essential component for the project:

- people using and visiting the site are to be made aware of the existing and potential value of the conservation area and its associated fauna habitat values;
- all site workers are to be made fully aware of the significance of the VMP areas and heritage items during induction and toolbox talks, so as to minimise the possibility of accidental or deliberate harm to these values; and
- value of the native vegetation and wetland areas in mitigating the heat island effects.

Prior to occupancy

Interpretive signs are to be installed at entrances, adjoining pathways and at seating locations. These are to be designed in consultation with the landscape architect and owners as required.

4.3.3 Management Objective 3 – Feral pest control and relocation of native species prior to works

As Black Rats are prolific in dumped rubbish and in the dense weed cover of Conservation Areas A and B, reduction in their numbers prior to commencement of works is advisable. To minimise risk of native species by-kill, live trapping using one way traps is likely to be the most humane way of reducing the existing population.

Feral cats control is challenging. Live trapping of cats is required so that the trapped cats can be scanned for microchips and returned to their owners, as required. Control of the main predators, feral cats, rats and foxes, is to be undertaken by a specialist fauna spotter and catcher.

Native fauna searches

Any native fauna species encountered during the live trapping program are to be relocated from the works area. [Note: The potential microbat roosting habitat in the culverts has been searched and none of the cracks and crevices were occupied. No Cumberland Land Snail nor microbats are considered unlikely to occur onsite nor microbats in the culverts due to the high number of their predators].

4.3.4 Management Objective 4 – Enhancement of the local native vegetation utilising the conservation assets

On this former farming land, the natural resilience is low. Developing seed resources onsite will be required.

Conservation assets onsite are limited and include:

- limited native seed sources for direct seeding and propagation;
- native tree biomass, especially seed bearing upper eucalypt branches;
- abundant woody weeds in the drainage swale (details in Objective 5);
 - for rafting into windrows either as rows of timber or as mulch along contour lines as erosion control and returning carbon to the soil;

- extensive non-woody weeds and weedy topsoil (details in Objective 5);
 - for construction of plastic covered windrows along contours for erosion control;
 - returning carbon and nutrients to the scalped soils of the conservation areas.

Collection of conservation assets:

- Timing of seed availability affects the harvesting of the conservation assets. Seeding and flowering times of the most common native species recorded onsite or nearby are given in Appendix 2;
- The staging of collection and re spread of native biomass component is to be carefully planned by the EM and the CM;
- Conservation assets are to be collected prior to and during clearing of native component on the development site, for re-use in the conservation areas;
- For native trees being cleared for the development or drainage works, logs can be cut into manageable pieces for machinery to relocate to the conservation areas, especially to Conservation Area C for the frog ponds;
- Any branches being pruned or from trees being removed are to be re-used in the conservation areas as seed bearing branches or for brushmatting;
- As the availability of native species is limited on site, seed collections may be required from nearby roadsides offsite or other living seedbanks nearby;
- Any seed collection from the conservation areas or offsite is to be carried out according to Flora Bank Guidelines (available online at <https://www.florabank.org.au/guidelines/>).

Some of the native species require pre-treatment of seed prior to sowing, such as:

- the legumes (*Acacia* spp., *Hardenbergia violacea*, *Indigofera australis*, etc) seeds which require hot water treatment; and
- *Bursaria spinosa* seeds which require frost for their germination in situ.

In addition to direct transfer of native biomass to the conservation areas:

- seed collected onsite or nearby is to be propagated in specialist nurseries and grown as tubestock for planting, as specified by the EM; and
- local native tubestock are to be utilised in the conservation areas.

Landscaping of road reserves and within development lots will progressively occur as stages are completed. Nursery stock grown from collected seed should be ready as planting areas become available.

Within the powerline easement, the height of the vegetation is to be restricted. These areas are to be densely planted as an onsite living seed banks especially with the fast growing native legumes such as *Hardenbergia violacea* and *Indigofera australis*. These areas are to form part of the living seed bank to be regularly slashed and the ripe seed harvested for re-use within the conservation areas.

The long term target for all of the conservation areas, except under the powerlines is:

- at least 15% cover by canopy species;
- at least 2 tree species;
- at least 3 shrub species;
- at least 5 groundcover species;

- less than 20% bare ground; and
- <5% weed cover.

[Note: in areas where the vegetation is predominantly exotic grasses and other weeds and it may be difficult to achieve the 5% weed cover target. For this area less than 30% weed cover may be all that can be achieved];

4.3.5 Management Objective 5 – Remove existing dumpings and weed control

Rubbish Removal

The invasion and establishment of the dense weedy understorey reduces the ecological function of Cumberland Plain Woodland. Dumping and widespread rubbish compounds the weed clean up. The dumpings include fences and old farm buildings.

[Note: Extreme care needs to be exercised that all the dumpings are removed and not incorporated into the windrowed weeds being utilised onsite].

The dumpings within this Riparian Corridor are widespread. The dumpings are to be sorted and removed, with contaminated waste managed in accordance with the Remediation Action Plan (RAP) (JBS&G 2024). The works undertaken to reduce the waste onsite are to be included in Monitoring Report 1 (Month 1), and subsequent reports as required.

Control of dense weed growth

Primary weed control

- after reducing the rubbish piles, it may be possible to slash / tritter the dense understorey weed, but it is more likely that the landform is too irregular and there is more dumped rubbish under the weed to safely use a tritter;
- **in the drainage swale (Conservation Areas A, B)**, the understorey is dominated by dense woody weeds including the former garden escapes *Ligustrum* spp, *Olea europaea* and *Lantana camara*. These woody weeds are a conservation asset on this highly degraded site. Windrowed stacks of woody weeds (not including Blackberry) are to be utilised for additional erosion control and to provide native fauna habitat. [Note: the windrowed woody weeds also provide carbon resources for its fungal breakdown, allowing re-establishment of the natural nutrient cycle];
- **in the areas of major weed infestations (Conservation Areas A, B and C) and elsewhere in conservation areas on the site**, the soil surface is to be ‘scalped’ (scraped) using onsite construction machinery (a small excavator or bob cat especially in Conservation Areas A and B). The scalping is to remove the weeds, weed seed bank and nutrient-enriched upper soil layer. The expected depth of scalping is restricted to the top 1 to 3 cm of the soil. In Conservation Areas A, B, this is to be carefully supervised to minimise risk to the roots of existing native canopy vegetation;
- depending on the rubbish content, the weedy scraped-off topsoil and biomass are to be pushed into windrows (less than 500 mm high) along the contours and covered in black plastic to kill the weed seeds. These windrows act as a necessary erosion control measure. It is essential that the black plastic is well secured to the ground and if necessary additional erosion control fencing may be installed up and downslope of these windrows, as directed by the EM. These windrows are NOT to be placed in areas where landform re-contouring is required by the civil engineer.

- the non-woody weedy plant material under the black plastic is to be inspected at 3 monthly intervals to determine its natural breakdown. Natural breakdown may be sufficient to reduce the weed seed viability. [Note: unless sufficient temperature is generated under the black plastic, the weed seeds may still be viable. Even controlled burns of weeds such as *Eragrostis curvula* are not always sufficient to kill their seeds]; and
- the material within the non-woody windrows is not to be spread across the site. Any weed growth after removal of the plastic is to be spot sprayed. If mass seed germination has occurred then the windrows are to be re-covered with black plastic. The use of the black plastic minimises the use of herbicide.

Re-contouring and soil preparation

Following the Primary weed control of soil scalping and windrowing, the area is re-contoured and the soil is prepared, as required and supervised by the EM in consultation with the Construction Manager and engineers (See Objective 5).

The deep ripping of these clay soils allows root penetration of the future plantings / direct seeding but also stimulates any weed seeds within the soil profile to germinate. Any native regrowth observed is to be flagged and any weed growth controlled with careful spot spraying to minimise herbicide use and soil disturbance, as required by the EM.

Ongoing Weed Control

The weeding in the conservation areas is to take place in successive stages, namely:

- secondary weed control, involving follow-up removal of weed regrowth; and
- tertiary weed control, involving maintenance.

Secondary and Tertiary weed control, including near the stacked windrows, is to be conducted by skilled bush regenerators and / or commercial spot sprayers as specified by the EM, with:

- the use of weed species profiles and control measures specified by the Department of Primary Industries (DPI), available online at NSW WeedWise <https://weeds.dpi.nsw.gov.au/>
- careful application of herbicides / spot spraying of weeds by skilled operators in areas with native species present; and
- any herbicide application is to occur during windless periods (0-5 km / hr) such as early mornings, using a nozzle set to large droplets to minimise risk of spray drift.

Invasive woody weeds onsite

The woody weeds recorded on the site were mostly spread by birds eating their seeds and most of these weeds are listed as High Threat Weeds on the BAM Calculator (BAM-C), namely:

Species
<i>Cestrum parqui</i> (Green Cestrum)
<i>Cotoneaster glaucophyllus</i> (Cotoneaster)
<i>Erythrina crista-galli</i> (Cockspur coral tree)
<i>Lantana camara</i> (Lantana)

Species
<i>Lycium ferocissimum</i> (African boxthorn)
<i>Ligustrum lucidum</i> Privet - broad-leaf)
<i>Ligustrum sinense</i> (Privet - small-leaf)
<i>Nerium oleander</i> (Oleander) (wind spread)
<i>Olea europaea subsp. cuspidata</i> (African Olive)
<i>Opuntia</i> sp. (Prickly Pear)
<i>Pyracantha</i> sp. (Hawthorn / Firethorn)
<i>Senna pendula</i> var. <i>glabrata</i> (Cassia / Senna)
<i>Syagrus romanzoffiana</i> (Cocos Palm)

Follow-up control of woody weeds:

There is the potential for re-infestation of woody weeds from bird dropped seed. Small seedlings are to be removed by hand where appropriate, and saplings or suckers are to be scraped and herbicide controlled. These actions will require regular implementation to exhaust the weed seed bank and prevent any new seedlings maturing and seeding.

Exotic vines and scramblers

Exotic vines recorded include the following;

Species
<i>Araujia sericifera</i> (Moth Vine)
<i>Anredera cordifolia</i> (Madeira Vine)
<i>Asparagus asparagoides</i> (Bridal Creeper)
<i>Asparagus plumosus</i> (Climbing Asparagus fern)
<i>Campsis radicans</i> (Trumpet Vine)
<i>Cardiospermum grandiflorum</i> (Balloon Vine)
<i>Lonicera japonica</i> (Japanese Honeysuckle)
<i>Rubus anglocandicans</i> (<i>Rubus fruticosus</i> sp. Aggr.) (Blackberry)

***Rubus anglocandicans* (Blackberry)** has a woody stem and forms impenetrable thickets. It is **not suitable to be placed in windrows** with the woody weeds. It needs to be composted under the black plastic. Any canes across the culverts entrances are to be removed and treated with the appropriate herbicide.

[Note: Blackberry is a preferred food and provides habitat for feral foxes. Blackberry control is an important part of the feral pest control program].

Other groundlayer weeds include some listed as High Threat Weeds, and others which are short term weeds which disappear with increased native cover:

Species
<i>Agrostis stolonifera</i> (Creeping Bent)

Species
<i>Anagallis arvensis</i> (Scarlet Pimpernel)
<i>Asparagus aethiopicus</i> (Asparagus Fern)
<i>Asparagus officinalis</i> (Asparagus)
<i>Aster subulatus</i> (Wild Aster)
<i>Avena barbata</i> (Bearded Oats)
<i>Bidens pilosa</i> (Cobblers Pegs)
<i>Bidens subalternans</i> (Great Beggars Ticks)
<i>Briza subaristata</i>
<i>Bromus catharticus</i>
<i>Cenchrus clandestinus</i> (Kikuyu)
<i>Chloris gayana</i> (Rhodes Grass)
<i>Cirsium vulgare</i> (Thistle)
<i>Conyza sumatrensis</i> (Fleabane)
<i>Cortaderia sp.</i> (Pampas Grass)
<i>Cyclospermum leptophyllum</i> (Slender Celery)
<i>Cyperus eragrostis</i> (Umbrella Sedge)
<i>Cyperus brevifolius</i> (Mullumbimby Couch)
<i>Ehrharta erecta</i> (Panic Veldtgrass)
<i>Eragrostis curvula</i> (African Love Grass)
<i>Festuca elatior</i> (Meadow Fescue)
<i>Foeniculum vulgare</i> (Fennel)
<i>Gomphocarpus fruticosus</i> (Narrow-leaved Cotton Bush)
<i>Hyparrhenia hirta</i> (Coolatai Grass)
<i>Hypericum perforatum</i> (St Johns Wort)
<i>Hypochaeris radicata</i> (Catsear)
<i>Juncus acutus</i> (Spiny Rush)
<i>Linum trigynum</i> (French Flax)
<i>Lolium perenne</i> (Perennial Ryegrass)
<i>Lotus sp.</i> (Lotus)
<i>Modiola caroliniana</i> (Red-flowered Mallow)
<i>Nothoscordum gracile</i> (Onion weed)
<i>Paspalum dilatatum</i> (Paspalum)
<i>Paspalum notatum</i> (Bahia grass)
<i>Phalaris aquatica</i> (Phalaris)
<i>Plantago lanceolata</i> (Plantain)
<i>Rumex crispus</i> (Curled Dock)

Species
<i>Senecio madagascariensis</i> (Fireweed)
<i>Senecio pterophorus</i>
<i>Setaria parviflora</i>
<i>Sida rhombifolia</i> (Paddy's Lucerne)
<i>Solanum americanum</i> (Glossy Nightshade)
<i>Solanum nigrum</i> (Black-berry Nightshade)
<i>Solanum sisymbriifolium</i>
<i>Sonchus oleraceus</i> (Common Sowthistle)
<i>Sporobolus africanus</i> (Parramatta Grass)
<i>Stachys arvensis</i> (Stagger Weed)
<i>Taraxacum officinale</i> (Dandelion)
<i>Tradescantia fluminensis</i> (Trad)
<i>Tragopogon porrifolius</i> (Oyster plant)
<i>Trifolium glomeratum</i> (Clustered Clover)
<i>Verbena bonariensis</i> (Purpletop)
<i>Vicia tetrasperma</i> (Slender Vetch)

***Juncus acutus* (Spiny Rush)** currently growing along Blacktown Creek is a 'nasty' weed with very sharp points on the end of stems and leaves that can injure people and animals. It readily forms dense infestations outcompeting native plants and seeds prolifically in moist habitat. Any sightings of this weed are to be reported to the EM for immediate, high priority control.

4.3.6 Management Objective 6 – Re-establish the landform and associated hydrology

The soil onsite is clay and easily compacted when wet. Soil at the time of earthworks must be sufficiently dry, especially in the conservation areas.

Slashing and retention of the dense paddock weeds during the earthworks on the site in general, may assist in limiting vehicles being bogged. The usefulness of this slashed weed cover during early earthworks needs to be considered by the Geotechnical engineer and the CM.

Extensive landform reconstruction is required to re-establish a watercourse to manage the water input and to provide native fauna habitat in particular for frogs including Green and Golden Bell Frog and the fishing bat, Southern Myotis (details shown on the Costin Roe 2024 drawing set, see relevant subset in Figures 4a, 4b-2).

Waterbody / wetland construction, especially in Conservation Area C, is to be carefully supervised by the EM, in consultation with the frog specialist, construction manager and civil engineers. Specific requirements for the threatened species, Green and Golden Bell Frog and Southern Myotis, are:

Species	Common Name	Preferred Habitat (source: NSW OEH species profiles)	Proposed Habitat
<i>Litoria aurea</i>	Green and Golden Bell Frog	Wetlands and slow flowing streams with emergent vegetation in woodland and open forest, or urban areas.	At least 4 open water ponds: – two permanent (20 x 10m & 10 x 5m, depth 1.1-1.9m), and – two ephemeral (20 x 5m & 10 x 5m, depth 0.3-0.7m). Rock piles/logs for shelter.
<i>Myotis macropus</i>	Southern Myotis	Forages over streams and ponds. Roosts close to water in hollow-bearing trees or dense foliage, and artificial structures such as under bridges, storm water channels or buildings.	The open waterbodies constructed for Green and Golden Bell Frog provide habitat for Southern Myotis provided there is sufficient glide path for the fishing bat to land on the water surface. Elongated ponds need to be oriented parallel to the watercourse. Southern Myotis requires unimpeded flight paths over open water with a glide slope of approximately 3 m on approach to these open ponds. The restoration works incorporate flight paths along Blacktown Creek for both bats and birds.

Following re-contouring and reconstruction of landform, the soils are to be prepared by deep ripping to allow root penetration into the substrate, as required by the EM in consultation with the civil engineer and the construction manager.

4.3.7 Management Objective 7 – Habitat enhancement for native fauna species

In addition to the open waterbodies created for Green and Golden Bell Frog and the Southern Myotis, fauna habitat enhancement includes for the following fauna species that have been recorded in the vicinity of the site (i.e. within 10 km) and anticipated to be the most likely to utilise the site following restoration:

Additional fauna species for habitat enhancement

Species	Common name	Preferred habitat (source: NSW OEH species profiles)	Proposed habitat enhancement
Microbats			
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Dry sclerophyll forests and woodland, roosts in tree hollows but also under bark or artificial structures.	Planting and restoration of native woodland in conservation areas. Installation of microbat nest boxes depending on feral pest control and available food resources. If possible, retrofit microbat roosts in culverts.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Woodland and moist or dry eucalypt forest. Roosts in tree hollows and buildings.	
<i>Miniopterus australis</i>	Little Bent-winged Bat	Moist eucalypt forest and wet/dry sclerophyll forests.	

Species	Common name	Preferred habitat (source: NSW OEH species profiles)	Proposed habitat enhancement
		Roosts in tree hollows, storm water drains, culverts, bridges and buildings.	
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	Roosts in caves or artificial structures such as storm water tunnels and buildings. Forages in forested areas.	
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Roosts in tree hollows, buildings or burrows. Occurs in most habitat types.	
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Moist habitats with trees taller than 20 m. Roosts in eucalypt hollows but also under loose bark or in buildings.	Riparian corridor plantings including <i>Casuarina glauca</i> . Installation of microbat nest boxes depending on feral pest control and available food resources.
Mammals			
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Forests and woodlands, including urban areas. Favours <i>Eucalyptus</i> spp. and <i>Melaleuca</i> spp. for feeding.	Planting <i>Eucalyptus tereticornis</i> , <i>E. moluccana</i> , <i>Melaleuca styphelioides</i> .
Birds			
<i>Lathamus discolor</i>	Swift Parrot	Woodlands and forests, favours <i>Eucalyptus robusta</i> , <i>E. tereticornis</i> , <i>E. moluccana</i> , <i>E. sideroxylon</i> and <i>Corymbia maculata</i> .	Restore sections of native woodland, plant <i>Eucalyptus tereticornis</i> , <i>E. moluccana</i> .
<i>Glossopsitta pusilla</i>	Little Lorikeet	Open eucalypt forest/woodlands, nests in hollows often in riparian zones.	Restore sections of native woodland, plant eucalypts. Install small nest boxes depending on feral pest control and available food resources. .
<i>Acrocephalus australis</i>	Australian Reed-Warbler	Riparian zones with dense emergent vegetation and reed beds.	Wetland plantings including in the basin.
<i>Hieraaetus morphnoides</i>	Little Eagle	Open eucalypt forest and woodland, nests in tall living trees.	Restore sections of native woodland.
<i>Anthochaera phrygia</i>	Regent Honeyeater	Open forest and woodland, particularly box-ironbark woodlands, favours mistletoes.	Restore sections of native woodland.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Eucalypt forests and woodlands, favours trees with	Restore sections of native woodland; retain / prune dead

Species	Common name	Preferred habitat (source: NSW OEH species profiles)	Proposed habitat enhancement
		dead branches.	trees where possible.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	Dry, open eucalypt forests or woodlands with a sparse understory of shrubs, groundcovers and debris.	Restore sections of native woodland, with features such as logs.
Terrestrial gastropod			
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	Cumberland Plain Woodland, i.e. open woodland with grassy understory and areas of shrubs.	Restore sections of native vegetation, with features such as logs.

Note: The windrowed woody weeds provide logs on the ground as a habitat feature.

Nest boxes

Installation of nest boxes on this highly degraded site is currently problematic due to the abundance of feral pests, especially Black rat, cats and foxes, and limited food resources for native fauna. The installation of nest boxes should only occur after successful completion of the pest control program and depends on availability of sufficient native food resources.

The precise number, time of installation and location of nest boxes is to be determined progressively through the project as habitats develop onsite. Some of the nesting and roosting sites are likely to naturally occur in the drainage culverts under the motorways with the control of rats, cats and foxes.

Culverts

The existing culverts under the M4 Motorway are 1.2 m diameter and generally meet the criteria for Southern Myotis roosting (Goreski 2020). The culverts are not currently being utilised by native fauna and are occupied by feral pests.

The literature points out requirements for the culvert entrances for use by native fauna – these requirements are not met onsite with entrances obscured by dense stands of Blackberry. The entrances to the culverts onsite are required to be kept weed free with clear visibility through the culvert.

Fauna culvert design specifications are detailed in Queensland, Victorian, and Western Australia Departments of Transport and Main Roads, as well as in the published literature such as Rowe 2010, and 62 papers presented in van der Ree *et al.* (editors) (2015).

Culverts specifications relevant to the site include:

- to have dimensions of the underpass relative to the size of the animals that will use it. The largest species likely to use underpasses are kangaroos and wallabies. Catering for larger species, the underpass should be between 800 mm to 1800 mm in height (internal height).
- to encourage use of the underpass by fauna it should provide a dry passage during low flow conditions and in some cases, this may require the construction of benches or flow diversions. The base surface should be covered in natural materials and soil

from the surrounding area where possible or at a minimum with sand. Modifying the base of the culvert is a matter for the owners of the highway (Transport for NSW);

- to have dense cover it should be planted in the area leading up to and away from the underpass to provide shelter from predators;
- to be designed with roughening the roof and walls of box culverts to encourage the roosting of small bats such as Little Bent-wing Bat (*Miniopterus australis*) and Large Bent-wing Bat (*M. schreibersii*). Enhancing microbat habitat within the culverts is a matter for the owners of the highway (Transport for NSW); and
- to provide access to, and view of, the entrance and exit. [Note; currently the culvert entrances onsite are currently obscured by weeds].

The following sketch illustrates the appropriate design features.

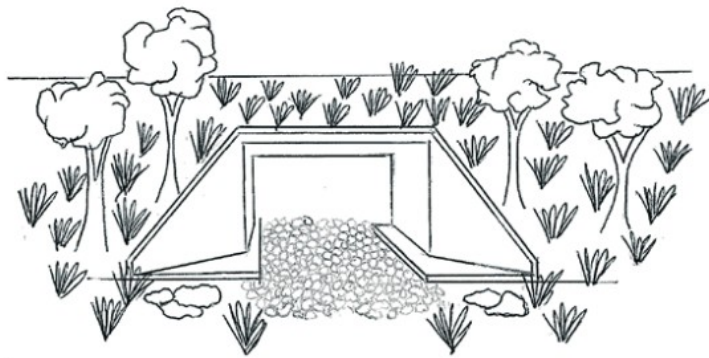


Figure 5: Standard culvert with natural substrate.
(Source: Transport Roads and Maritime Services, Wildlife Connectivity Guidelines. November 2010).

Planting / direct seeding

Locations of native plantings for habitat enhancement in Conservation Area C are shown on Costin Roe's drawing set (see Figures 4b-2, 4b-3 to 4b-5). Plantings / direct seeding in Conservation Areas A and B are more widespread with species selection influenced by topographic location (see Figure 4b-1).

Plantings / direct seeding in Conservation Areas A and B are for the reconstruction of a native woodland with plant species' cover and diversity long-term targets based on the CPW bench marks (details in Objectives 4, 9).

In the case of all three conservation areas, the native soil seed bank is low. The assisted regeneration of these conservation areas is dependent on:

- good soil preparation, for maximising germination from direct seeding and survival of plantings (discussed in Objective 6);
- retaining and minimising soil disturbance around the bases of the local native trees (discussed under Objective 1), to maximum tree vigour and abundance of eucalypt seed showers;
- local native seed availability for direct seeding;
- establishing community structure of species, such as trees and shrubs, especially *Acacia* spp., eucalypts and *Bursaria spinosa*. *Bursaria* is the ideal CPW shrub

species in the Conservation Areas as it provides nectar resources and protected habitat for a wide range of species, especially small birds and insects. These structuring species encourage fauna to spread native seed to the site.

To complement the direct seeding and tree retention, dense row planting of tubestock is to occur along contours (approximately 20 cm centres) separated by 1-2 m of bare soil. The separation is to allow ready weed control (details in Objective 5) and germination from the developing seed bank (direct seeded and from seed showers).

The species selection includes the following:

Species	Habitats in Conservation Areas A, B	Habitats in Conservation Areas C
TREES		
<i>Acacia binervia</i>	Slopes and close to drainage line	Tree habitat on Costin Roe's drawings
<i>Angophora floribunda</i>	Lower slopes	
<i>Casuarina glauca</i>	Damp area where some inundation expected	Damp area where some inundation expected
<i>Eucalyptus amplifolia</i>	Damper area	
<i>Eucalyptus crebra</i>	Upper slope	
<i>Eucalyptus moluccana</i>	Slopes	Slopes
<i>Eucalyptus tereticornis</i>	Slopes and close to drainage line	Slopes and close to drainage line
<i>Melaleuca decora</i>	Close to drainage line and wetter depressions	Close to drainage line and wetter depressions
<i>Melaleuca linariifolia</i>	Slopes and close to drainage line	Slopes and close to drainage line
<i>Melaleuca styphelioides</i>	Lower slopes, close to drainage line and damper area	Lower slopes, close to drainage line and damper area
SHRUBS		
<i>Acacia falcata</i>	Good fast cover species	Tree/shrub habitat on Costin Roe's drawings
<i>Bursaria spinosa</i>	All areas. Ideal to direct seed with frosts.	All areas. Direct seed with frosts.
<i>Callistemon linearis</i>	Lower slopes, close to drainage line and damper area	Tree/shrub habitat on Costin Roe's drawings
<i>Daviesia acicularis</i>	Upper slopes in showy location	
<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	Good fast cover species	Tree/shrub habitat on Costin Roe's drawings
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Upper drier positions, slopes in showy location	
<i>Indigofera australis</i>	Good fast cover species. Flowers and seeds prolifically	Ideal. Good fast cover species. Flowers and seeds prolifically
<i>Melaleuca nodosa</i>	Plant in small numbers	
<i>Melaleuca thymifolia</i>	Moist areas	Moist areas

Species	Habitats in Conservation Areas A, B	Habitats in Conservation Areas C
<i>Ozothamnus diosmifolius</i>	Good fast cover species. Flowers and seeds prolifically	Tree/shrub habitat on Costin Roe's drawings
CLIMBERS AND TRAILERS		
<i>Clematis glycinoides</i>	It can be rampant. Ideal for walls to be covered.	
<i>Convolvulus erubescens</i>	Woody tap-root. Good early coloniser.	Woody taproot. Good early coloniser.
<i>Glycine clandestina</i>	Weak climber.	Weak climber
<i>Glycine microphylla</i>	Weak climber	Weak climber
<i>Glycine tabacina</i>	Mainly underground growth. Ideal for soil development.	Open area.
<i>Hardenbergia violacea</i>	The local Western Sydney <i>Hardenbergia violacea</i> is small shrub – good fast early coloniser.	Tree/shrub habitat on Costin Roe's drawings
<i>Pandorea pandorana</i>	It can be rampant. Ideal for walls to be covered.	
<i>Polymeria calycina</i>	Perennial with trailing and twining stems.	
GROUNDCOVERS		
<i>Atriplex semibaccata</i>	Prostrate colonising species. Ideal for bare areas	Prostrate colonising species. Ideal for bare areas
<i>Brunoniella australis</i>	Good coloniser of slopes	Good coloniser
<i>Calotis lappulacea</i>	Good coloniser of slopes	
<i>Chrysocephalum apiculatum</i>	Good coloniser of slopes	
<i>Centella asiatica</i>	Good coloniser of moist area	Good coloniser of moist area
<i>Dianella longifolia</i>	Soil stabiliser	Soil stabiliser
<i>Dianella revoluta</i>	Soil stabiliser	Soil stabiliser
<i>Dichondra repens</i>	Persistent and good coloniser	Persistent and good coloniser
<i>Einadia hastata</i>	Prostrate colonising species. Ideal for bare areas	Prostrate colonising species. Ideal for bare areas
<i>Einadia nutans</i>	Prostrate colonising species. Ideal for bare areas	Prostrate colonising species. Ideal for bare areas
<i>Eremophila debilis</i>	Plant in clumps on slopes	
<i>Goodenia hederacea</i>	Forms rosettes. On slopes	On bare areas.
<i>Hibbertia diffusa</i>	Plant for diversity	
<i>Lomandra filiformis</i>	Soil stabiliser	Soil stabiliser
<i>Lomandra longifolia</i>	Soil stabiliser	Soil stabiliser
<i>Scaevola albida</i>	Plant for diversity	
<i>Tricoryne elatior</i>	Plant for diversity	Plant for diversity
<i>Veronica plebeia</i>	Early coloniser with stolons to 1 m long	Early coloniser with stolons to 1 m long
<i>Viola hederacea</i>	Moist areas	Moist areas near ponds
<i>Wahlenbergia communis</i>	Small forb but early coloniser.	Early coloniser.

Species	Habitats in Conservation Areas A, B	Habitats in Conservation Areas C
GRASSES, SEDGES, RUSHES		
<i>Austrostipa ramosissima</i>	Slopes and gully	Slopes and gully
<i>Carex appressa</i>	Damp places	Damp places
<i>Chloris truncata</i>	Slopes and gully	Slopes and gully
<i>Chloris ventricosa</i>	Slopes and gully	Slopes and gully
<i>Cymbopogon refractus</i>	Open areas	Open areas
<i>Cynodon dactylon</i>	Early coloniser	Early coloniser
<i>Echinopogon caespitosus</i>	Open areas	Open areas
<i>Entolasia marginata</i>	Moist areas	Moist areas
<i>Juncus usitatus</i>	Damp places	Damp places
<i>Microlaena stipoides</i>	Slopes, gullies	Slopes, gullies
<i>Rytidosperma fulvum</i>	Open areas	Open areas
<i>Themeda triandra</i>	Open areas	Open areas
WETLAND PLANTS		
<i>Alisma plantago-aquatica</i>	Aquatic grows in shallow water up to 1.5 m high	Aquatic grows in shallow water
<i>Alternanthera denticulata</i>	Slopes, gully. Early coloniser.	Open areas. Early coloniser.
<i>Bolboschoenus caldwellii</i>	Shallow water. Grows up 1-2 m tall.	Shallow water. Grows up 1-2 m tall.
<i>Carex appressa</i>	Damp places. Ideal for basins.	Damp places. Ideal for basins.
<i>Eleocharis acuta</i>	Shallow water. Grows usually up to approx 0.6 m tall.	Shallow water. Grows usually up to approx 0.6 m tall.
<i>Liparophyllum exaltatum</i>	Perennial aquatic herb with emergent leaves; stems 1-few, to 1.5 m high	Perennial aquatic herb with emergent leaves; stems 1-few, to 1.5 m high
<i>Philydrum lanuginosum</i>	Emergent aquatic perennial to 2 m or more high	Emergent aquatic perennial to 2 m or more high
<i>Phragmites australis</i>	Self seeds in areas of standing water	Self seeds in areas of standing water
<i>Schoenoplectus validus</i>	Standing water. 1-2 m.	Standing water. 1-2 m.
<i>Typha domingensis</i>	Self seeds in areas of standing water	Self seeds in areas of standing water

Planting is to occur following sufficient rain (at least 30 mm) in autumn to spring. Planting in summer is not recommended unless supplementary watering is readily available.

4.3.8 Management Objective 8 – Enhancing water quality in bioretention and reconstructing wetlands using local native species

The stormwater works are detailed by Costin Roe (2024), which includes two Bioretention / detention basins, a constructed wetland, frog ponds and drainage discharge points in Conservation Area C (see Figure 4b-2). The requirements for the bio-retention / detention basins are outlined in Blacktown City Council's (BCC) Water Sensitive Urban Design Standard Drawings.

Immediately post the construction, the entire bio-retention / detention basin is to be covered by geotextile fabric to minimise risk of clay sediment downwash to the filter medium, as specified by the supervising engineer.

After the adjoining land has been stabilised, direct seeded and planted, the geotextile fabric is to be carefully removed immediately prior to planting the basins. The basins are not to be mulched. The areas immediately upslope of the basins are only to be mulched, as specified by the EM. Mulch from adjoining land is not to enter the basins.

At time of basin planting, it is advised that jute fabric (not weed mat) be placed over the surface to minimise risk of weed invasion during the establishment phase, and if required, planting is undertaken using planks to minimise risk of soil compaction. Mulch is not to be used in the basins as weed suppressant. Jute fabric breaks down readily and allows good water infiltration through the basin substrate.

As these basins form part of the conservation area, the species selection on Sheet 12 of BCC's Water Sensitive Urban Design Standard Drawings (see Appendix 3) was reviewed to ensure only local native species are used. Hence the recommended planting schedule is as follows:

Species	BCC Pref*	BCC Alt**	Bioretention basin	Detention Basin	Adjoining batter
BIOTENTION BASIN					
<i>Carex appressa</i>	X		X	X	
<i>Carex longebrachiata</i>			X	X	
<i>Juncus continuus</i>			X	X	
<i>Juncus planifolius</i>	X		X	X	
<i>Juncus usitatus</i>	X		X	X	
<i>Haloragis heterophylla</i>			X	X	
<i>Lachnagrostis filiformis</i>	X		X	X	

Species	BCC Pref*	BCC Alt**	Bioretention basin	Detention Basin	Adjoining batter
BASIN					
<i>Austrostipa ramosissima</i>				X	X
<i>Austrostipa setacea</i>		X		X	X
<i>Bolboschoenus caldwellii</i> (note,	X			X	

Species	BCC Pref*	BCC Alt**	Bioretention basin	Detention Basin	Adjoining batter
vigorous wetland plant to 1.5 m)					
<i>Bolboschoenus fluviatilis</i> (note, vigorous wetland plant to 1.5 m)	X			X	
<i>Chloris divaricata</i>				X	X
<i>Chloris truncata</i>				X	
<i>Chloris ventricosa</i>				X	
<i>Cymbopogon refractus</i>		X		X	
<i>Dianella longifolia</i>	X			X	X
<i>Dichanthium sericeum</i>		X		X	
<i>Einadia nutans</i>				X	X
<i>Einadia trigonos</i>				X	X
<i>Entolasia marginata</i>				X	
<i>Eragrostis elongata</i>				X	
<i>Eragrostis leptostachya</i>		X		X	X
<i>Ficinia nodosa</i>	X			X	
<i>Melaleuca thymifolia</i>				X	
<i>Microlaena stipoides</i>	X			X	X
<i>Panicum effusum</i>				X	
<i>Poa labillardieri</i>	X			X	X
<i>Polymeria calycina</i>				X	X
<i>Sorghum leiocladum</i>				X	X

* **BCC Pref** = BCC preferred planting list

****BCC Alt** = BCC alternate planting list for when preferred list is not commercially available

It should be noted that the basins do dry out and therefore require a mixture of moisture tolerant and more drought tolerant species. These basins form an important landscape component for mitigating heat island effects and provide fauna habitat.

In addition to the listed adjoining batter species, the following are recommended:

- local native shrubs, especially
 - *Bursaria spinosa*, usually a small shrub about 3 to 4m tall which produces abundant small white flowers through Summer. Its dense prickly foliage provides protective shelter for birds and the flowers also provide an important food source for butterflies and other insects;
 - *Hardenbergia violacea* (western Sydney provenance) grows as a subshrub forming dense clusters, flowers prolifically; and
 - *Indigofera australis*, spreading shrub up to 2.5 m tall that flowers prolifically in spring and in a good nectar and food source for butterflies;
- as appropriate, local native trees *Eucalyptus moluccana* and *E. tereticornis*.

Avoid planting *Casuarina glauca* close to the basin, as this species rapidly colonises basins and threatens the integrity of the substrate in the bioretention basins.

Lead time between ordering plants and planting needs to be being sufficient. It should be remembered that planting is to occur from autumn to late spring unless an adequate water supply is available.

4.3.9 Management Objective 9 – Monitoring and maintenance

The aims of the VMP are the protection, enhancement and management of the riparian corridors to provide terrestrial and aquatic habitat, expected for a Category 2 drainage line under the Huntingwood Precinct DCP, as well as provides direction for the conservation areas, not within the Huntingwood Precinct DCP Riparian Corridor.

The satisfaction of each management objective will be contingent on meeting specific targets throughout the monitoring period. These are presented in the Target Table (Table 3 in the VMP) along with the outline of details of the vegetation management and time frames for completion.

Specific short-term targets, including during construction phase(s), relate to:

- removal of rubbish and major weed infestations;
- sediment and erosion control;
- re-establishment of natural and engineered landforms;
- harvesting conservation assets prior to clearing of development areas;
- utilisation of these conservation assets in the conservation areas; and
- any other requirements for achieving successful native vegetation establishment.

The long-term targets for the life of the proposed development include weed control and conservation and enhancement of the conservation areas and associated habitats, with:

- **Weed control** – <5% cover in the conservation areas;
- **Native canopy cover** – at least 15% cover by canopy species, except under powerlines;
- **Native species diversity** – at least 2 tree species; at least 3 shrub species, at least 5 groundcover species based on the benchmarks for PCT 3319 Cumberland Shale Hills Woodland (profile in Appendix 7); and
- **Bare ground** – less than 20% bare ground, with leaf litter being an essential component of the native ecosystem.

Fixed photographic monitoring points are to be established in readily accessible locations to monitor progress of the restoration of the conservation areas.

Scheduling - Monitoring, maintenance and reporting relate to the time periods of Month 1, Month 3, Month 6, Month 12, then yearly for the life of the proposed development (for the enduring protection and maintenance of conservation areas and riparian corridors under private ownership). For each of the monitoring periods, the specific performance targets are related to the successes in previous monitoring periods. The targets are set by the Environmental Manager to guide site management for the next monitoring period(s).

Any issues that arise through the monitoring process are to be reported, addressed and corrective actions implemented.

Monitoring Reports are to include:

- Details of rainfall;
- Changes in the extent of weed versus native cover & diversity;
- Records of any heritage items detected and copies of the investigation reports;
- Works done;
- Progress to date and works required;
- A photographic record from the fixed photographic monitoring points;
- Vegetation structure, species composition and percent projected foliage cover recorded over time;
- Any native fauna observed, including photographs if possible; and
- Documentation of implementation and outcomes of any corrective actions.

These reports are to be used to evaluate success of the project over each monitoring period and to assess the long-term potential resilience of the ecosystems.

Results of the monitoring are to be discussed with the Construction Manager and/or Land manager. The monitoring reports are to be submitted to the client for distribution to the relevant authorities.

References

Bannerman SM and Hazelton PA (1990) *Soil landscapes of the Penrith 1:100000 Sheet*. Soil Conservation Service of New South Wales.

Benson DH and Howell J (1990) *Taken for Granted: the bushland of Sydney and its suburbs*. Kangaroo Press Pty Ltd. Kenthurst NSW.

Benson D and McDougall L (1995, 1996, 1998, 1999) *Ecology of Sydney plant species. Cunninghamia*.

Canopy Consulting (2023) *Industrial Estate Huntingwood – Tree Species Map*. Dated September 2023.

Clark S (2022). Targeted survey for the Cumberland Plain Land Snail (*Meridolum corneovirens* (Pfeiffer, 1851)) at Augusta Street, Huntingwood (in Appendix 8 of the BDAR).

Clements A., Simmonds A., Hazelton P., Inwood C., Woolcock C., Markovina A-L. and O'Sullivan P. (2010) Construction of an Environmentally Sustainable Development on a Modified Coastal Sand Mined and Landfill Site—Part 2. Re-Establishing the Natural Ecosystems on the Reconstructed Beach Dunes. *Sustainability* 2(3), 717-741.

Cuneo, P., Gibson-Roy, P., Fifield, G., Broadhurst, L., Berryman, T., Crawford, A. & Freudenberger, D. (2018). Restoring grassy woodland diversity through direct seeding: Insights from six "best-practice" case studies in southern Australia. *ECOLOGICAL MANAGEMENT & RESTORATION*, 19 (2), pages 124-135.
<https://doi.org/10.1111/emr.12315>.

Department of Planning, Industry and Environment (DPIE) (2020) *Biodiversity Assessment Method* (BAM). Dated October 2020.

Department of Transport and Main Roads (2010) *Fauna Sensitive Road Design, Volume 2: Preferred Practices*, Queensland Government, Brisbane.

Ecoplaning (2020) *Biodiversity Development Assessment Report, Augusta Street, Huntingwood, State Significant Development Application*. Prepared for EMKC Australia C/O Air Trunk – Final dated 6 August 2020.

Gibson-Roy P (2018) Restoring grassy ecosystems – Feasible or fiction? An inquisitive Australian's experience in the USA. *Ecological Management & Restoration* 19 (S1), pages 11- 25. doi: 10.1111/emr.12327.

Gibson-Roy P (2022) Australian grassy community restoration: Recognizing what is achievable and charting a way forward. *Ecological Management & Restoration* 23 (1), pages 10- 24. doi: 10.1111/emr.12546.

Gibson-Roy P, Moore G, Delpratt J and Gardner J (2010) Expanding horizons for herbaceous ecosystem restoration: the Grassy Groundcover Restoration Project. *Ecological Management & Restoration* 11(3), pages 176-186. doi: 10.1111/j.1442-8903.2010.00547.x

Goreski V. (2020) *The ecology and conservation of the largefooted myotis (Myotis macropus) in an urban environment*. PhD thesis. Queensland University of Technology.

Hazelton P. and Clements A. (2009) Construction of an Environmentally Sustainable Development on a Modified Coastal Sand Mined and Landfill Site – Part 1. Planning and Implementation. *Sustainability*. 2009; 1(2):319-334.

Hazelton P and Clements A (2011) Historic and Environmental Significance of Ecological Communities in NSW, Australia. *International Journal of Heritage and Sustainable Development*. 1(1), 72-83. ISSN: 1647-4112.

Natural Resources Access Regulator (NRAR) (2018) *Guidelines for controlled activities on waterfront land—Riparian corridors*. NSW Department of Industry | INT19/15607|. Dated May 2018.

Ralph M (1997) *Growing Australian Native Plants from Seed..* Published by Murray Ralf / Bushland Horticulture.

Rowe N (2010) *Design of fauna Underpasses*. Version 2 dated 15 June 2010. Available online at <https://www.mainroads.wa.gov.au/technical-commercial/technical-library/road-traffic-engineering/roadside-items/design-of-fauna-underpasses>. Main Roads, Government of Western Australia.

van der Ree, R, Smith DJ and Grilo C (2015) *Handbook of Road Ecology*. Wiley Blackwell, Chichester, UK.

VicRoads (2012) *Fauna Sensitive Road Design Guidelines*, Revision 0 / August 2012, Document ID: 1447218, State Government Victoria.

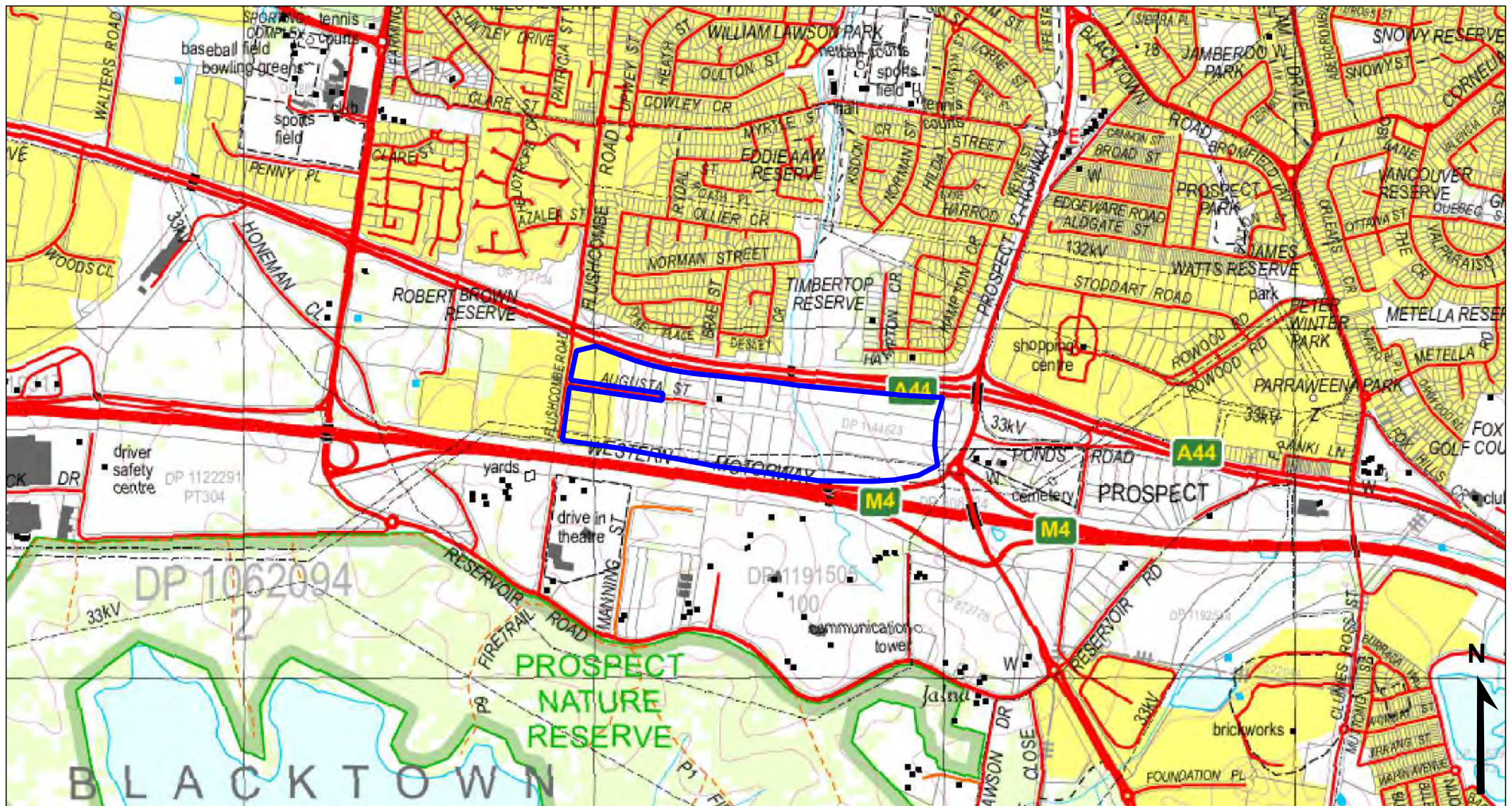
Windsor D.M., Clements A., Nolan M.B. and Sandercock H. (2000) *Recreating a eucalypt*

woodland with a grassy understorey on a gold mine in the Central Tablelands of New South Wales. In: *Temperate Eucalypt Woodlands in Australia: biology, conservation, management and restoration*. (ed. R.J. Hobbs and C. J. Yates) Surrey Beatty & Sons, Sydney.

Figures



Figure 1a.
Site boundary and mapped watercourses overlaid on the Nearmap aerial photograph dated 21 August 2022



 Site boundary

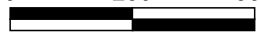
0 250 500 m

 Geocentric Datum of Australia 1994

Figure 1b.
 Site boundary overlaid on the E-topo Prospect topographic map sheet 9030-2N

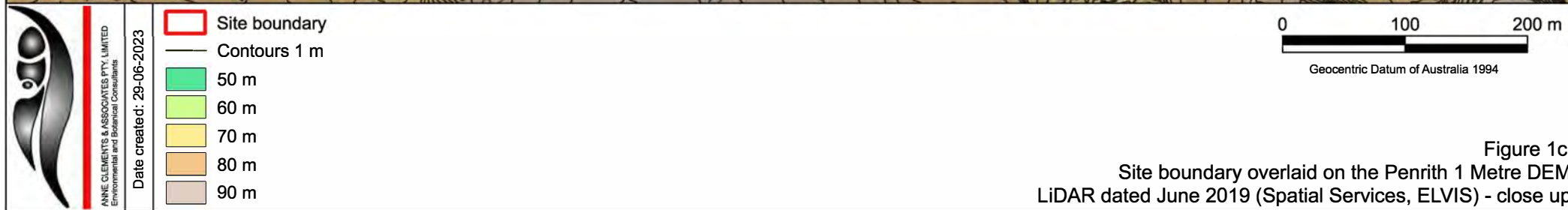
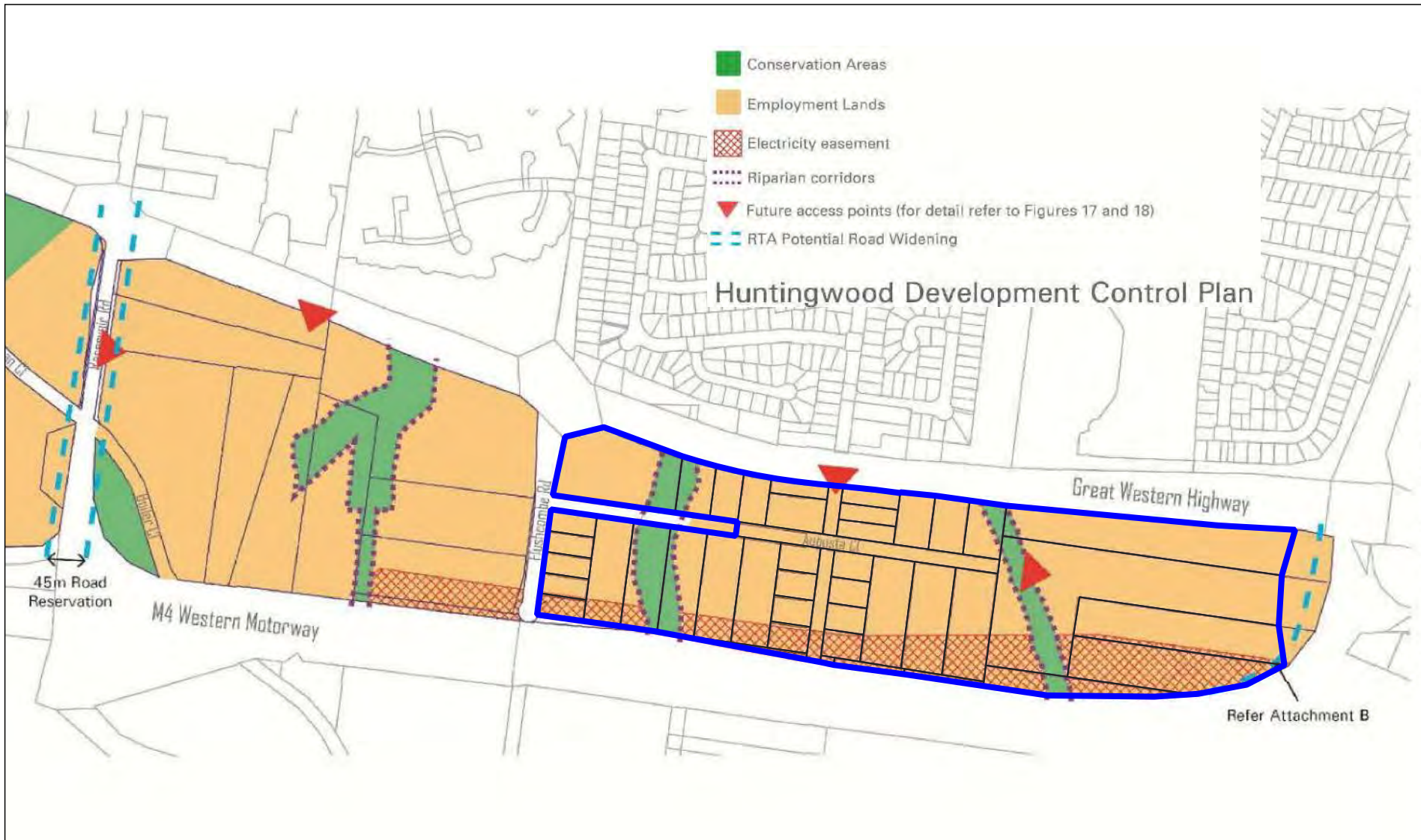


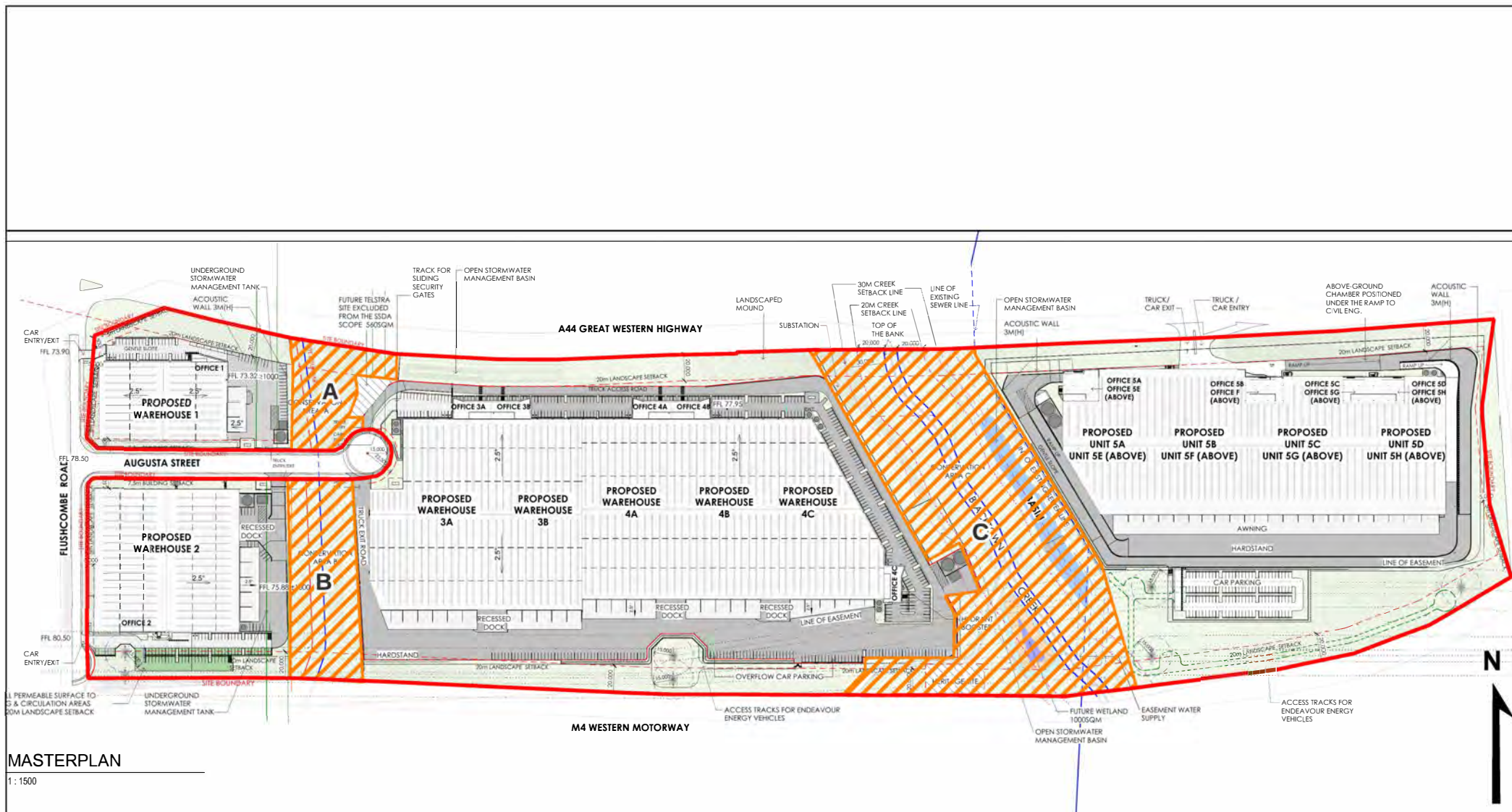
Figure 4: Huntingwood Precinct Development Framework



Refer Attachment B

Site boundary

0 100 200 m
Geocentric Datum of Australia 1994



MASTERPLAN

1 : 1500



Date created: 09-05-2024

- Site boundary
- Conservation areas

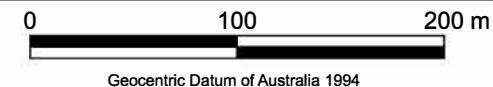
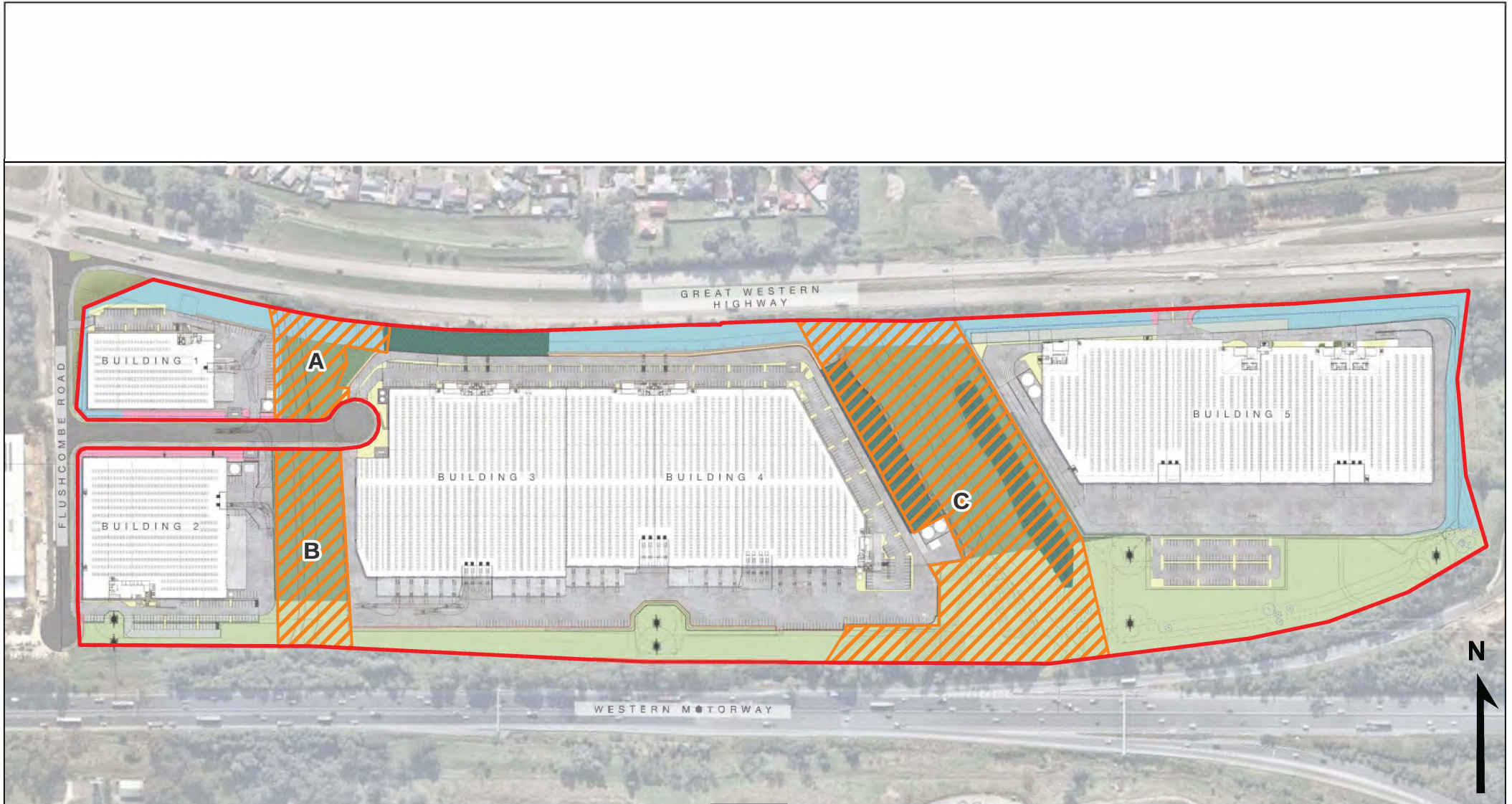


Figure 2a.
Conservation Areas A, B and C overlaid on the Masterplan
(PACE Architects, Dwg no. 220207-DA-001, Issue E, Dated 20.02.24)



Date created: 09-05-2024

- Site boundary
- Conservation areas

0 100 200 m
Geocentric Datum of Australia 1994

Figure 2b.
Conservation Areas A, B and C overlaid on the Masterplan
(PACE Architects, Dwg no. 220207-DA-001, Issue E, Dated 20.02.24)

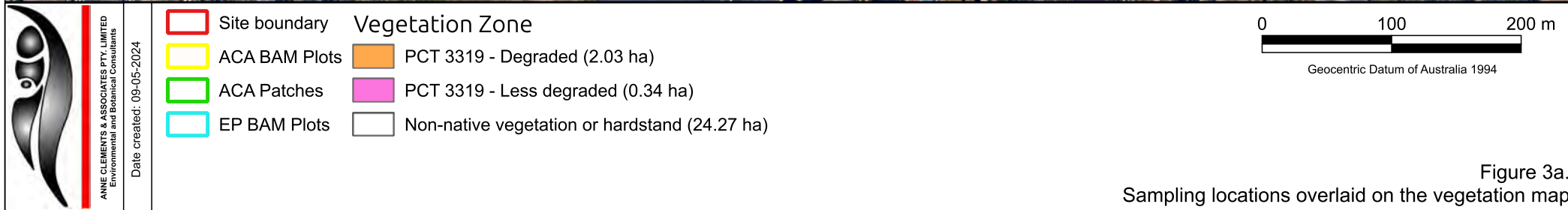
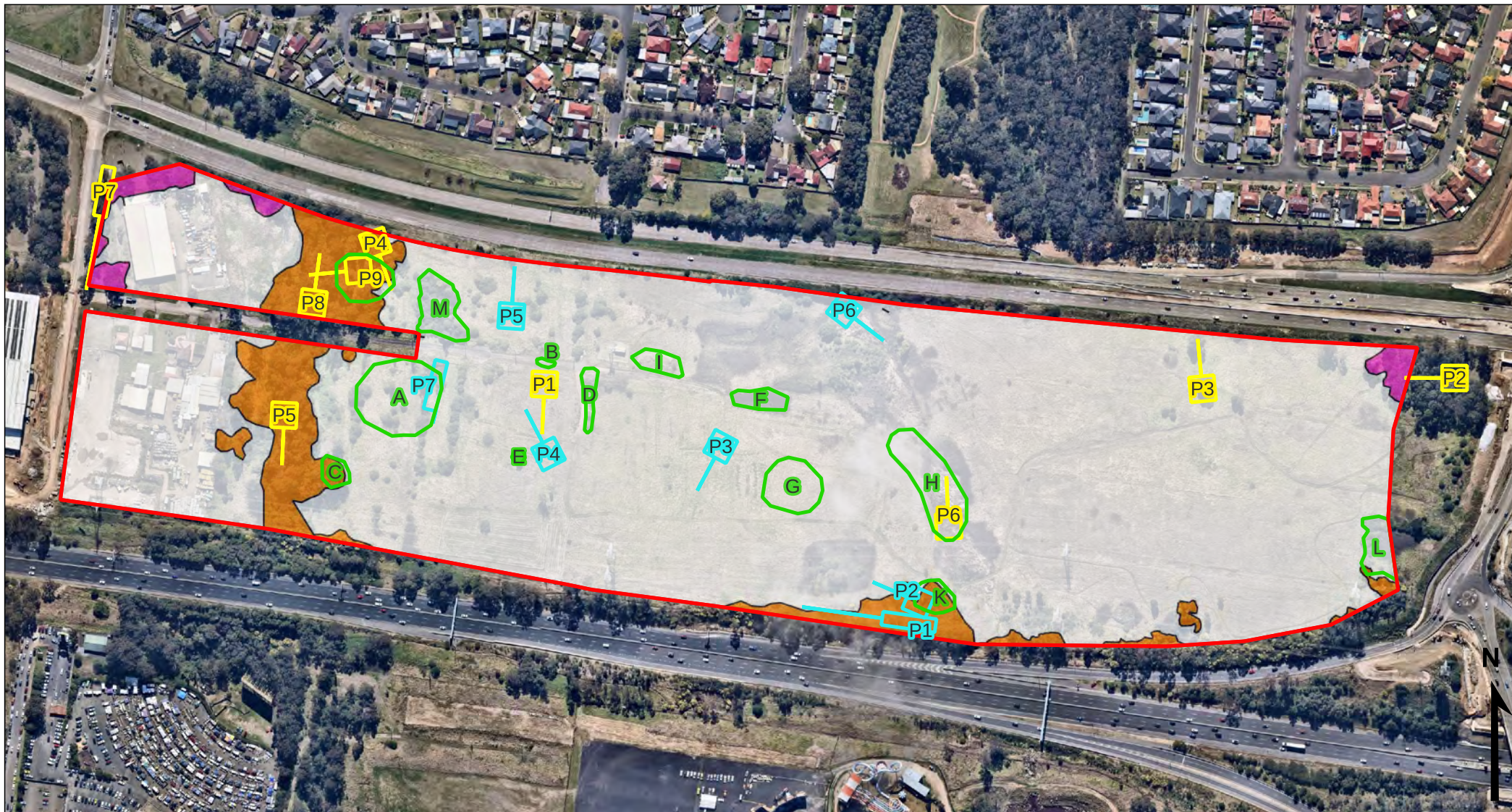


Figure 3a.
Sampling locations overlaid on the vegetation map

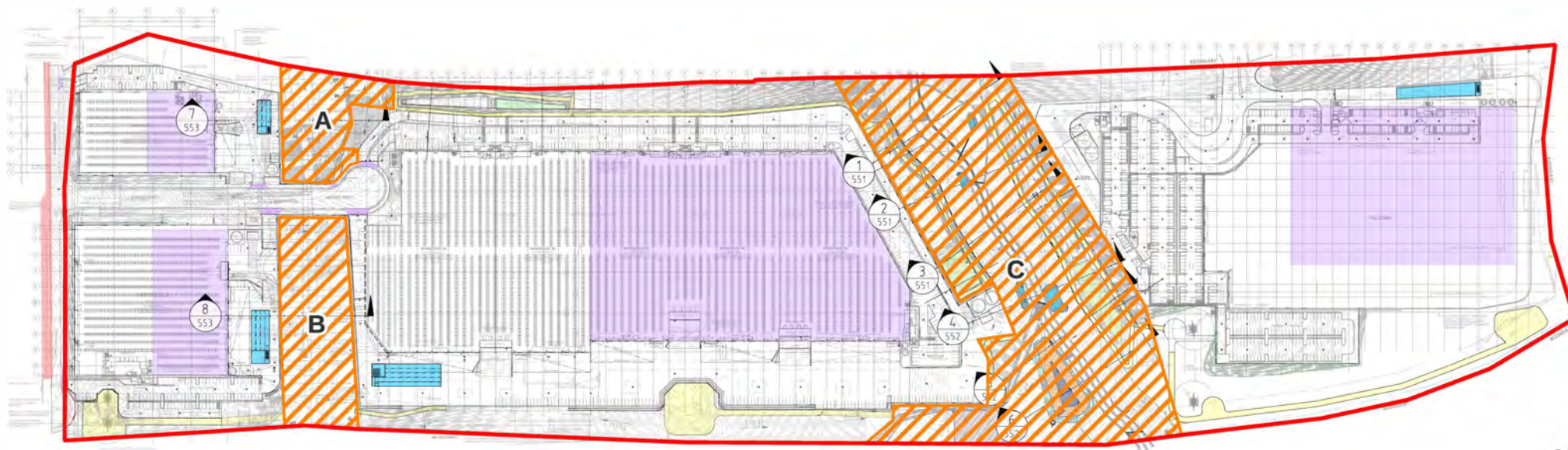


Date created: 08-09-2023

- *Eucalyptus moluccana*
- *Eucalyptus tereticornis*
- Site boundary

0 50 100 m
Geocentric Datum of Australia 1994

Figure 3b.
Native canopy trees from Canopy Consulting overlaid on the
Nearmap aerial photograph dated 21 August 2022



KEY SECTIONS PLAN

- Site boundary
- Conservation areas

0 100 200 m
Geocentric Datum of Australia 1994

Figure 4a.
Location of Conservation Areas A, B, C overlaid on Costin Roe
Drawing No. C013904.03-SSDA550, Issue B, dated 13.03.24

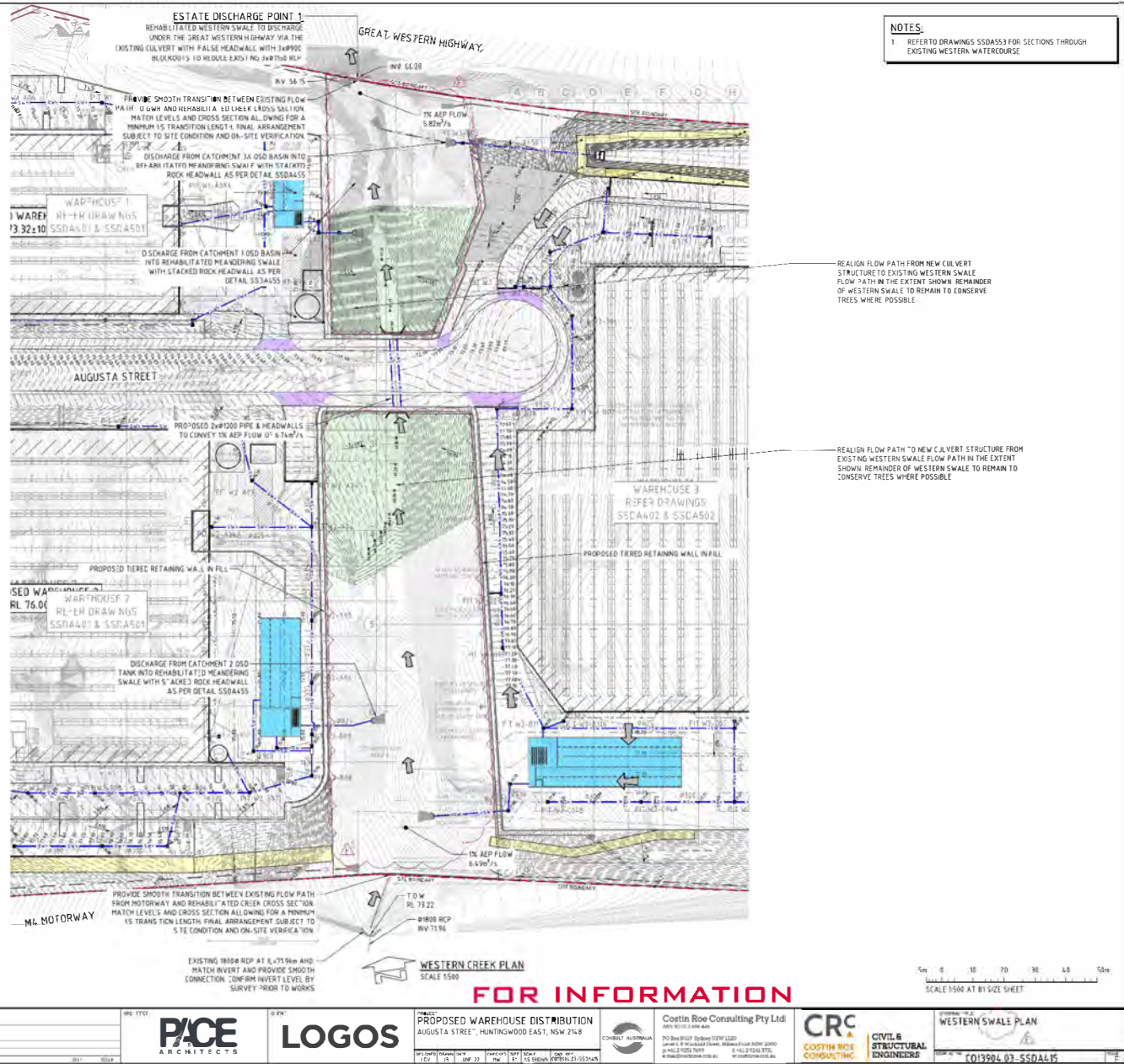


Figure 4b-1.

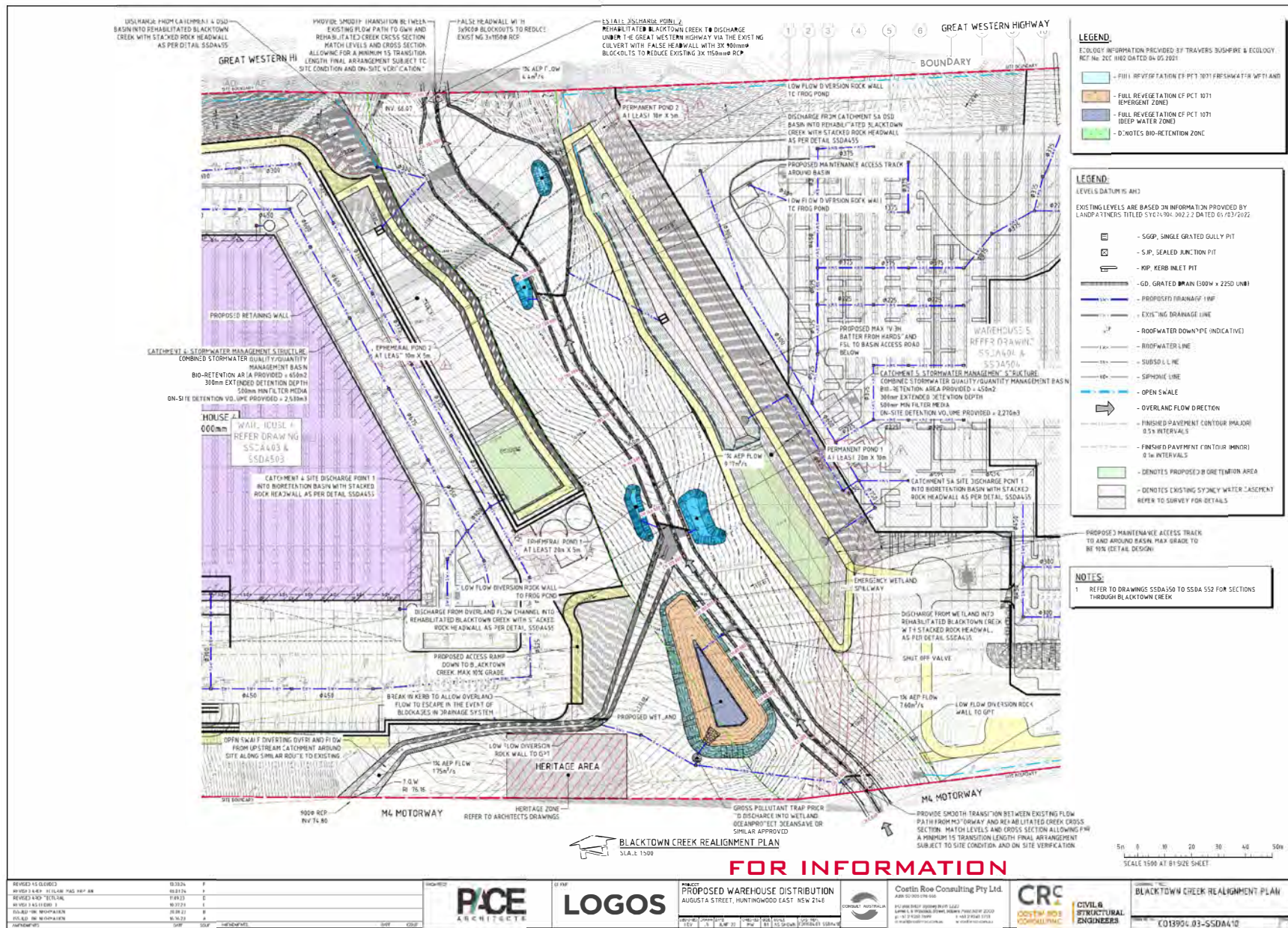


Figure 4b-2.

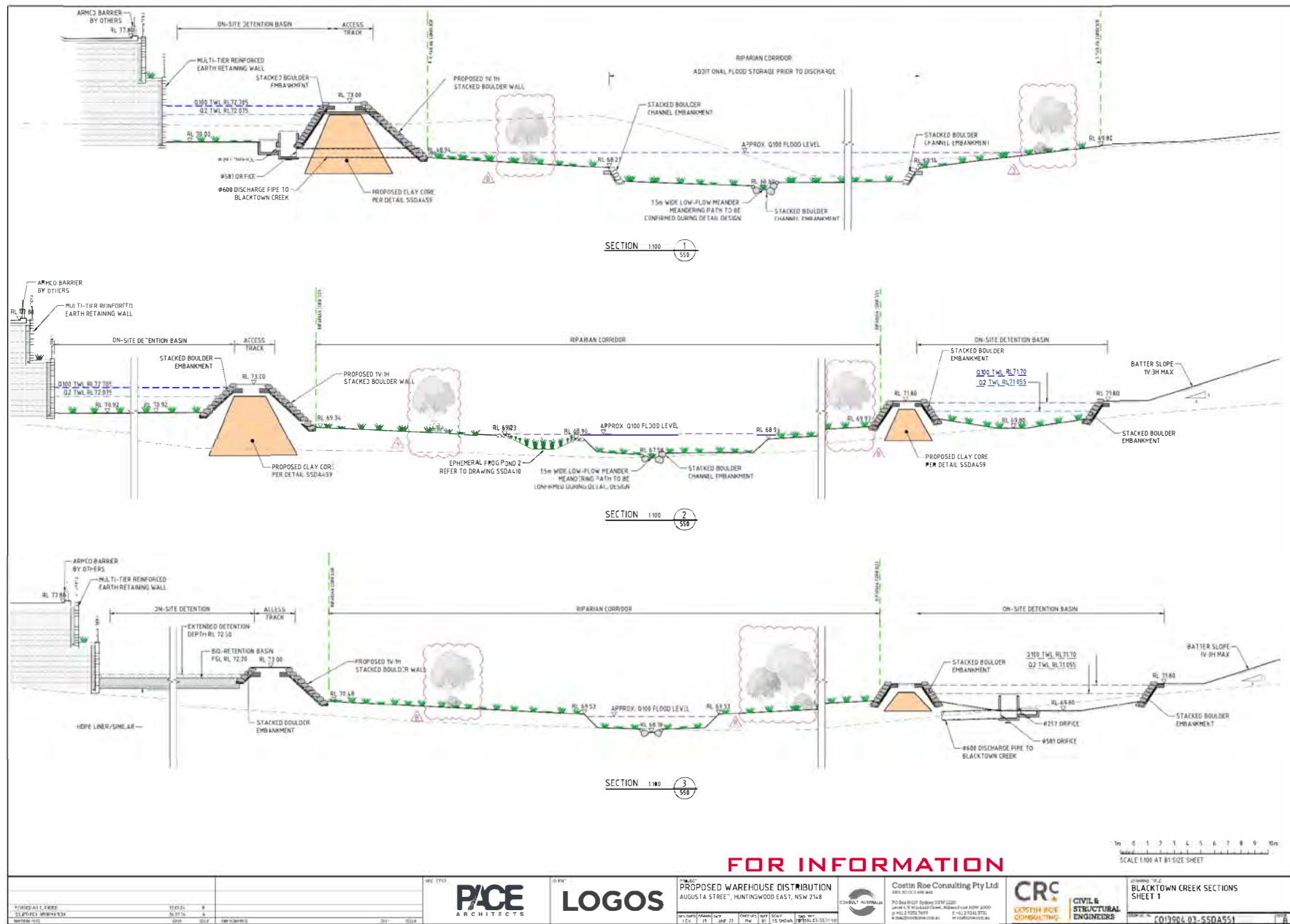


Figure 4b-3.

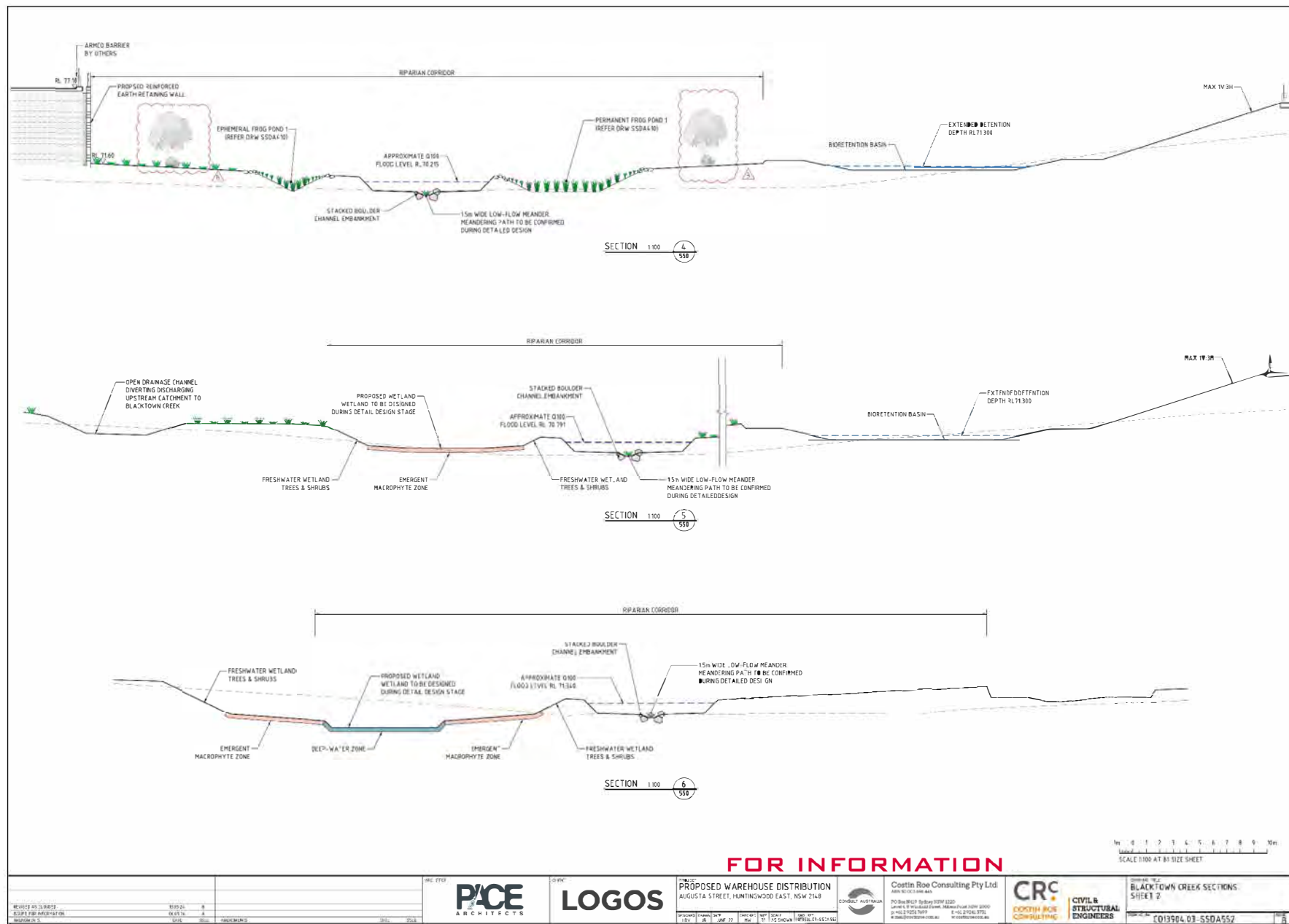


Figure 4b-4.



Tables

Table 1. Cover of species recorded in the conservation areas

Note, additional species listed were recorded elsewhere onsite

Species					
	Q5	Q6	Q8	H	K
Tree (TG)					
<i>Acacia parramattensis</i>					X
<i>Eucalyptus moluccana</i>	10		10		
<i>Eucalyptus tereticornis</i>	0.5		5		
Shrub (SG)					
<i>Acacia falcata</i>					X
<i>Acacia fimbriata</i>					
<i>Acacia floribunda</i>					
<i>Acacia implexa</i>					
<i>Atriplex semibaccata</i>					
<i>Breynia oblongifolia</i>					
<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	0.1				
<i>Daviesia genistifolia</i>					
<i>Dillwynia sieberi</i>					
<i>Eremophila debilis</i>					
<i>Pittosporum undulatum</i>					
<i>Platysace lanceolata</i>					
Grass & grasslike (GG)					
<i>Anthosachne scabra</i>					
<i>Aristida ramosa</i>					
<i>Aristida vagans</i>					
<i>Bolboschoenus caldwellii</i>		0.2			
<i>Bothriochloa decipiens</i> var. <i>decipiens</i>					
<i>Bothriochloa macra</i>					
<i>Carex inversa</i>					
<i>Chloris ventricosa</i>					
<i>Cymbopogon refractus</i>					
<i>Cynodon dactylon</i>					
<i>Cyperus exaltatus</i>					
<i>Cyperus gracilis</i>					
<i>Dichelachne micrantha</i>					
<i>Digitaria diffusa</i>					
<i>Digitaria parviflora</i>					
<i>Eleocharis plana</i>					
<i>Entolasia marginata</i>					
<i>Eragrostis brownii</i>					
<i>Eragrostis leptostachya</i>					
<i>Eriochloa pseudoacrotricha</i>					
<i>Fimbristylis dichotoma</i>					
<i>Juncus usitatus</i>				X	
<i>Lachnagrostis filiformis</i>				X	
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>					
<i>Microlaena stipoides</i>	0.5				
<i>Oplismenus aemulus</i>			2		
<i>Paspalidium distans</i>					
<i>Paspalum orbiculare</i>					
<i>Rytidosperma racemosum</i>					
<i>Rytidosperma</i> spp.					
<i>Sporobolus creber</i>					
<i>Themeda triandra</i>					
<i>Typha domingensis</i>		90		X	
<i>Typha orientalis</i>					
Forb (FG)					
<i>Alternanthera denticulata</i>					
<i>Arthropodium milleflorum</i>					
<i>Asperula conferta</i>					
<i>Brunoniella australis</i>					
<i>Caesia parviflora</i>					
<i>Calotis lappulacea</i>					

Species					
	Q5	Q6	Q8	H	K
<i>Commelina cyanea</i>			0.1		
<i>Dianella longifolia</i>					
<i>Dichondra repens</i>			1		
<i>Einadia hastata</i>					
<i>Einadia nutans</i>			0.3		
<i>Einadia nutans</i> subsp. <i>linifolia</i>					
<i>Einadia nutans</i> subsp. <i>nutans</i>					
<i>Einadia polygonoides</i>					
<i>Einadia trigonos</i>			0.1		
<i>Einadia trigonos</i> subsp. <i>trigonos</i>					
<i>Epilobium hirtigerum</i>				X	
<i>Euchiton sphaericus</i>					
<i>Euphorbia drummondii</i>					
<i>Geranium solanderi</i>					
<i>Grona varians</i>					
<i>Opercularia diphylla</i>					
<i>Oxalis exilis</i>					
<i>Oxalis perennans</i>					
<i>Phyllanthus virgatus</i>					
<i>Plectranthus parviflorus</i>					
<i>Portulaca oleracea</i>					
<i>Rumex brownii</i>					
<i>Senecio hispidulus</i>					
<i>Tricoryne elatior</i>					
<i>Vittadinia cuneata</i> var. <i>cuneata</i>					
<i>Wahlenbergia gracilis</i>					
Other (OG)					
<i>Amyema miquelii</i>					
<i>Glycine clandestina</i>					
<i>Glycine tabacina</i>					
<i>Hardenbergia violacea</i>					
<i>Livistona australis</i>		0.3			
Unknown					
Cyperaceae unknown genus					
<i>Cyperus</i> sp.					
Non-local native					
<i>Acacia baileyana</i>					
<i>Eucalyptus robusta</i>					X
<i>Grevillea robusta</i>					
<i>Melia azedarach</i>			0.1		
<i>Pandorea jasminoides</i>					
<i>Plumbago zeylanica</i>					
High threat weed					
<i>Anredera cordifolia</i>	1		3		
<i>Asparagus aethiopicus</i>	0.1		0.1		
<i>Asparagus asparagoides</i>	0.1				
<i>Asparagus plumosus</i>					
<i>Bidens pilosa</i>					
<i>Bidens subalternans</i>					
<i>Briza subaristata</i>					
<i>Cardiospermum grandiflorum</i>	0.5				
<i>Cenchrus clandestinus</i>			2		
<i>Cestrum parqui</i>				X	
<i>Chloris gayana</i>			0.8		
<i>Cyperus eragrostis</i>				X	
<i>Ehrharta erecta</i>	5		5		
<i>Eragrostis curvula</i>					
<i>Hyparrhenia hirta</i>					
<i>Hypericum perforatum</i>					
<i>Juncus acutus</i>		5		X	
<i>Lantana camara</i>	20		5		
<i>Ligustrum lucidum</i>	15		3		
<i>Ligustrum sinense</i>	3		0.8	x	

Species					
	Q5	Q6	Q8	H	K
<i>Lonicera japonica</i>					
<i>Opuntia monacantha</i>			0.8		
<i>Paspalum dilatatum</i>					
<i>Rubus anglocandicans</i>		5			
<i>Senecio madagascariensis</i>					
<i>Senna pendula</i> var. <i>glabrata</i>			2		
Exotic					
<i>Agrostis stolonifera</i>				X	
<i>Anagallis arvensis</i>					
<i>Araucaria columnaris</i>					
<i>Araujia sericifera</i>					
<i>Asparagus officinalis</i>					
<i>Aster subulatus</i>					
<i>Avena barbata</i>					
<i>Bromus catharticus</i>					
<i>Campsis radicans</i>					
<i>Cirsium vulgare</i>			0.3		
<i>Conyza bonariensis</i>					
<i>Conyza</i> sp.					
<i>Conyza sumatrensis</i>					
<i>Cortaderia selloana</i>			1		
<i>Cotoneaster glaucophyllus</i>					
<i>Cyanthillium cinereum</i> var. <i>cinereum</i>					
<i>Cyclosporum leptophyllum</i>					
<i>Cyperus brevifolius</i>					
<i>Dactylis glomerata</i>					
<i>Epilobium hirsutum</i>					
<i>Erythrina crista-galli</i>	30				
<i>Erythrina x sykesii</i>					
<i>Festuca elatior</i>					
<i>Foeniculum vulgare</i>					
<i>Gomphocarpus fruticosus</i>					
<i>Hibiscus rosa-sinensis</i> (unidentified cultivar)					
<i>Hypochaeris microcephala</i> var. <i>albiflora</i>					
<i>Hypochaeris radicata</i>					
<i>Lactuca serriola</i>					
<i>Lepidium bonariense</i>					
<i>Linum trigynum</i>					
<i>Lolium perenne</i>					
<i>Lotus</i> sp.				X	
<i>Lycium ferocissimum</i>					
<i>Malva parviflora</i>					
<i>Modiola caroliniana</i>			0.1		
<i>Nerium oleander</i>					
<i>Nothoscordum gracile</i>					
<i>Olea europaea</i> subsp. <i>cuspidata</i>	4		5		
<i>Osteospermum ecklonis</i>					
<i>Osteospermum spinescens</i>					
<i>Paspalum notatum</i>					
<i>Pavonia hastata</i>					
<i>Phalaris aquatica</i>				X	
<i>Phalaris</i> sp.					
<i>Plantago lanceolata</i>					
<i>Pyracantha</i> sp.					
<i>Rosa banksiae</i> <i>Alboplana</i>					
<i>Rumex conglomeratus</i>					
<i>Rumex crispus</i>				X	
<i>Schinus molle</i> var. <i>areira</i>					
<i>Senecio pterophorus</i>					
<i>Setaria parviflora</i>					
<i>Sida rhombifolia</i>	0.1				
<i>Solanum americanum</i>					
<i>Solanum nigrum</i>			0.1		

Species					
	Q5	Q6	Q8	H	K
<i>Solanum sisymbriifolium</i>			0.3		
<i>Sonchus oleraceus</i>					
<i>Sorghum halepense</i>					
<i>Sporobolus africanus</i>					
<i>Stachys arvensis</i>					
<i>Syagrus romanzoffiana</i>					
<i>Taraxacum officinale</i>					
<i>Tradescantia fluminensis</i>	0.1				
<i>Tragopogon porrifolius</i>					
<i>Trifolium glomeratum</i>					
<i>Trifolium</i> sp.					
<i>Verbena bonariensis</i>					
<i>Verbena incompta</i>					
<i>Verbena quadrangularis</i>			0.3		
<i>Verbena rigida</i> var. <i>rigida</i>					
<i>Vicia</i> sp.					
<i>Vicia tetrasperma</i>					
<i>Yucca elephantipes</i>					

Table 2. Maximum heights and numbers of individuals per 10 m x 10 m subquadrat, for species present $\geq$ 2 m.

Botanical name	Subquadrat 1		Subquadrat 1		Subquadrat 1		Subquadrat 1	
	Number	Height	Number	Height	Number	Height	Number	Height
Plot 5								
<i>Eucalyptus moluccana</i>	1	12m	2	17m			2	25
<i>Eucalyptus tereticornis</i>					1	10m		
* <i>Erythrina crista-galli</i>					6	13m	6	10m
* <i>Ligustrum lucidum</i>			3	7m			1	3m
* <i>Ligustrum sinense</i>			1	4m			4	4m
* <i>Olea europaea</i> subsp. <i>cuspidata</i>	1	4m	5	7m				
Plot 6								
No trees								
Plot 8								
<i>Eucalyptus moluccana</i>	3	25 m	2	25 m	1	20 m	1	16 m
<i>Eucalyptus tereticornis</i>	5	23 m			1	22 m		
* <i>Ligustrum lucidum</i>	3	4 m			2	5 m		
* <i>Ligustrum sinense</i>					2	2 m		
* <i>Opuntia monacantha</i>			2	3 m			2	2 m

= non-local native

* = exotic

Table 3. Target Table for implementing the Vegetation Management Plan

The aims of the VMP are the protection, enhancement and management of the riparian corridors including re-establishing local native fauna habitat. The following management objectives have been set:

1. Protection of the VMP areas;
2. Increase community awareness of the benefits of canopy vegetation to minimise heat island effects;
3. Feral pest control and relocation of native fauna species;
4. Enhancement of the local native vegetation utilising the conservation assets
5. Remove existing dumpings and weed control;
6. Re-establish the landform and associated hydrology;
7. Habitat enhancement for native fauna species;
8. Enhancing water quality in bioretention and reconstructing wetlands using local native species; and
9. Monitoring and Maintenance.

The VMP applies to Conservation Areas, A, B and C and additional conservation areas shown on the Landscape Strategy Plan (Figure 2b).

Conservation Area	Target	Action	Person responsible	Time-frame
Objective 1. Protection of the VMP areas				
A,B,C	Environmental Manager (EM) appointed	Appoint an Environmental Manager (EM). The EM is to have at least 5 years experience of supervising the restoration of degraded native ecosystems using onsite construction machinery and with at least a tertiary education in natural sciences to supervise, co-ordinate and document conservation works.	The client.	Prior to commencement of works.
A,B,C	VMP areas clearly identified on plans and onsite	VMP area to be clearly identified on plans and on site with appropriate signage to indicate “no-go” / conservation works areas. The EM is to meet with the Site Manager/Construction Manager (CM) about appropriate fencing, vehicle	CM in consultation with the EM	Prior to commencement of works.

Conservation Area	Target	Action	Person responsible	Time-frame
		cleanliness and site induction. Areas of planned landform changes in the VMP areas are to clearly identified on the site and on plan to minimise risk of double handling of materials and spread of weeds.		
A,B,C	VMP areas adequately fenced off and fencing maintained.	To avoid any confusion, the Construction Area is to be fenced to clearly demarcate the limits of the construction activities. Fencing is to be maintained in good condition during the life of the project as specified by the EM in consultation with the CM at which point the fencing can be carefully removed.	CM in consultation with the EM	Prior to commencement of works.
A,B,C	Minimal erosion risk	In areas with extensive exposed soil in and adjoining the VMP area, erosion control fencing is to be installed, as specified by the EM in consultation with CM.	CM in consultation with the EM	Prior to commencement of works, and as required
A,B,C	All personnel entering the site inducted.	Prepare induction documents. Induct all persons entering the site, explain the issues including heritage item and associated procedures, and have induction form signed. All workers onsite are to be made fully aware of the “no go” areas during induction and tool box talks.	CM in consultation with the EM	Prior to commencement of works. Prior to and during the construction phase.
A,B,C	Risk of pathogen introduction to VMP areas minimised	Any machinery is to be clean / free of dirt prior to entry into VMP areas and will be inspected and photographed, as required by the EM (details are to be included in Monitoring Report 1 (Month 1). Weed controllers/ bush regenerators are to adhere to hygiene protocols. The nurseries used for plant propagation must have cleanliness and hygiene protocols and procedures in place. (Note, for any native vegetation being cleared, seeds are to be harvested for propagation at a specialist nursery).	EM in consultation with the CM.	Ongoing for the life of the project.

Conservation Area	Target	Action	Person responsible	Time-frame
Objective 2. Increase community awareness of the benefits of canopy vegetation to minimise heat island effects				
A,B,C	Increase conservation awareness	All site workers are to be made fully aware of the significance of the VMP areas and heritage item and the value of native vegetation and wetland areas in mitigating heat island effects during induction and regular toolbox talks.	EM and CM.	During works
A,B,C	Increase conservation awareness and the value of	Interpretive signs are to be installed at entrances, adjoining pathways and at seating locations in and or near the VMP areas emphasising the benefits of native vegetation and wetland areas in mitigating heat island effects	EM. These are to be designed in consultation with the landscape architect and owners as required.	At completion of landscaping near development areas. Prior to occupancy
Objective 3. Feral pest control and relocation of native fauna species				
A,B,C	Control of feral pests	In both the development area and the VMP areas a live-trapping program for the onsite feral pests (rats, cats and foxes) is to be implemented. Trapped cats are to be scanned for microchips and returned to their owners, as required by the EM.	EM in consultation with fauna expert and the CM	Prior to any clearing / earthworks / rubbish removal.
A,B,C	Native fauna searches and relocation	During live-trapping program for the onsite feral pests, any native fauna species encountered are to be relocated from the works area to a safe location as specified by the EM.	EM in consultation with fauna expert and the CM	Prior to any clearing / earthworks / rubbish removal.
Objective 4. Enhancement of the local native vegetation utilising the conservation assets				
A, B, C	Conservation assets collected from the Development Area and transferred to the Conservation Areas	All of the conservation assets from the Development Area are available for re-use including local provenance seed sources, native tree biomass, especially seed bearing upper branches and logs. Staging of collection and spread is to be carefully planned by the EM and the CM. Seed availability affects the timing of harvesting of the conservation assets.	EM in consultation with the CM	Prior to and during clearing
A, B, C	Nursery stock propagated	Tubestock is to be grown on for planting in conservation	EM in consultation with	Plants to be available by

Conservation Area	Target	Action	Person responsible	Time-frame
		areas.	specialist nurseries	April of each year.
A, B, C and all conservation areas	<u>Long term targets:</u> - at least 15% cover by canopy species; - at least 2 Tree species; - at least 3 shrub species; - at least 5 groundcover species; and - less than 20% bare ground.	Supplementary planting and direct seeding as required. Note: Tree cover and shrub cover are not to occur unless specified in the stormwater management areas. Tree cover is not permitted within the powerline easement.	EM	Ongoing
Objective 5. Remove existing dumpings and weed control				
A,B,C	Area cleared of rubbish dumpings	Dumpings are to be removed as specified in the site specific RAP. Details of the removal are to be included in Monitoring Report 1 and subsequent reports as required.	EM in consultation with the CM.	Prior to any earthworks
A, B	Primary weed control of woody weeds and re-use in windrows for erosion control and native fauna habitat reconstruction.	Utilisation of the dense woody weeds including the former garden escapes <i>Ligustrum</i> spp, <i>Olea europaea</i> and <i>Lantana camara</i> (not including Blackberry) into stacked windrows using onsite machinery. These stacks are <u>not</u> to be placed in areas requiring engineering / earthworks. This requires careful supervision by the EM and the CM.	EM in consultation with the CM.	Early eathworks.
A,B,C	Non-woody weed infestations, windrowed and covered with black plastic	For the non-woody weed infestations (including Blackberry) the 1-3 cm of soil surface is to be 'scalped' (scraped) using onsite construction machinery (excavator bucket or similar), as specified by and under the supervision of the EM, to remove the weed bulk, weed seed bank and nutrient enriched upper soil layer; The weedy scraped off topsoil and biomass are to be pushed into windrows (less than 500 mm high) along the contours and covered in black plastic to kill the weed seed bank. These windrows also act as an erosional control measure. It is essential that the black plastic is well secured to the	EM in consultation with the CM.	Prior to any earthworks and inspected at 3 monthly intervals

Conservation Area	Target	Action	Person responsible	Time-frame
		ground and if necessary additional erosion control fencing may be installed up and downslope of these windrows, as directed by the EM. These windrows are NOT to be placed in areas where landform re-contouring is planned; The weedy plant material under the black plastic is to be inspected at 3 monthly intervals to determine the natural breakdown. These windrowed weeds are <u>not</u> to be spread across the site.		
All conservation areas	Secondary weed control	This will be required close to the stacked windrows and in the prepared soil. The management of weed species is to be conducted by skilled bush regenerators and / or commercial spot sprayer as specified by the EM.	Skilled bush regenerators and / or commercial spot sprayer as specified by the EM	Ongoing post earthworks
All conservation areas	Tertiary weed control	Small seedlings are to be removed by hand where appropriate, and saplings or suckering are to be scraped and herbicide controlled. These actions will require regular implementation to exhaust the weed seed bank and prevent any new seedlings maturing and seeding.	Skilled bush regenerators and / or commercial spot sprayer as specified by the EM	Ongoing
All conservation areas	Long term target of <5% weed cover in most of the Conservation areas.	[Note: in areas where the vegetation is predominantly exotic grasses and other weeds and it may be difficult to achieve the 5% weed cover target. For this area less than 30% weed cover may be all that can be achieved];	Skilled bush regenerators and / or commercial spot sprayer as specified by the EM	Ongoing
All conservation areas	Immediate control of any sightings of <i>Juncus acutus</i> (Spiny Rush)	Any sightings of this weed are to be reported to the EM and CM for immediate, high priority control.	EM in consultation with CM and / or Land owner	Ongoing
Objective 6. Re-establish the landform and associated hydrology				
Entire site	Limiting soil compaction during earthworks	The soil onsite is clay and easily compacted when wet. Soil at the time of earthworks must be sufficiently dry, especially in the conservation areas. Slashing and retention of the dense paddock weeds	EM in consultation with the geotechnical engineer and the CM	Prior to and during Earthworks.

Conservation Area	Target	Action	Person responsible	Time-frame
		during the earthworks on the site in general, may assist in limiting vehicles being bogged. The usefulness of this slashed weed cover during early earthworks needs to be considered.		
A, B, C	Extensive landform reconstruction to re-establish a watercourse to manage the water input and to provide native fauna habitat	Details in Costin Roe 2024 drawing set (see relevant subset in Figures 8b-1 to 8b-6). These include specific waterbody requirements for the threatened species Green and Golden Bell Frog and the Southern Myotis.	EM, in consultation with the frog specialist, construction manager and civil engineers.	During Earthworks.
A, B, C	Exposed recontoured soil prepared to receive conservation assets.	The exposed scalped soil being recontoured is deep ripped in preparation to receive conservation assets. Any native regrowth observed post scalping and soil preparation is to be flagged and any weed growth spot sprayed, as required by the EM.	Any earthworks in the VMP areas are to be carried out under strict supervision of the EM, in consultation with the CM.	Post re-establishment of the landform.
Objective 7. Habitat enhancement for native fauna species				
A, B, C	Successful Implementation of pest control program	Live trapping program	EM and pest control specialist	Prior to enhancement of habitat and ongoing.
A, B, C	Culverts entrances made clear, unobscured and weed free	Implement weed control program	Skilled bush regenerators and / or commercial spot sprayer as specified by the EM in consultation with the Engineers and CM.	Prior to enhancement of habitat and ongoing.
A, B, C	Soils prepared and ready for planting / direct seeding.	Deep ripping of soils.	EM in consultation with CM	Prior to planting and direct seeding.
A, B, C	Planting and restoration of native woodland.	Implementing planting and / or direct seeding program in the conservation areas	As specified by the EM in consultation with the CM	Following sufficient rain (at least 30 mm) in

Conservation Area	Target	Action	Person responsible	Time-frame
				autumn to spring. Planting is summer is not recommended unless supplementary watering is readily available.
A, B, C	Ongoing weed control.	Implement weed control program	Skilled bush regenerators and / or commercial spot sprayer as specified by the EM	Ongoing
A, B, C	Nest boxes installed as required / appropriate.	Installation of nest boxes	EM in consultation with fauna expert	Dependant on feral pest control and available food resources.
Objective 8. Enhancing water quality in bioretention and reconstructing wetlands using local native species				
C plus bioretention basins elsewhere onsite	The construction of the stormwater management structures as specified by Costin Roe (2024)	Details in Costin Roe 2024 drawing set (see relevant subset in Figures 8b-1 to 8b-6).	Civil engineers.	Post primary weed removal
C plus bioretention basins elsewhere onsite	Sufficient local native species stock for the stormwater management basin planting.	Local seed collection, propagation of sufficient species diversity and numbers and confirm hygiene protocols.	EM in consultation with specialist nurseries	Prio to and during construction of the stormwater management structures
C plus bioretention basins elsewhere onsite	Basins protected until adjoining batters stabilised	Bio-retention / detention basins are to be covered by geotextile fabric until adjoining land has been stabilised, direct seeded and planted.	EM in consultation with the engineer and CM	Immediately post the construction

Conservation Area	Target	Action	Person responsible	Time-frame
C plus bioretention basins elsewhere onsite	Adjoining batters planted and stabilised	Planting as directed by the EM	EM in consultation with the engineer and CM	Post construction of the basins and batters.
Objective 9. Monitoring and maintenance				
A, B, C	Monitoring points established	Fixed photographic monitoring points are to be established in readily accessible locations.	EM	By Month 1
A, B, C	Record of works documented	Record works done	EM	To be included in monitoring reports
A, B, C	Documentation of implementation and outcomes of any corrective actions.	Results of the monitoring are to be discussed with the Construction Manager and/or Land manager. Any issues that arise through the monitoring process are to be reported, addressed and corrective actions implemented.	EM	As required, to be included in monitoring reports.
A, B, C	Monitoring reports prepared and submitted	The monitoring reports are to be prepared and submitted to the client for distribution to the relevant authorities.	EM submitted to the client, Client submits to the authority.	Month 1, Month 3, Month 6, Month 12, then yearly

Table 4. Timeline / schedule of activities

The VMP applies to Conservation Areas A, B and C and other conservation areas shown on the Landscape Strategy Plan (Figure 1f).
The 5 year Vegetation Management Plan is to be reviewed in 2028.

Timing:

Expected timing

Management Actions	Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Initial actions prior to works commencing																				
Environmental Manager (EM) to meet with Construction Manager (CM) to discuss: - VMP Management areas, areas of planned landform changes and 'No Go' areas are clearly identified on plans and onsite; - Locations of existing dumpings and dense weed infestations - Appropriate fencing and erosion controls; - Induction form ready for use; - Use of onsite equipment for rubbish removal and primary weed control; - Use of onsite equipment for planned staging of harvesting conservation assets from the Development Area prior to and during earthworks for re-use in the VMP Areas. - Timing of construction of sediment control basins/ stormwater management basins, habitat ponds in the Conservation Areas and use of onsite equipment. - Feral pest control program																				
Fixed photographic monitoring points are to be established in readily accessible locations.																				
Monitoring reports prepared and submitted Month 1, Month 3, Month 6, Month 12, then yearly.																				
Immediately prior to and during works																				
Implementing feral pest control program using live traps (ongoing) with searches and translocations of native fauna (includes searching of any Hollow Bearing Trees)																				
Appropriate exclusion fencing installed around the Conservation areas, as required by EM and CM.																				
During works - all areas																				

Management Actions	Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Induct all persons entering the site and ongoing tool box talks. Records supplied for inclusion in Monitoring Report as required by EM.																				
Machinery entering the VMP areas is to be inspected for cleanliness and photographed, as required by the EM.																				
Clean up rubbish dumpings with dumping removed as specified in the RAP																				
Prior to re-contouring, non-woody weeds and weedy topsoil is 'scalped' and windrowed and covered with black plastic. This includes Blackberry.																				
Immediate control of any sightings of <i>Juncus acutus</i> (Spiny Rush) ongoing. May re-infest from flood water or vehicle tyres.																				
Re-contouring using onsite equipment as required by the engineers (including stormwater management basins, and in Conservation Area C, habitat frog ponds);																				
Soil preparation and deep ripping along contours using onsite equipment.																				
Secondary and tertiary weed control (ongoing)																				
Harvest any available native tree biomass being pruned or cleared for re-spread in the prepared conservation areas. Collect sufficient seed for propagation.																				
Nursery stock to be propagated within adequate timeframe for planting																				
Logs cut into manageable pieces and relocated to the prepared conservation areas, as specified by the EM. Note, logs are required for the frog pond restoration area.																				
Planting and direct seeding as required to achieve long term targets (ongoing), including stormwater management areas.,																				
Prior to occupancy, and at completion of landscaping interpretive signs are to be installed depending on staging.																				
Conservation Areas A and B – drainage swale in the west																				
Clearly identify the contamination containment area to the NW of Conservation Area A.																				
Woody weeds are to be placed in stacked windrows for erosion control and fauna habitat logs.																				

Management Actions	Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
The placement of windrows is not to be in areas requiring future earthworks.																				
Conservation Area C – along Blacktown Creek																				
Stormwater management construction including habitat frog ponds (depends on staging). (discussed under 'all areas')																				

Table 5. Costing estimates

The VMP applies to Conservation Areas A, B and C and other conservation areas shown on the Landscape Strategy Plan (Figure 1f).

Management Actions	Management details	Unit	Qty	Costs \$ (excl GST)
Project management				
Initial - Environmental Manager (EM) to meet with Construction Manager (CM)	To clarify work done using onsite equipment and in consultation with CM (@ \$200 per hour)	hr	4	800
Weekly meetings/ emails and phone conversations during construction phase (assumed 40 weeks)	2 hr per weekly meeting @ \$400 per meeting, including preparation	Meeting	40	16,000
Fixed photographic monitoring points are to be established in readily accessible locations.	At least 12 monitoring points and 8 monitoring events @\$500 per event	Event	8	4,000
Monitoring reports prepared and submitted Month 1, Month 3, Month 6, Month 12, then yearly.	\$1500 per report	Report	8	12,000
All Management areas including Development Area				
Induct all persons entering the site and ongoing tool box talks. Records supplied for inclusion in Monitoring Report as required by EM.	Part of project management			
Machinery entering the VMP areas is to be inspected for cleanliness and photographed, as required by the EM.	Part of project management			
Feral pest control program using live traps (ongoing) with searches and translocations of native fauna (includes searching of any Hollow Bearing Trees)	Specialist fauna spotter/ catcher estimate \$1500 per visit	Site visit	10	15,000
Supervision of clean up of rubbish dumpings with dumping removed as specified in the RAP	Supervision of clean-up using onsite equipment (\$150 per hour for supervision)	hr	200	30,000
Prior to re-contouring, non-woody weeds and weedy topsoil is 'scalped' and windrowed and covered with black plastic. This includes Blackberry.	Supervision of works using onsite equipment (\$150 per hour for supervision).	hr	200	30,000

Management Actions	Management details	Unit	Qty	Costs \$ (excl GST)
Purchase of black plastic.	Cost of black plastic (\$130 per 50 m long x 4 m wide)	roll	50	6,500
Supervision and ecological input for re-contouring using onsite equipment as required by the engineers (including stormwater management basins, and in Conservation Area C, habitat frog ponds);	Supervision of works using onsite equipment (\$150 per hour for supervision, \$200 per hour for frog specialist)	hr	200 @ \$150/hr plus 50 @ \$200/hr	30,000 plus 10,000
Supervision of soil preparation and deep ripping along contours using onsite equipment.	Supervision of works using onsite equipment (\$150 per hour for supervision)	hr	100	15,000
Secondary and tertiary weed control (ongoing)	Spot spraying at least weekly for 12 months by commercial licenced weed controller (6hrs per visit) and once every 3 month for 4 years @ \$100/hr	hr	312 hours for year 1. 100 hours for years 2 to 5. Total 423 hours x \$100.	165,000
Harvest any available native tree biomass being pruned or cleared for re-spread in the prepared conservation areas. Collect sufficient seed for propagation.	Specialist seed collectors at \$180 per hour.	hr	40	7200
Nursery stock to be propagated and planted	Tubestock for supplementary planting (@\$6 per tubestock/ hiko planted in the ground)	Tube-stock	40,000	240,000
Planting contingency	Water cost and replacement (10% of cost)			24,000
Logs cut into manageable pieces and relocated to the prepared conservation areas, as specified by the EM. Note, logs are required for the frog pond restoration area.	Cost met by construction team			
Prior to occupancy, and at completion of landscaping interpretive signs are to be installed.	Signs @150 each	Sign	6	1,000
Conservation Areas A and B – drainage swale in the west				
Clearly identify the contamination containment area to the NW of	Part of project management			

Management Actions	Management details	Unit	Qty	Costs \$ (excl GST)
Conservation Area A.				
Woody weeds are to be placed in stacked windrows for erosion control and fauna habitat logs. The placement of windrows is not to be in areas requiring future earthworks.	Supervision of works using onsite equipment (\$150 per hour for supervision)	hr	100	15,000
Conservation Areas A and B – drainage swale in the west				
Monitoring success of stormwater management including the habitat frog ponds and associated research.	Frog specialist and EM (\$200 per hour) extent of works depends on weather, water quality and colonisation rates by frogs.	hr	Assumed estimate	15,000
Total				\$620,500

Appendices

Appendix 1

Examples of Major projects designed and implemented by Anne Clements & Associates

Saltmarsh restoration adjoining Parramatta River

Client: Thiess Constructions

The conservation of the expanded saltmarsh, including the population of *Wilsonia backhousei* at Ermington, is important for the long-term viability of saltmarsh within NSW. The work undertaken for this project includes:

- Flora assessment of the saltmarsh
- Determining the extent and frequency of natural inundation by saline tidal waters
- Identification of potential rehabilitation resources
- Designing with the engineers the dual seawall enclosing the enlarged area of saltmarsh that allows for tidal inundation (which is enhanced by RiverCat wake) as well as protecting the development area from erosive river action
- Supervision of earthwork
- Translocation of saltmarsh using excavator bucket and bobcat mounted tree spade as well as hand transplants of saltmarsh species
- Supervision of bush regeneration
- Monitoring success
- Presentation of results to local community and at professional conferences.



Settlement Shores, Port Macquarie

Client: Port Shores Pty Ltd

Ensuring environmental compliance for a large residential subdivision developed by Port Shores Pty. Ltd. in Port Macquarie. The work undertaken for this project includes:

- Environmental Management during the construction phase of the earthworks associated with the development of residential land, embayments and conservation areas to ensure that the off site sensitive estuarine environment was not adversely impacted by discharge of treated acid sulphate waters and sediment movement
- Designing, supervision and monitoring of constructed estuarine wetland and adjoining Casuarina forest and rainforest on former dairy land
- Designing and supervision re-establish of natural landform and coastal dune vegetation on a former dredge disposal site and on-going monitoring
- Long-term monitoring any changes in sediment movement and vegetation on the nearby wetlands
- Establishment of seagrass beds within the constructed canals and embayment
- Ongoing monitoring assessment of water quality within the main canals, newly constructed embayments and in the adjoining river
- Compliance with consent conditions, including establishment of conservation offsets areas



Constructed estuarine wetlands at Settlement Shores, Port Macquarie.
Saltmarsh and mangrove ecosystems were established on excavated former grazing paddocks.

Tourist Facility, Magenta Shores

Client: Mirvac Homes

Environmental management of a large golf course/resort/housing estate development adjoining the coastal sand dunes and littoral rainforest containing the Vulnerable species *Syzygium paniculatum*.

The works involved in the project include:

- Flora assessments
- Preparation of a Habitat Restoration Plan
- Preparation of REFS for roadworks associated with the development
- Roadside vegetation survey to assess the impact of a water pipeline
- Research into re-use of the noxious weed Bitou Bush on the site as an organic additive for growing golf course grasses
- Design and implement of dune restoration works in the Coastal Protection Zone including removal of the noxious weed Bitou Bush, reshaping of dune and re-establishment of local native flora
- Preparation of an experimental design and monitoring program to assess the potential effects (if any) that the development may have on the population of *Syzygium paniculatum* (Magenta Lilly Pilly) that occurs on or adjacent to the site and development areas (including the pipeline routes);
- Full-time environmental officer on Site to supervise and monitor construction works to ensure compliance with environmental conditions

Dune reshaping works at Magenta Shores

**Wind eroded landform of
foredune with Bitou**



**Reconstructing dune and
sediment erosion measures**



Replanted foredune

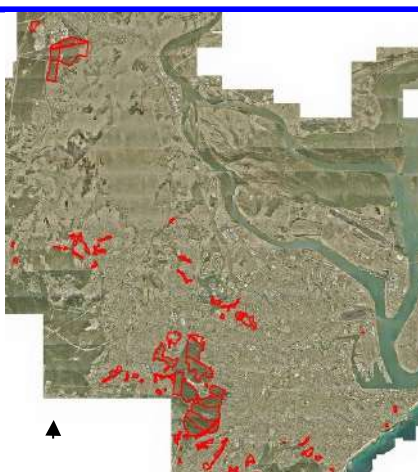


Bushland Asset Management Plan

Client: Newcastle City Council

Flora and conservation significance of Newcastle bushland assets were assessed to assist Council in developing a strategy to improve bushland quality and to enable Council to target its resources. The works for approximately 100 Council selected bushland reserves and parks included:

- Review of previous surveys, published literature and aerial photographs
- Categorisation of areas based on geology, soil landscape mapping, park size, bushland patch size, connectivity to other bushland patches
- Development of standardised survey methods with data-collection forms for the study and future monitoring
- Flora assessment using data collected from 209 plots (0.04 ha in size with at least one plots per reserve or park). Data were consistent with the Lower Hunter and Central Coast regional study
- Providing Council with an updated and a Newcastle focused database with information added as Geographic Information System layers to the existing Council database
- Determining the extent of weed invasion through survey and aerial photograph interpretation
- Development of a strategy to identify and rank bushland in need of assisted regeneration
- Preparation of a Bushland Asset Management Plan with recommendations for each bushland parcel surveyed
- Workshop participation, presentations, discussion and collaboration with Council staff.



Bushland reserves and parks surveyed in Newcastle LGA



Survey location in Blackbutt Reserve



Bushland in George McGregor Park on Killingworth Soil Landscape

Appendix 2.

Seed availability for native species recorded onsite or nearby

Seed availability for native species recorded on site (Benson and McDougall 1995, 1996, 1998, 1999, Ralph 1994, Greening Australia's Factsheets)

	Flowering times	Seed availability	Reference
Native trees			
<i>Eucalyptus moluccana</i>	Feb – Mar, Jun – Jul, variable	Sheds at maturity, Mar – Sep	Part 6 (Benson and McDougall)
<i>Eucalyptus tereticornis</i>	Sep – Nov	Matifies Jun – Nov, retained on tree till probably mid Nov.	Part 6 (Benson and McDougall)
<i>Acacia parramattensis</i>	Nov – Feb (rarely to Apr), peak Dec – Jan	Nov – Jan	Part 4 (Benson and McDougall)
Native shrubs			
<i>Acacia falcata</i>	May–June.	November–December.	Part 4 (Benson and McDougall)
<i>Acacia fimbriata</i>	Jul - Oct	Nov – Jan	Part 4 (Benson and McDougall)
<i>Acacia floribunda</i>	July–September, peak August.	November–December	
<i>Acacia implexa</i>	Dec – Apr	No timing listed	Part 4 (Benson and McDougall)
<i>Acacia linifolia</i>	Jan – Aug	Oct – Dec	Part 4 (Benson and McDougall)
<i>Bursaria spinosa</i>	No timing listed	No timing listed	Part 7a (Benson and McDougall)
<i>Daviesia genistifolia</i>	August–October.	October–November.	Part 4 (Benson and McDougall)
<i>Dillwynia sieberi</i>	April–November	December	Part 4 (Benson and McDougall)
<i>Eremophila debilis</i>	Summer but spasmodic flowering may occur at other times	Feb – Mar	Greening Australia
<i>Indigofera australis</i> (not recorded onsite)	Aug – Nov (readily established and forms a living seedbank)	Mature Nov – Jun, peak Dec	Part 4 (Benson and McDougall)
Native grasses and graminoids including			
<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Oct - Nov	Late Jan - late Feb	Greening Australia
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Oct - Nov	Late Jan - late Feb	Greening Australia
<i>Lomandra multiflora</i>	Jun – Nov	Oct - Mar	Greening Australia flowering – Ralph (1994) Seeding
<i>Themeda australis</i>	No timing listed	Late Dec – Feb	Ralph (1994) (Benson and McDougall)
Native forbs			
<i>Dianella longifolia</i>	Oct – Dec	Late Oct - Jan	Greening Australia

	Flowering times	Seed availability	Reference
<i>Dichondra repens</i>	Sep – Feb	No timing listed	Part 3 (Benson and McDougall)
<i>Einadia hastata</i>	Winter	March	Part 3 (Benson and McDougall)
<i>Einadia nutans</i> subsp. <i>linifolia</i>	Any time	Aug – Apr	Part 3 (Benson and McDougall)
<i>Einadia trigonos</i>	No timing listed	No timing listed	Part 3 (Benson and McDougall)
Other			
<i>Glycine tabacina</i> (spreading and roots at nodes)	Oct – May	Oct - Jun	Part 4 (Benson and McDougall)

Benson and Mc Dougall (Ecology of Sydney Plant species. *Cunninghamia* journal) available online at <https://www.botanicgardens.org.au/our-science/publications/cunninghamia>.

Greening Australia, *Lomandra filiformis*, accessed 7/11/23 at https://www.greeningaustralia.org.au/wp-content/uploads/2017/11/FACT-SHEET_Lomandra_filiformis.pdf

Greening Australia, *Lomandra multiflora*, accessed 7/11/23 at https://www.greeningaustralia.org.au/wp-content/uploads/2017/11/FACT-SHEET_Lomandra_multiflora.pdf

Greening Australia, *Dianella longifolia*, accessed 7/11/23 at https://www.greeningaustralia.org.au/wp-content/uploads/2017/11/FACT-SHEET_Dianella_longifolia.pdf

Greening Australia, *Eremophila debilis*, accessed 7/11/23 at https://www.greeningaustralia.org.au/wp-content/uploads/2017/11/FACT-SHEET_Eremophila_debilis.pdf

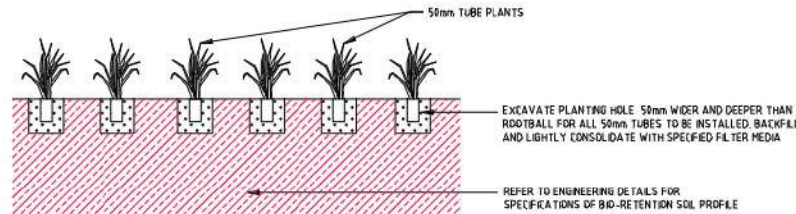
Ralph M, *Seed collection of Australian native plants: for revegetation, tree planting and direct seeding*, 2nd ed.1994, Imprenta, Fitzroy, VIC

Appendix 3.

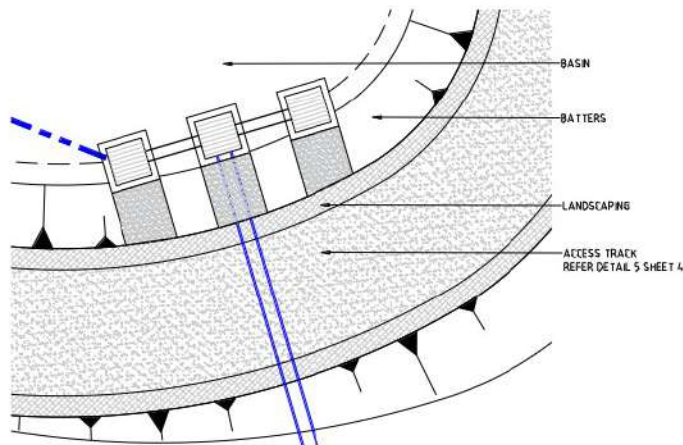
Sheet 12 of Blacktown City Council's Water Sensitive Urban Design Standard Drawings

DESIGN NOTES:

1. VEGETATION COVER IS AN ESSENTIAL FUNCTIONAL COMPONENT OF THE BIORETENTION BASIN
2. PLANTS ARE TO BE 25mm HKD CELLS OR 50mm TUBESTOCK
3. PLANTING SHOULD OCCUR NO LATER THAN 14 DAYS AFTER INSTALLATION OF THE FILTER MEDIA. AFTER PLANTING THE SOIL SHOULD BE RE-INSTATED TO A FLAT SURFACE.
4. THE PLANTS SHALL BE PLANTED AS A MATRIX ENSURING A DIVERSE COVERAGE
5. PLANTING SHOULD INCORPORATE SEVERAL TYPES OF VEGETATION INCLUDING SHRUBS AND GRASSES AND TUFTED PLANTS FROM THE PLANTING LIST.
6. A MINIMUM OF 4 DIFFERENT SPECIES IS REQUIRED FOR RAINGARDENS (>30m²), A MIN OF 6 FOR SMALL SYSTEMS <100m² & 10 OR MORE FOR LARGE SYSTEMS (>100m²)
7. PLANT ESTABLISHMENT AND WATERING IS REQUIRED FOR 12 MONTHS FROM PLANTING.
8. NO SURFACE MULCHING OF BIORETENTION BASINS IS PERMITTED.
9. NO WEED MAT OR HYDRO-MULCH IS TO BE APPLIED TO THE SURFACE OF THE BIORETENTION BASIN FOLLOWING THE CONSTRUCTION PHASE I.E. IN ITS FINAL DESIGN FORM. VEGETATED AS PER PLANTING SCHEDULE, AS THIS WILL HINDER FILTRATION OF STORMWATER THROUGH THE FILTER MEDIA. JUTE MATTING IS PERMITTED.
10. <2% OF COVERAGE SHALL COMPRISE OF THE PLANTS MARKED WITH ***
11. PLANTS FROM THE PREFERRED PLANTING LIST SHALL BE PLANTED IN PREFERENCE TO PLANTS FROM THE ALTERNATIVE PLANTING LIST. PLANTS FROM THE ALTERNATIVE PLANTING LIST CAN BE USED WHERE PREFERRED PLANTS ARE COMMERCIALY UNAVAILABLE.
12. PLANTING SHALL IDEALLY OCCUR FROM OCTOBER TO MARCH TO IMPROVE VIABILITY OF JUVENILE PLANTS.
13. ALL PLANTS SHALL BE HARDENED PRIOR TO PLANTING.
14. SOME PLANTS MAY NOT BE AVAILABLE COMMERCIALY & MAY NEED TO BE GROWN FROM SEED. THIS CAN TAKE UP TO 12 MONTHS. PLANNING OF PLANTING STAGE SHALL TAKE LONG LEAD IN TIMES INTO ACCOUNT.
15. THE FINAL PLANTING LIST SHALL BE APPROVED BY COUNCIL.



DETAIL 17
TYPICAL PLANTING
NTS



PLAN 8
BIORETENTION PLANTING ZONES
NTS

PREFERRED PLANTING LIST

COMMON NAME	SPECIES	TYPE OF VEGETATION	PLANT DENSITY PER m ²	PLANTING ZONE (REFER PLAN 8)
Tall Sedge ***	<i>Carex appressa</i>	Tufted short rhizomatous, 1.2 h	8-10	Basin
Blue Flax-Lily	<i>Dianella revoluta</i>	Tufted perennial herb, 1 h	8-10	Basin
Wallaby Grass ***	<i>Rytidosperma tenuior</i> , <i>Austrodanthonia tenuior</i> , <i>Danthonia tenuior</i>	Tufted perennial grass, 1.2 h	8-10	Basin
Common Rush ***	<i>Juncus usitatus</i>	Tufted short rhizomatous, 1 h	8-10	Basin
Kangaroo Grass ***	<i>Themeda triandra</i> , <i>Themeda australis</i>	Densely tufted leafy perennial, 1.2 h	8-10	Basin
Knobby Club Rush ***	<i>Ficinia nodosa</i>	Rhizomatous perennial, 1 h	8-10	Basin
Eskdale, Tussock Grass	<i>Poa labillardieri</i>	Densely tufted perennial grass, 0.6 h	8-10	Basin
Gorse Bitter Pea	<i>Daviesia ulicifolia</i>	Small shrub, 2 h	1 per 2 m ²	Basin & Batters
Pink Honey Myrtle	<i>Melaleuca erubescens</i>	Hard, rough barked shrub, 2 m	1 per 2 m ²	Basin & Batters
Blueberry Lily	<i>Dianella longifolia</i>	Perennial rhizomatous tufted herb, 1 h	8-10	Batters & Landscape
Wattle Mat-rush	<i>Lamandra filiformis</i>	Perennial tussock, 0.5 h	8-10	Batters & Landscape
Tanika, Spiny Mat-rush	<i>Lamandra longifolia</i>	Perennial weeping tussock, 0.7 h	8-10	Batters & Landscape
Weeping Grass	<i>Microlaena stipoides</i>	Slender, tufted perennial grass, 0.7 h	8-10	Batters & Landscape
Pale Rush	<i>Juncus pallidus</i>		8-10	Basin
Sea Rush	<i>Juncus kraussii</i>	Tussock, rhizomatous perennial, 1 m	8-10	Basin
N/A	<i>Lachnagrostis filiformis</i>	Erect perennial grass, 0.7 h	8-10	Basin
N/A	<i>Lachnagrostis billardieri</i>	Erect perennial grass, 0.7 h	8-10	Basin
Chaffy Saw-sedge	<i>Gahnia filum</i>	Tussock forming perennial, 1 h	8-10	Basin
N/A	<i>Cyperus polystachyos</i>	Tufted perennial, short rhizome, 0.6 h	8-10	Basin
N/A	<i>Austrostipa stipoides</i>	Tufted perennial grass, 1.2 h	8-10	Basin
Tassel Sedge	<i>Carex fascicularis</i>	Tufted rhizomatous perennial, 1 h	8-10	Basin
Swamp Foxtail Grass	<i>Pennisetum alopecuroides</i>	Clumping tussocks perennial, 1.5 h	8-10	All
N/A	<i>Baloskion / Restio pallens</i>	Dioecious perennial herb, 1 h	8-10	Basin
N/A	<i>Schoenoplectus mucronatus</i>	Tufted perennial, 1 h	8-10	Basin
Marsh Clubrush	<i>Bolboschoenus fluviatilis</i>	Rhizomatous tufted perennial, 2.5 h	8-10	Basin
N/A	<i>Bolboschoenus coldwellii</i>	Rhizomatous tufted perennial, 1 h	8-10	Basin

THE PLANTS IN THIS LIST HAVE BEEN SELECTED SPECIFICALLY FOR WESTERN SYDNEY CONDITIONS BY HUNTER & SAINTY. h REFERS TO MATURE HEIGHT (m)

ALTERNATIVE PLANTING LIST

COMMON NAME	SPECIES	TYPE OF VEGETATION	PLANT DENSITY PER m ²	PLANTING ZONE (REFER PLAN 8)
Corkscrew Grass	<i>Austrostipa setacea</i>	Tufted perennial grass, 0.8h	8-10	Basin
Barbed Wire Grass	<i>Cymbopogon refractus</i>	Tufted perennial grass, 1 h	8-10	Basin
Shorthair Plume Grass	<i>Dichelachne micrantha</i>	Tufted perennial grass, 1.2 h	8-10	Basin
Forest Hedgehog Grass	<i>Echinopogon ovatus</i>	Rhizomatous perennial, 1.2 h	8-10	Basin
Wiry Panic Grass	<i>Entolasia stricta</i>	Shrubby rhizomatous perennial, 0.8 h	8-10	Basin
Paddock Lovegrass	<i>Eragrostis leptostachya</i>	Loosely tufted perennial, 1 h	8-10	Basin
Hop Goodenia	<i>Goodenia ovata</i>	Erect, ascending or prostrate shrub, 2 h	1 per 2 m ²	Basin & Batters
Sticky Hop Bush	<i>Dodonaea viscosa</i>	Small shrub to tree, 8 m	1 per 2 m ²	Batters & Landscape
N/A	<i>Cyperus laevigatus</i>	Rhizomatous perennial, 0.6 h	8-10	Basin
Queensland Bluegrass	<i>Dichanthium sericeum</i>	Tufted warm season perennial, 1.2 h	8-10	Basin

				Blacktown City Council				12 OF 25	
PREPARED BY:		PUBLIC UTILITIES LEGEND		DATE: 17 FEB 17		APPROVED: [Signature]		PROJECT TITLE: WSUD STANDARD DRAWINGS	
BY:		WATER MAINS: BAS VALVE, 50mm VALVE, WATER METER, WATER TAP, SEWER, SEWER LAMP/POLE, SEWER MANHOLE		TYPED: A1		DATE: 17 FEB 17		SHEET TITLE: BIORETENTION - LANDSCAPING	
O: DEC 17		BAS VALVE		SHEET 1 OF 1		DATE: 17 FEB 17		CADD FILE: A(BS)175M.dwg	
C: FEB 17		50mm VALVE		TITLES BLOCK: A		DATE: 17 FEB 17		FILE NO: N/A	
I: DEC 16		ELECTRICITY PIT		TITLES BLOCK: A		DATE: 17 FEB 17		PLAN NO: A(BS)175M	
A: MAY 16		POWER POLE		TITLES BLOCK: A		DATE: 17 FEB 17		REV: D	
REV: DATE		LIGHT POLE		TITLES BLOCK: A		DATE: 17 FEB 17			
		STAY POLE		TITLES BLOCK: A		DATE: 17 FEB 17			

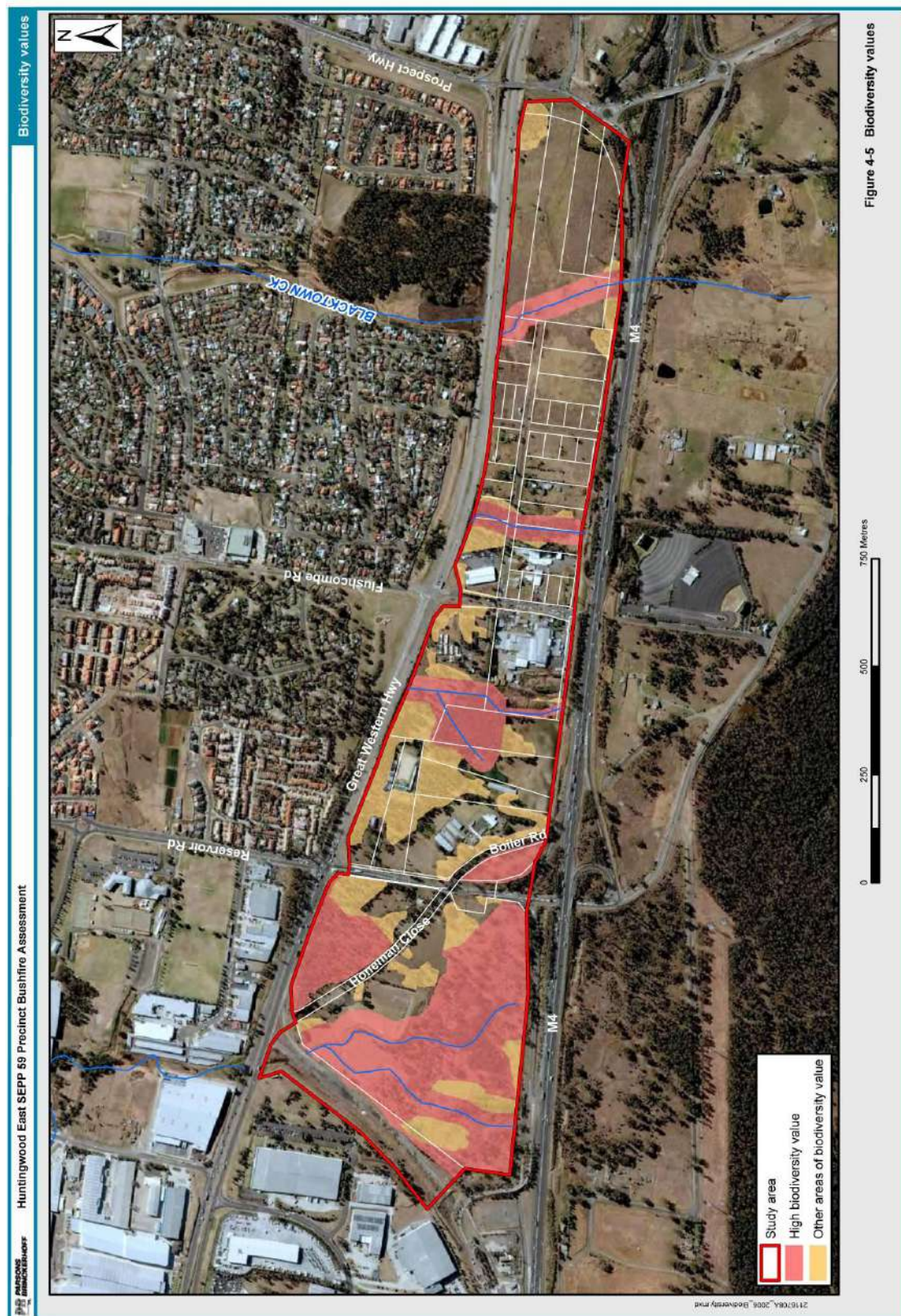
Appendix 4

Figures 13 and 14 from Huntingwood Precinct DCP

Figure 13 – Vegetation conservation significance



Figure 14 – Biodiversity values



Appendix 5.

**Huntingwood frog survey outcomes and habitat suitability for microbats with
recommendations for habitat restoration for threatened fauna (Grant Webster and
Jayden Walsh 2022)**

**Huntingwood Frog Survey Outcomes and
Habitat Suitability for Microbats with
Recommendations for Habitat Restoration for Threatened Fauna**

Date: 24 August 2022



Prepared by: Grant Webster and Jayden Walsh

Prepared for: Anne Clements & Associates

Table of Contents

1.0 Introduction.....	3
1.1 Previous surveys.....	3
2.0 Survey effort and methodology for the current survey.....	3
3.0 Survey results.....	4
4.0 Habitat suitability and likelihood of occurrence of threatened species.....	4
4.1 Green and Golden Bell Frog.....	4
4.2 Microbats.....	5
4.3 Other threatened fauna species.....	5
5.0 Habitat reconstruction / restoration.....	6
5.1 Existing habitat.....	6
5.2 Key fauna species for habitat reconstruction / restoration.....	7
5.3 Reconstruction / restoration areas.....	7
5.3.1 Woodlands.....	7
5.3.2 Blacktown Creek riparian corridor.....	7
Acknowledgements.....	11
References.....	11
Appendix 1. Details of authors.....	12
Appendix 2. Daily survey effort.....	12
Appendix 3. Survey date climatic conditions	13
Appendix 4. Fauna species detected onsite	14
Appendix 5. Site photographs.....	15

Table of Figures

Figure 1.	Site location
Figure 2.	Records of Green and Golden Bell Frog (blue circles) in close proximity to the site with the dates of the records labelled
Figure 3.	Records of Green and Golden Bell Frogs (blue circles) in the broader area with the dates of the records labelled
Figure 4.	Records of Southern Myotis (blue circles) in the broader area around the site.
Figure 5.	Historic aerial photograph of the site in 1956
Figure 6.	Sketch of proposed permanent and ephemeral ponds with direct connectivity to Blacktown Creek.

List of Tables

Table 1.	Threatened microbat species records within 10 km of the site
Table 2.	Threatened fauna species records in the vicinity of the site (within a 10 km radius)
Table 3.	Key fauna species for habitat reconstruction / restoration
Table 4.	Suitable plant species for restoration plantings within the conservations areas.
Table 5.	Aquatic and fringing vegetation suitable for Green and Golden Bell Frogs that is recommended for planting within and around the proposed permanent and ephemeral ponds (Beranek et al 2020).

Front cover image: Green and Golden Bell Frog. Photo by Grant Webster

1.0 Introduction

This report has been prepared to assess the presence of and habitat suitability for threatened fauna species in particular the Green and Golden Bell Frog (*Litoria aurea*) and the Southern Myotis (*Myotis macropus*) along Blacktown Creek on the Huntingwood site in Blacktown City Local Government Area. This report also provides advice on habitat restoration for threatened species with a likelihood of local occurrence.

The approximately 27 ha site is located west of the Prospect Highway between the Great Western Highway and the M4 Motorway and accessed via Augusta Street. The 1st Order watercourse Blacktown Creek flows through the site from south to north (**Figure 1**).

It is an approximately 270 m wide strip of former agricultural land, highly degraded and largely cleared of native vegetation. The riparian corridor associated with Blacktown Creek is heavily overgrown with native and exotic vegetation leaving little open water.

1.1 Previous surveys

Ecoplaning (2020) in their Biodiversity Development Assessment Report for a previous development application considered:

- Green and Golden Bell Frog as a candidate species for the subject site. The species was assumed to be present due to Blacktown Creek being considered to have characteristics of suitable habitat for Green and Golden Bell Frog. Its presence was not confirmed by targeted survey;
- Southern Myotis as a candidate species for the subject site and assumed present as the 18 targeted survey nights (two ultrasonic detectors over 9 nights from 8-17th April 2020) were outside the allowable survey period for the species.

Ecoplaning (2020) in their targeted microbat survey recorded a *total of seven microchiropteran bat species from calls within and near the site, including three species listed as vulnerable under the BC Act (Little Bent-winged Bat, Large Bent-winged Bat, Eastern Coastal Free-tailed Bat)*.

2.0 Survey effort and methodology for the current survey

The approximately 300 m stretch of the Blacktown Creek riparian corridor was surveyed for the presence of Green and Golden Bell Frog and the site was assessed for habitat suitability for the Southern Myotis and other threatened microbat species. Other fauna species detected during the surveys were noted and opportunistic searches for threatened birds were also conducted.

Surveying consisted of nocturnal aural-visual spotlighting as well as diurnal habitat searches on four separate nights over February and March 2022 for 2-3 hours per night by Jayden Walsh, accompanied by Joelan Sawyer on one of these nights (see Appendix 2 for daily survey effort and Appendix 3 for associated climatic conditions).

Total survey effort (>480 mins/~300 m transect) exceeded that required for Green and Golden Bell Frogs according to the NSW Guidelines which recommend four surveys and at least 288 mins of survey time for a 300 m transect (NSW DPIE, 2020). The NSW guidelines also require surveys to be conducted between November and March (NSW DPIE, 2020) but do not state specific environmental conditions necessary for surveying.

The Green and Golden Bell Frog species profile (OEH, 2017) states *the species is active by day and usually breeds in summer when conditions are warm and wet*.

The targeted survey was undertaken at a suitable time with favourable conditions for species detection and breeding activity, including recent rainfall and warm temperatures and with one of the surveys following a flood.

3.0 Survey results

Common fauna species, generally typical of the region, were detected on the site (listed in Appendix 4), namely:

- 24 bird species (21 native and three exotic) including Australian Reed-Warbler, listed as “Marine” on the EPBC Act being recorded in dense reeds of the riparian corridor;
- two frog species, Common Eastern Froglet and Striped Marsh Frog;
- three reptiles, Eastern Brown Snake, Dark-flecked Sunskink and Pale-flecked Sunskink; and
- two mammals, Eastern Grey Kangaroo and European Rabbit.

The Green and Golden Bell Frog was not detected during the current targeted survey.

4.0 Habitat suitability and likelihood of occurrence of threatened species

4.1 Green and Golden Bell Frog

In the current targeted survey along Blacktown Creek riparian corridor, it was found that there was a lack of suitable habitat, in the form of open and pooling water. It is unlikely that this species would utilise the site for breeding.

Further, given the species was not detected over the course of the February-March 2022 surveys, it is unlikely that the species occurs on the site or that the site forms an important area for the species.

Green and Golden Bell Frogs are now very rare in Western Sydney and despite some relatively close records to the site, none of these records are more recent than the 1960s (**Figure 2**).

The closest more recent records from the broader area are from 1998-1999 in the Guildford-Holroyd region and are along a different creek system from Blacktown Creek (**Figure 3**). The most recent record in the broader area is from 2012 at Tregear about 12 km from the site and again along a separate creek system (**Figure 3**). According to the Draft Recovery Plan for this species a population persists at Holroyd Gardens (approximately 9km from the site)

but it is highly unlikely that frogs would be able to disperse from this population to the site given the dense urbanisation between these locations.

It is unlikely that Green and Golden Bell Frogs still persist in the immediate vicinity of the site (within about 5km of the site). However, if a population of the species does still occur undetected in the vicinity, perhaps in very low density, the site would at best currently provide only marginally suitable habitat. This degraded creek corridor is limited to potential foraging habitat and could possibly enable dispersal across the landscape by providing sheltering habitat amongst aquatic vegetation as well as access to water.

As part of a sustainable development, restoration of breeding habitat for Green and Golden Bell Frog is being proposed (details below).

4.2 Microbats

There are eight species of threatened microbats with records within 10 km of the site (**Table 1**). The Eastern Coastal Free-tailed Bat, Southern Myotis, Eastern False Pipistrelle, Greater Broad-nosed Bat, Little Bent-winged Bat and Large Bent-winged Bat are recorded particularly close to the site (within approximately 3 km). Ecoplaning (2020) recorded three of these microbat species within and near the subject site (Little Bent-winged Bat, Large Bent-winged Bat, Eastern Coastal Free-tailed Bat).

There are numerous nearby records of the Southern Myotis (**Figure 4**) particularly around Prospect Reservoir to the south of the site and along Eastern Creek to the north-west of the site.

Suitable roosting habitat for microbats exists on / adjacent to the site in the form of a culvert as well as dead / potential hollow bearing trees and possibly infrastructure (buildings etc) in the immediate vicinity (photos in Appendix 4). Along Blacktown Creek within the site, there is reduced habitat suitability for Southern Myotis due to the lack of open water (i.e., foraging space). However, given the records in close proximity and suitability of the culverts for roosting, occurrence of, and utilisation of the site by Southern Myotis is moderately likely.

The site may also provide potential foraging/dispersal or roosting habitat for the Yellow-bellied Sheath-tail-bat, and the Greater Broad-nosed Bat, it is also possible that these species could occur on or utilise the site. Due to the lack of suitable more extensive areas of forest or woodland on the site, occurrence of the Large-eared Pied Bat and Eastern False Pipistrelle is unlikely.

As part of a sustainable development, restoration of microbat habitat is being proposed in particular, foraging habitat for Southern Myotis (details below).

4.3 Other threatened fauna species

A total of 28 threatened fauna species have been recorded in the vicinity of the site (10 km radius) (**Table 2**).

In its current state, the site provides little opportunity for other threatened species with the exception of Grey-headed Flying-fox and some woodland bird species (e.g. Swift Parrot, Little Lorikeet and Dusky Woodswallow) which may forage among remnant trees and woodland patches on the site.

The Grey-headed Flying-fox and Dusky Woodswallow are likely to occur on and utilise site, while the Swift Parrot and Little Lorikeet are moderately likely to occupy the site when flowering eucalypts provide valuable food resources. All of these species are either migratory or nomadic in their behaviour and move between areas of suitable habitat within their range.

5.0 Habitat reconstruction / restoration

5.1 Existing habitat

The proposed industrial subdivision is on the former productive agricultural land, which included market gardens with houses and sheds. With urban expansion, the agricultural activities decreased over time and now have ceased on the site. Inferred by aerial photographs, the land use changes have been the following:

Year	Observed from aerial photographs
1956	Farming activities with dam offsite to the north of the site;
1965	The high voltage pylons installed in the south of the site;
1970	The Great Western Highway built along the northern boundary, agriculture decreasing east of Blacktown Creek onsite, but intensifying west of the creek;
1986	Market gardens having ceased onsite; and
1991	The Western Motorway (M4) being built to the south of the site.

The aerial photo from 1956 (**Figure 5**) shows roughly the same extent of native vegetation and cleared land on the site as the present day with some losses of native woodland remnants on neighbouring land since 1956.

In terms of breeding habitat for Green and Golden Bell Frog, there were visible sections of open and pooling water suitable for breeding along Blacktown Creek in 1956, which are no longer present.

Habitat value along Blacktown Creek is presently significantly reduced for most stream-dwelling fauna. Invasion of the exotic *Juncus acutus* (Sharp/Spiny Rush) has resulted in a loss of open water that receives direct sunlight and water bodies being no longer deep enough for Green and Golden Bell Frog tadpoles to complete development.

The large stand of *Juncus acutus*, however, currently supports a population of the 'marine' protected Australian Reed-Warbler (*Acrocephalus australis*) (EPBC Act). Proposed riparian corridor works need to minimise impact upon this species and other wetland birds potentially present such as Bitterns, Crakes and Rails.

5.2 Key fauna species for habitat reconstruction / restoration

There are a number of threatened fauna species that have been recorded within the vicinity of the site that are likely to benefit from habitat reconstruction / restoration on the site (see Table 3).

5.3 Reconstruction / restoration areas

5.3.1 Woodlands

The woodland conservation areas largely cover existing treed land in the west of the site. Mature eucalypt trees are to be retained where practicable in these areas to provide important foraging resources for microbats and birds as well as potential hollows and anchor points for nest boxes.

Restoration efforts within these conservation areas focus on progressively replacing weeds with local native vegetation.

5.3.2 Blacktown Creek riparian corridor

Background

This is the largest of the conservation areas for the site and covers the riparian zone of Blacktown Creek, closely following the creek corridor and extending at least 10 m beyond the top of bank. This will potentially benefit the Green and Golden Bell Frog, which was formerly very common and widely distributed across much of coastal NSW including the Cumberland Plain.

The species declined severely following the global spread of the amphibian chytrid fungus, among other existing pressures such as land clearing and habitat modification. Additionally, *Gambusia holbrooki* (Mosquito Fish) pose a significant threat to tadpole mortality. For an effective wetland habitat construction these factors need to be considered and accounted for.

Best practice management involves a matrix of ephemeral and permanent water sources, saline influence and earthen bund walls (Klop-toker et al, 2017; Beranek et al, 2020; Klop-toker et al, 2021).

This wetland/creek restoration proposal is consistent with habitat known to support extant Green and Golden Bell Frog populations and restored wetlands occupied by this species (Beranek et al 2020). For example, Klop-toker et al. (2021) found that ideal Green and Golden Bell Frog habitat *included a mosaic of permanent and ephemeral ponds, increased salinity in a subset of ponds, fencing to exclude predators and prevent L. aurea dispersal, and rock piles for shelter.*

Wetlands should also be constructed to have a short hydro-period where chytrid fungus zoospores are eliminated due to desiccation (Scheele et al. 2015); this will also prevent the establishment of large populations of Mosquito Fish. This is achievable at the site, by establishing ephemeral ponds and also by incorporating inflow/outflow drains into the

earthen bunds of the ponds that allow for the mechanical regulation of water level and filling/draining of all the proposed ponds in the riparian zone.

If run-off/discharge or detention basin ponds are proposed as part of the development, then these could potentially be formed into additional wetlands suitable for Green and Golden Bell Frogs and other fauna. These are to be planted with aquatic vegetation and landscaping of the surrounding area should utilise native vegetation species proposed for planting in the riparian corridor.

Water from these detention basins could potentially be used to help regulate water level during droughts in the permanent ponds proposed as part of the Blacktown Creek riparian corridor reconstruction / restoration. Further, water from detention basins could be used to periodically inundate the proposed ephemeral ponds in the riparian corridor during drier periods to provide additional available breeding habitat for frogs, and foraging habitat for wetland birds, when environmental conditions are otherwise not conducive to natural inundation of these ponds.

An off-line matrix of four or five ponds with direct connectivity to Blacktown Creek is proposed within the riparian corridor, below the top of bank (**Figure 6**). This will consist of at least two ephemeral and two permanent ponds with bund walls controlling water flow, allowing for the inundation of the ephemeral wetlands during flood events and the regulating of water level in the permanent ponds. A matrix of permanent and ephemeral ponds allows for frog populations to persist during droughts, where the permanent ponds form refugia, while during wetter periods ephemeral ponds are likely to be favoured for breeding.

At a minimum, both an ephemeral and a permanent pond should be >20 m long each, with the permanent pond >10 m wide and the ephemeral pond >5 m wide. The other two ponds may be smaller, both approximately 10 m long by 5 m wide. Depths will be dependent upon nature of water body, and should be 1.1–1.9 m deep for permanent ponds and 0.3–0.7 m deep for ephemeral ponds (Pyke & White, 1996; Beranek et al, 2020). All ponds should be slightly deeper at the end where water inflows from the creek (Pyke & White, 1996), with capacity to drain/overflow from the shallow end. Water inflow access and drainage/overflow channels, with associated mechanisms for regulating pond water level, need to be constructed within and on the bund walls in direct contact to the closest upstream and downstream flowing section of the creek respectively.

All ponds need to be surrounded on every bank with a constructed bund, being an elevated earthen wall that sits >0.6 m and >1.2 m above the respective maximum water levels of the ephemeral and permanent ponds (Beranek et al 2020), and at least 1 m higher than the maximum water level of the creek (i.e. during flood events). The bunds should be roughly 3.5 m wide and can be created from material excavated during pond construction, and compacted for stability (Beranek et al 2020). Bunding is necessary to prevent the predatory exotic Mosquito Fish (*Gambusia holbrooki*) from entering the ponds during floods (Chapman & Kramer, 1991; Kerezszy, 2015).

Within the appropriate bund walls, regulated water inflow and outflow access points need to be constructed to allow water to flow in from Blacktown Creek and be drained back into the creek as required. On the bund wall containing the outflow access, an additional above

ground, gently sloping, overflow “spillway” needs to be constructed in the event that extreme rainfall causes the pond water level to reach the top of the bund.

The access (i.e. inflow) points need to be well below the normal or average water level of the creek (i.e. close to the streambed) for the permanent ponds, and well above the normal water level but below the maximum/ “flood” level for ephemeral ponds. The inflow access then connects to the pond entry point, best located just above the bottom of the bund near where it joins the base of the pond, allowing the ponds to fill from the deepest point. The outflow point within the ponds must to be located at the pond base, where it joins the bottom of the bund, with the exit point into the creek located below the normal creek water level.

Valves to open and close the water access points need to be installed so pond water level can be regulated, with valve filters fitted at inflow (creek side) and outflow (pond side) points to prevent Mosquito Fish entering the ponds.

Once constructed, the bunds can be vegetated with local native groundcover species.

As water salinity has an important influence on the persistence of Green and Golden Bell Frog populations, a salinity of 2 ppt in the proposed large permanent pond at the northern end of the site and 4 ppt in the smaller proposed permanent pond is recommended. Salinity of the ephemeral ponds should be lower, ideally between 1 and 2 ppt. Salinity should never exceed 9 ppt in any of the ponds.

Pond salinity can be regulated either by:

1) physically adding rock salt (NaCl) into the pond (while concurrently measuring pond salinity) to reach the desired salt concentration (Stockwell et al 2014; Klop-toker et al, 2017); or

2) digging deep enough or boring a hole within the base of the pond to intersect the water table, allowing groundwater to enter the pond and increase salinity (Beranek et al 2020).

For the proposed ephemeral ponds, adding rock salt post inundation would be a practical way to regulate salinity level, especially as lower salt concentration is recommended for these ponds. Adding rock salt to the proposed permanent ponds could also be used to regulate or alter salt levels in these water bodies, however depending on the depth of the water table, boring to allow groundwater to mix with the pond water may be a better method of maintaining salinity in the long term (particularly as these ponds are intended to be permanent water sources).

Monitoring salt concentration could be achieved by taking measurements with a salinity meter or installing data loggers, the latter being more practical for the permanent water bodies. From the salinity report for the site (PSM letter, dated 22 March 2022) the concentrations of chlorides in soil samples varied from less than 50 mg/kg to 830 mg/kg, it is likely that the natural groundwater is slightly saline.

Table 4 provides a list of suitable aquatic and fringing vegetation for Green and Golden Bell Frogs that is recommended for planting within and around the proposed permanent and ephemeral ponds. Species such as *Phragmites australis* and *Typha* spp. should be mostly avoided in plantings given their tendency to quickly colonise water bodies and reducing the amount of open water (Pyke & White, 1996; Beranek et al 2020), however actively facilitating

Typha domingensis to naturally colonise some sections of Blacktown Creek as a replacement for existing *Juncus acutus*, that will be removed, is important to ensure the local population of Australian Reed-Warblers persists.

Trees should not be planted close enough to the proposed ponds that they would shade or overhang any of the pond area (Pyke & White, 1996). Rather, tree planting along the riparian corridor should occur along sections of Blacktown Creek away from the proposed ponds, and higher up the bank. Maintaining sections of unshaded, open water will benefit both Green and Golden Bell Frogs and Southern Myotis.

Other habitat features, such as logs and rock piles should be placed around the perimeter of the deeper ends of the ponds in order to provide overwintering and sheltering habitat for Green and Golden Bell Frogs (Pyke & White, 1996; Klop-toker et al 2021).

Rock piles along the pond perimeter should extend for 2–3 m and range from at least 1 m below and up to 5 m above the water level of the pond when full (Pyke & White, 1996).

In brief

As part of creek reconstruction / restoration works, open and pooling water ponds are designed to provide breeding habitat for the Green and Golden Bell Frog and to minimise the risks of:

- Amphibian Chitrid fungus by use of permanent and ephemeral ponds; and
- Predation of Green and Golden Bell Frog tadpoles by *Gambusia holbrooki* (Mosquito Fish) by encouraging the threatened fishing bat, Southern Myotis. This bat's diet includes *Gambusia holbrooki*.

Southern Myotis requires unimpeded flight paths over open water with a glide slope of approximately 3 m on approach to these open ponds. The restoration works incorporate flight paths along Blacktown Creek for both bats and birds.

The ponds will include at least:

- two permanent (at least 20m x 10m & 10m x 5m), depth 1.1-1.9m;
- two ephemeral (20m x 5m & 10m x 5m), depth 0.3-0.7m; and
- Rock piles/logs for shelter.

These ponds are being designed by the hydro engineer to meet the requirements of the Green and Golden Bell Frog as part of the water management for the proposal.

Tree plantings within this riparian zone are to be away from the constructed ponds so that they will not shade or overhang the ponds when mature.

Acknowledgements

We wish to thank Chad Beranek for his helpful discussions on Green and Golden Bell Frog designs and his research findings on the implementation of reconstruction of habitat ponds at Ash Island in the Kooragang Wetlands in Hunter Wetlands National Park.

We would also like to thank Joelan Sawyer with assistance with field survey.

References

Beranek, C. T., Clulow, J. & Mahony, M. (2020) Wetland Restoration for the Threatened Green and Golden Bell Frog (*Litoria aurea*): Development of a Breeding Habitat Designed to Passively Manage Chytrid-Induced Amphibian Disease and Exotic Fish. *Natural Areas Journal*, 40(4): 362-374.

Chapman, L. J. & Kramer, D. L. (1991) The consequences of flooding for the dispersal and fate of poeciliid fish in an intermittent tropical stream. *Oecologia*, 87: 299-306.

Ecoplanning (2020) Biodiversity Development Assessment Report– Augusta Street, Huntingwood. Final v1.3. Prepared for EMKC Australia C/O Air Trunk.

Kerezszy, A. (2015) Development of a technique for quarantining Great Artesian Basin springs from colonisation by the invasive fish eastern gambusia (*Gambusia holbrooki*). *Ecological Management & Restoration*, 16: 229-232.

Klop-Toker, K. L., Valdez, J. W., Stockwell, M. P., Edgar, M. E., Fardell, L., Clulow, S., Clulow, J. & Mahony, M. J. (2017) Assessing host response to disease treatment: how chytrid-susceptible frogs react to increased water salinity. *Wildlife Research*, 44: 648-659.

Klop-Toker, K., Callen, A., King, J. P., Beranek, C., Lenga, D., Valdez, J., Clulow, S., Pizzatto, L., Stockwell, M., Clulow, J. & Mahony, M. (2021) Reintroduction of green and golden bell frogs into created habitats on Kooragang Island, Australia. *Global conservation translocation perspectives*, pp.70-75.

NSW DPIE (Department of Planning, Infrastructure & Environment) (2020) NSW Survey Guide for Threatened Frogs A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method. NSW Government, vi + 43 pp.

OEH (Office of Environment & Heritage) (2017) Green and Golden Bell Frog – profile. NSW Government, accessed from: <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10483> (12 August 2022).

Pyke, G. H. & White, A. W. (1996) Habitat requirements for the Green and Golden Bell Frog *Litoria aurea* (Anura: Hylidae). *Australian Zoologist*, 30(2): 224-232.

Scheele, B. C., Driscoll, D. A., Fischer, A., Fletcher, J., Hanspach, J., Vörös, J. & Hartel, T. (2015) Landscape context influences chytrid fungus distribution in an endangered European amphibian. *Animal Conservation*, 18: 480-488.

Stockwell, M. P., Storrie, L. J., Pollard, C. L., Clulow, J. & Mahony, M. J. (2014) Effects of Pond Salinization on Survival Rate of Amphibian Hosts Infected with the Chytrid Fungus. *Conservation Biology*, 29(2): 391-399.

Appendix 1. Details of authors

Name	Position	Tasks performed include	Relevant qualifications
Grant Webster	Fauna Ecologist	- Report preparation, - Data analysis; - Research.	B.Sc (Hons) in Biology and a M.Res in Science. Grant graduated from his Masters degree in 2017, with a project studying the geographic variation in the frogs <i>Pseudophryne bibronii</i> and <i>P dendyi</i>. Grant is currently completing his PhD on the conservation and ecology of the threatened frog species, Mahony's Toadlet.
Jayden Walsh	Ecologist	- Field survey, - data collection - photography	Experienced naturalist with a B.Sc from Macquarie University

Appendix 2. Daily survey effort

07/02/22 – 7-9:45pm - JW

08/02/22 – 8-10pm - JW

14/02/22 – 8-10pm - JW

09/03/22 – 6:30-9:45pm – JW & JS

(JW = Jayden Walsh, JS = Joelan Sawyer)

Appendix 3. Survey date climatic conditions

Date / time	Rainfall (Prospect)	Rainfall (Horsley Park)	Temp at 3 pm (Horsley Park)	Wind at 3 pm (Horsley Park)
07/02/22 – 7-9:45pm	Dry	7.4 mm	21.2	15 km/hr SSE
08/02/22 – 8-10pm	Dry	5.6 mm	24.1	11km/hr ENE
14/02/22 – 8-10pm	Dry	19 mm from 11, 12, 13 Feb, none on 14 Feb	28.2	6 km/hr N
09/03/22 – 6:30-9:45pm	More than 500 mm recorded between 16 Feb and 8 March.	30 mm on 9 Mar More than 350 mm between 11 Feb and 8 March (226.2 + 129mm)	24.0	20 km/hr SSW

(Source: Bureau of Meteorology online climate data)

Appendix 4. Fauna species detected onsite

Common Name	Scientific Name	Observation Type
Birds		
Bell Miner	<i>Manorina melanophrys</i>	OW
Red-whiskered Bulbul*	<i>Pycnonotus jocosus</i>	OW
Black-shouldered Kite	<i>Elanus axillaris</i>	OW
Australian Raven	<i>Corvus coronoides</i>	OW
Australian Magpie	<i>Gymnorhina tibicen</i>	O
Australian Reed-Warbler^	<i>Acrocephalus australis</i>	OW
Grey Fantail	<i>Rhipidura albiscapa</i>	OW
Willie Wagtail	<i>Rhipidura leucophrys</i>	O
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	OW
Little Grassbird	<i>Megalurus gramineus</i>	W
Spotted Dove*	<i>Spilopelia chinensis</i>	OW
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	OW
Red-rumped Parrot	<i>Psephotus haematonotus</i>	OW
Rainbow Lorikeet	<i>Trichoglossus moluccanus</i>	OW
Superb Fairywren	<i>Malurus cyaneus</i>	OW
Magpie Lark	<i>Grallina cyanoleuca</i>	OW
Common Myna*	<i>Acridotheres tristis</i>	O
Noisy Miner	<i>Manorina melanocephala</i>	OW
Red Wattlebird	<i>Anthochaera carunculata</i>	OW
Welcome Swallow	<i>Hirundo neoxena</i>	OW
Grey Butcherbird	<i>Cracticus torquatus</i>	OW
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	OW
Frogs		
Common Eastern Froglet	<i>Crinia signifera</i>	OW
Striped Marsh Frog	<i>Limnodynastes peronii</i>	OW
Reptiles		
Eastern Brown Snake	<i>Pseudonaja textilis</i>	O
Dark-flecked Sunskink	<i>Lampropholis delicata</i>	O
Pale-flecked Sunskink	<i>Lampropholis guichenoti</i>	O
Mammals		
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	O
European Rabbit*	<i>Oryctolagus cuniculus</i>	O

O = seen; W = heard; OW = seen and heard, ^ = listed on EPBC Act, * = exotic species

Appendix 5. Site photographs

Plate 1. Site access via Augusta Street.

Plate 2. Dead trees along Augusta Street

Plate 3. View east across cleared former agricultural land towards the riparian zone onsite

Plate 4. Culvert of Blacktown Creek with potential microbat roosting habitat

Plate 5. View of paddock grassland typical of the site

Appendix 5. Site photographs



Plate 1. Site access via Augusta Street.



Plate 2. Dead trees along Augusta Street



Plate 3. View east across cleared former agricultural land towards the riparian zone onsite



Plate 4. Culvert of Blacktown Creek with potential microbat roosting habitat



Plate 5. View of paddock grassland typical of the site

FIGURES



Figure 1. Site location

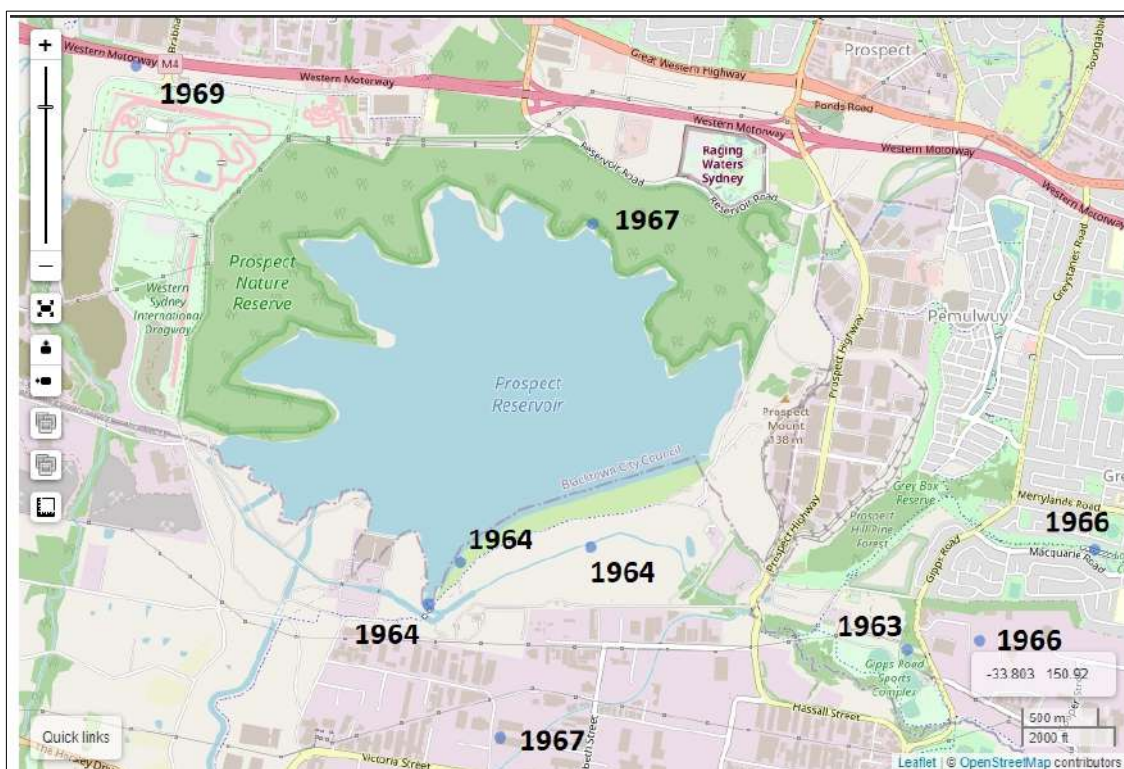


Figure 2. Green and Golden Bell Frog records (blue circles) in close proximity to the site with the dates of the records labelled

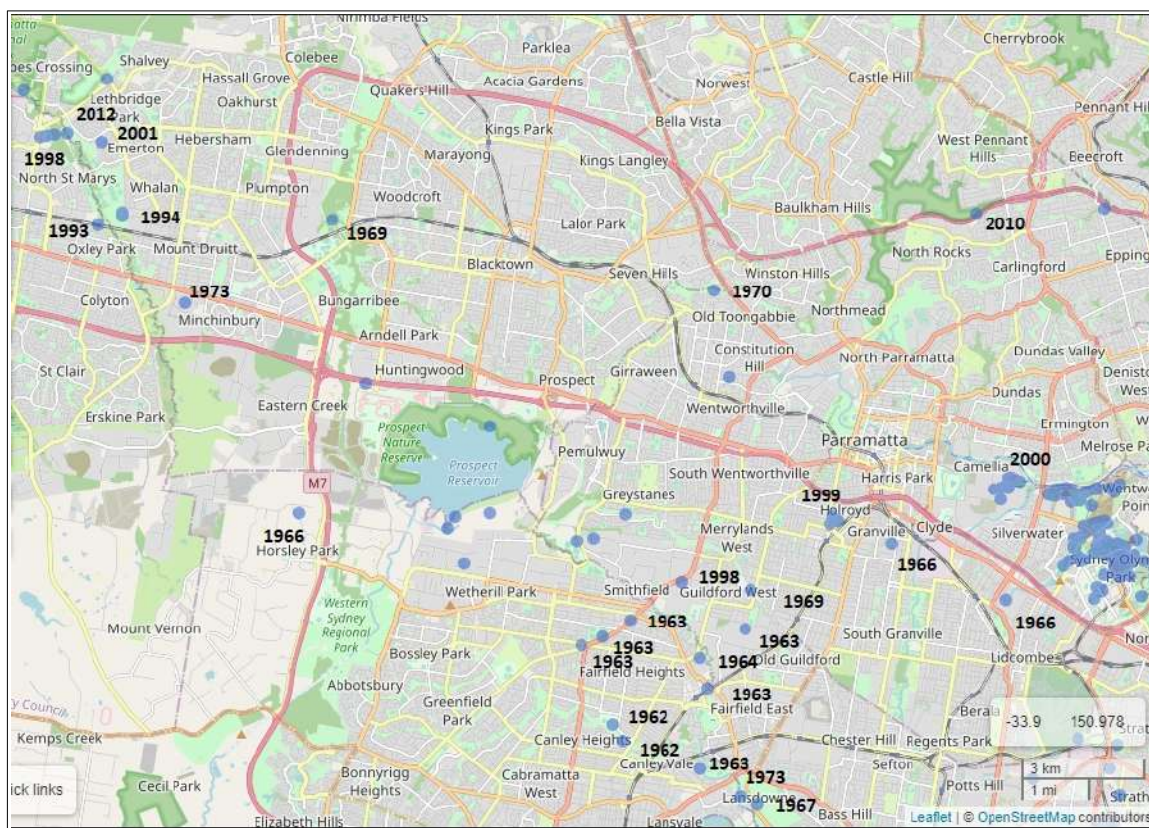


Figure 3. Records of Green and Golden Bell Frogs (blue circles) in the broader area with the dates of the records labelled

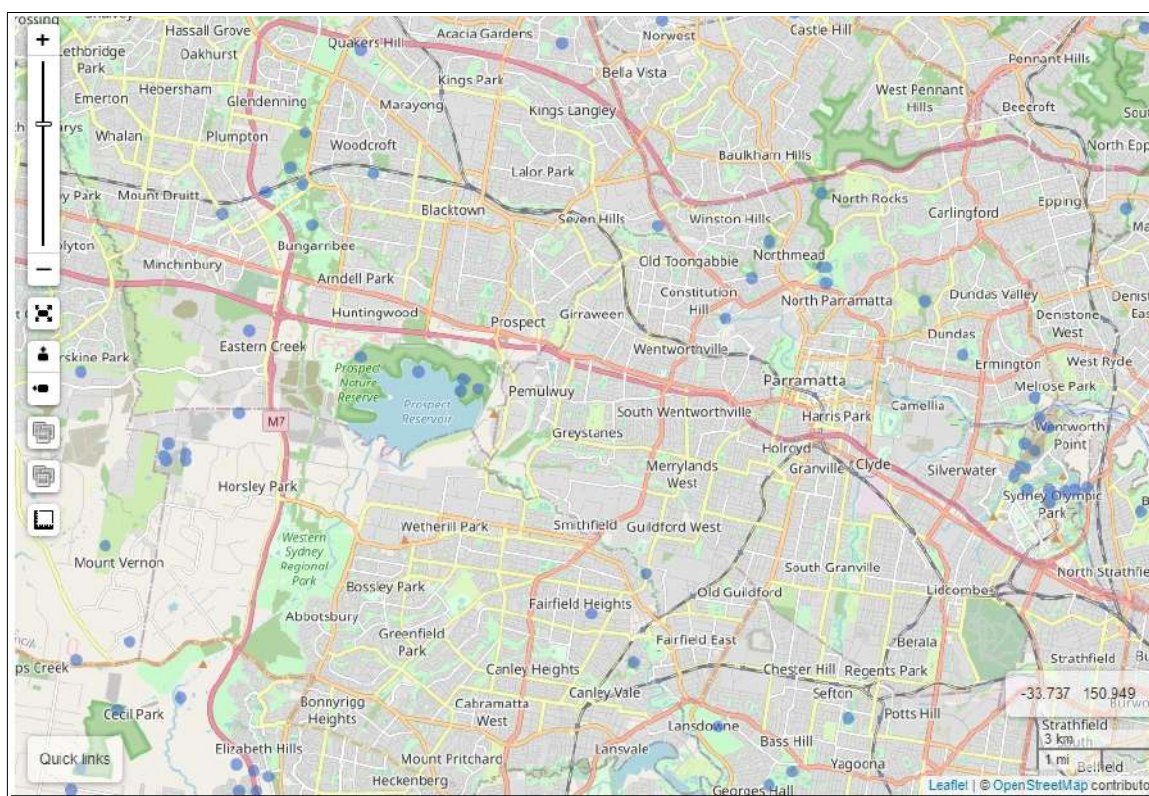


Figure 4: Records of Southern Myotis (blue circles) in the broader area around the site.



Figure 5. Historic aerial photograph of the site in 1956

Note: Permanent Ponds = Blue outline; ephemeral ponds = green outline; approximate alignment of water channel is the shaded dark blue line, indicated with blue arrow.

TABLES

Table 1. Threatened microbat species records within 10 km of the site

(Note: all species other than the Large-eared Pied Bat are recorded within 5km of the site)

Emballonuridae	Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>	☐	V,P		1
Molossidae	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	☐	V,P		23
Vespertilionidae	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	☐	V,P	V	1
	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	☐	V,P		9
	Southern Myotis	<i>Myotis macropus</i>	☐	V,P		10
	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	☐	V,P		11
Miniopteridae	Little Bent-winged Bat	<i>Miniopterus australis</i>	☐	V,P		4
	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	☐	V,P		41

Table 2. Threatened fauna species records in the vicinity of the site (within a 10 km radius).

	Common name	Scientific name	Map [Clear all]	NSW status	Comm. status	No. of records
Animalia	Green and Golden Bell Frog	<i>Litoria aurea</i>	☐	E1,P	V	10
Amphibia						
Hylidae						
Aves	Fork-tailed Swift	<i>Apus pacificus</i>	☐	P	C,J,K	4
Apodidae	White-throated Needletail	<i>Hirundapus caudacutus</i>	☐	P	V,C,J,K	1
Accipitridae	Little Eagle	<i>Hieraaetus morphnoides</i>	☐	V,P		12
Falconidae	Black Falcon	<i>Falco subniger</i>	☐	V,P		1
Charadriidae	Grey Plover	<i>Pluvialis squatarola</i>	☐	P	C,J,K	1
Scolopacidae	Latham's Snipe	<i>Gallinago hardwickii</i>	☐	P	J,K	1
Psittacidae	Little Lorikeet	<i>Glossopsitta pusilla</i>	☐	V,P		2
	Swift Parrot	^{^^} <i>Lathamus discolor</i>	☐	E1,P,3	CE	28
	Turquoise Parrot	^{^^} <i>Neophema pulchella</i>	☐	V,P,3		1
Strigidae	Barking Owl	^{^^} <i>Ninox connivens</i>	☐	V,P,3		2
	Powerful Owl	^{^^} <i>Ninox strenua</i>	☐	V,P,3		4
Tytonidae	Masked Owl	^{^^} <i>Tyto novaehollandiae</i>	☐	V,P,3		3
Meliphagidae	Regent Honeyeater	<i>Anthochaera phrygia</i>	☐	E4A,P	CE	13
Neosittidae	Varied Sittella	<i>Daphoenositta chrysoptera</i>	☐	V,P		6
Artamidae	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	☐	V,P		10
Petroicidae	Flame Robin	<i>Petroica phoenicea</i>	☐	V,P		1
Mammalia	Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	☐	V,P	E	7
Dasyuridae						
Pteropodidae	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	☐	V,P	V	318
Emballonuridae	Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>	☐	V,P		1
Molossidae	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	☐	V,P		23
Vespertilionidae	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	☐	V,P	V	1
	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	☐	V,P		9
	Southern Myotis	<i>Myotis macropus</i>	☐	V,P		10
	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	☐	V,P		11
Miniopteridae	Little Bent-winged Bat	<i>Miniopterus australis</i>	☐	V,P		4
	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	☐	V,P		41
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	☐	E1		74
Camaenidae						

Table 3. Key fauna species for habitat reconstruction / restoration

Species	Common Name	Preferred Habitat (source: NSW OEH species profiles)	Proposed Habitat creation
Frogs			
<i>Litoria aurea</i>	Green and Golden Bell Frog	Wetlands and slow flowing streams with emergent vegetation in woodland and open forest, or urban areas.	At least 4 open water ponds: – two permanent (20x10m & 10x5m, depth 1.1-1.9m), and – two ephemeral (20x5m & 10x5m, depth 0.3-0.7m). Rock piles/logs for shelter.
Microbats			
<i>Myotis macropus</i>	Southern Myotis	Forages over streams and ponds. Roosts close to water in hollow-bearing trees or dense foliage, and artificial structures such as under bridges, storm water channels or buildings.	Wetlands proposed as for Green and Golden Bell Frog. Installation of microbat nest boxes mounted on wood pylons in the riparian zone. If possible, retrofit microbat roosts in culverts.
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Dry sclerophyll forests and woodland, roosts in tree hollows but also under bark or artificial structures.	Planting and restoration of native woodland in conservation areas. Installation of microbat nest boxes. If possible, retrofit microbat roosts in culverts.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Woodland and moist or dry eucalypt forest. Roosts in tree hollows and buildings.	Planting and restoration of native woodland in conservation areas. Installation of microbat nest boxes.
<i>Miniopterus australis</i>	Little Bent-winged Bat	Moist eucalypt forest and wet/dry sclerophyll forests. Roosts in tree hollows, storm water drains, culverts, bridges and buildings.	Planting and restoration of native woodland in conservation areas. Installation of microbat nest boxes. If possible, retrofit microbat roosts in culverts.
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	Roosts in caves or artificial structures such as storm water tunnels and buildings. Forages in forested areas.	Planting and restoration of native woodland in conservation areas. If possible, retrofit microbat roosts in culverts.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Moist habitats with trees taller than 20 m. Roosts in eucalypt hollows but also under loose bark or in buildings.	Riparian corridor plantings e.g. <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Casuarina glauca</i> . Installation of microbat nest boxes.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	Roosts in tree hollows, buildings or burrows. Occurs in most habitat types.	Planting and restoration of native woodland in conservation areas. Installation of microbat nest boxes.
Other Mammals			
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Forests and woodlands, including urban areas.	Planting <i>Eucalyptus tereticornis</i> , <i>E.</i>

Species	Common Name	Preferred Habitat (source: NSW OEH species profiles)	Proposed Habitat creation
		Favours <i>Eucalyptus</i> spp and <i>Melaleuca</i> spp for feeding.	<i>moluccana</i> , <i>E. crebra</i> , <i>Melaleuca styphelioides</i> .
Birds			
<i>Lathamus discolor</i>	Swift Parrot	Woodlands and forests, favours <i>Eucalyptus robusta</i> , <i>E. tereticornis</i> , <i>E. moluccana</i> , <i>E. sideroxylon</i> and <i>Corymbia maculata</i> .	Restore sections of native woodland, plant <i>Eucalyptus tereticornis</i> , <i>E. moluccana</i> .
<i>Glossopsitta pusilla</i>	Little Lorikeet	Open eucalypt forest/woodlands, nests in hollows often in riparian zones.	Restore sections of native woodland, plant eucalypts, install small nest boxes.
<i>Acrocephalus australis</i>	Australian Reed-Warbler	Riparian zones with dense emergent vegetation and reed beds.	Sequentially replace sections of <i>Juncus acutus</i> with native species e.g. <i>Typha domingensis</i> , <i>Bolboschoenus caldwellii</i> , <i>Carex appressa</i> .
<i>Hieraaetus morphnoides</i>	Little Eagle	Open eucalypt forest and woodland, nests in tall living trees.	Restore sections of native woodland; retain existing living native trees.
<i>Anthochaera phrygia</i>	Regent Honeyeater	Open forest and woodland, particularly box-ironbark woodlands, favours mistletoes.	Restore sections of native woodland, plant <i>Eucalyptus moluccana</i> , <i>E. crebra</i> .
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Eucalypt forests and woodlands, favours trees with dead branches.	Restore sections of native woodland; retain /prune dead trees where practicable.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	Dry, open eucalypt forests or woodlands with a sparse understory of shrubs, groundcovers and debris.	Restore sections of native woodland, ensuring natural vegetation structuring and features such as logs are present.
Invertebrates			
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	Cumberland Plain Woodland, i.e. open woodland with grassy understory and areas of shrubs.	Restore native vegetation, ensuring natural vegetation structuring and features such as logs are present.

Table 4. Aquatic and fringing vegetation suitable for Green and Golden Bell Frogs that is recommended for planting within and around the proposed permanent and ephemeral ponds (Beranek et al 2020).

Species	
<i>Bolboschoenus caldwellii</i>	<i>Persicaria decipiens</i>
<i>Bolboschoenus fluviatilis</i>	<i>Persicaria praetermissa</i>
<i>Carex appressa</i>	<i>Ranunculus inundates</i>
<i>Eleocharis acuta</i>	<i>Schoenoplectus validus</i>
<i>Eleocharis sphacelata</i>	<i>Cynnogeton procerum</i>
<i>Juncus usitatus</i>	<i>Lomandra longifolia</i>

Appendix 6.

**Additional microbat survey on 27 February 2024 (Kane Durrant of Wild Conservation
2024)**

5 MARCH 2024

Microbat Survey at Augusta Street Warehouse Site Blacktown

REPORT PREPARED FOR
ANNE CLEMENTS AND ASSOCIATES PTY LTD
BY WILD CONSERVATION PTY LTD - KANE DURRANT
MARCH 2024



WILD Conservation March 2024

WILD CONSERVATION | PO BOX 1143, NARELLAN, NSW 2567

Microbat Survey WILD Conservation March 2024

WILD Conservation Pty Ltd were engaged by Anne Clements and Associates Pty Ltd to undertake surveys for the Microbat presence at a site in western Sydney, specifically Augusta Street Blacktown (Augusta Street Warehouse and Distribution Centre SSD-36138263) on February 27, 2024. Principal Ecologist Kane Durrant and two qualified Fauna Spotter Catchers attended the site during the afternoon and searched the potential roosting sites for Microbat activity or evidence of presence. The culverts were searched on foot by torchlight and an Echo Meter Touch 2 was utilised to detect calls.

The site is highly degraded with heavy aggregations of blackberry, privet and lantana vegetation wrapped around sparse native trees. Two creek lines transect the site from south to north originating in the south through culverts under the M4 Motorway and exiting the site in the north through culverts under the Great Western Highway (Figure 1)

Culverts are known roosting sites for various Microbat species including the target *Myotis*. The culverts were first assessed for their viability as a roost site in terms of flight access, proximity to open water and safety from predators. The culverts were walked on foot by Kane Durrant and each crack and crevice was searched by torchlight for Microbats, as well as evidence such as scratch marks and faeces (Figure 2)

An Echo Meter Touch 2 was deployed at the entrance of each culvert and recorded the frequencies. No Microbat calls were detected during the dusk or night hours of survey. The culverts were mostly inaccessible and would not be suitable for Microbats to fly into as most culverts were fully obscured by exotic weed species. The thickets of brambles were so impenetrable that the culverts could not be seen by the investigating team (Figure 3).

The site was walked in a random meander pattern through the paddock that dominated the site with no Microbats seen or detected by Echo Meter Touch 2. The creek lines were both walked from south to north with no Microbats detected by sight, torch or Echo Meter Touch 2.

No evidence of Microbats was found during the surveys conducted at this site. The only fauna detected during surveys were domestic cats wandering the site, European red foxes and their scat in the culverts, and black rats swarming through the exotic weeds.



Figure 1. Aerial image of the site with culvert locations marked X. Each culvert was inspected for Microbat activity and presence.



Figure 2. One of many cracks formed by the joins in the culvert sections. These cracks and other crevices were searched by torchlight during surveys. No evidence of Microbat presence was found.



Figure 3. This is the location of two culverts. They are completely obscured by vegetation and are unsuitable flight paths for Microbats.



Figure 4. The larger culverts are more open but allow for fox and cat travel. This one had more water than the others but still showed no signs of Microbat presence during the visual inspections or Echo Meter Touch 2 monitoring.



Figure 5. There is minimal open water on the site. It is nearly all covered by vegetation and is likely not suitable for fishing bats to utilise as a forage site.

Company profile for WILD Conservation Pty Ltd and brief CV of Kane Durrant

WILD Conservation Pty Ltd is led by Director and Principal Ecologist Kane Durrant BSc Ecology UNSW. We have been involved in the ecology and conservation space for approximately the last decade. I am currently undertaking my Honours at UNSW where I have also been employed as a casual Academic teaching Vertebrate Zoology, and as a guest lecturer in Herpetology. Our team at WILD Conservation consists of several Ecologists and Fauna Spotter Catchers with varying levels of experience from undergrads to post doctoral researchers, each with their own specialisations spanning several disciplines within the ecological field.

I am a member of the IUCN Species Survival Commission for Tortoises and Freshwater Turtles Specialist Group, as well as the Australian Society of Herpetologists and Editor at Australian Herpetological Society here in Sydney. We have undertaken Microbat surveys and installed supplementary habitat for them at several sites across Sydney, including some of those listed below.

Some of the major projects and roles we have worked on include:

- Windsor Bridge Upgrade (Ecology and Fauna Management)
- King Georges Road Upgrade (Pre clearance surveys)
- Heathcote Road Upgrade (Project Ecologist)
- Figtree Hill Master Community (Project Ecologist)
- Northern Road Upgrade (Fauna management and pre clearance surveys)

Appendix 7.

PCT 3319 Profile

BioNet Vegetation Classification - Community Profile Report

Plant Community Type ID (PCT ID): 3319

PCT Name: Cumberland Shale Hills Woodland

Classification Confidence Level: 2-High

Total Number of Replicates: 133

Number of Primary Replicates: 106

Number of Secondary Replicates: 27

Vegetation Description: A tall to very tall sclerophyll woodland to open forest with a mid-stratum of soft-leaved shrubs and small trees with a grassy ground cover that is extensive on rises and upper slopes of hills south from Cecil Hills, in the south-western part of the Cumberland Plain to the west of Sydney. It is most extensive in Campbelltown, Camden and Wollondilly local government areas. The canopy commonly includes *Eucalyptus moluccana* and *Eucalyptus tereticornis*, with a sparse shrub to small tree layer which very frequently includes *Bursaria spinosa* and at least one species of *Acacia*, of which *Acacia implexa* is most frequent. The presence of *Acacia implexa* helps distinguish this PCT from PCT 3320, which has a similar assemblage and structure. The mid-dense ground layer typically includes forbs, grasses and twiners. *Dichondra repens* is almost always present and *Microlaena stipoides*, *Desmodium varians*, *Brunoniella australis* and *Aristida ramosa* are very frequent. This PCT typically occurs in a warm, moist climate between 90-300 metres asl. It has been heavily cleared and now occurs in small remnants with varying levels of disturbance within a rural landscape. The canopy in these remnants often comprises immature cohorts of trees that have regenerated after thinning or clearing. The distribution of this PCT overlaps with PCT 3320 between Cecil Hills and the Nepean River, in which area of overlap PCT 3319 typically occurs on higher elevation hills and ridges. This PCT grades into PCT 3318 on lower protected slopes in the more dissected hills around Cecil Hills and the Razorback Range, and into PCT 3321 near the interface with the sandstone plateaus on the edge of the Cumberland Plain. PCT 3318 includes shrubs, ferns and vines typical of sheltered habitats that are rare in this PCT. Ironbark eucalypts are very frequent and *Eucalyptus punctata* is common in the canopy of PCT 3321, and *Eucalyptus moluccana* and *Eucalyptus tereticornis* are both rare.

Vegetation Formation: Grassy Woodlands;

Vegetation Class: Coastal Valley Grassy Woodlands;

IBRA Bioregion(s): Sydney Basin;

IBRA Sub-region(s): Burrangorang; Cumberland;

LGA: CAMDEN; CAMPBELLTOWN; FAIRFIELD; LIVERPOOL; PENRITH; WOLLONDILLY;

Elevation (m) (Min, Median, Max): 53.7 179.1 363.0

Annual Rainfall (mm) (Min, Median, Max): 735 827 880

Annual Mean Temperature (deg C) (Min, Median, Max): 14.50 15.43 16.67

Median Native Species Richness per plot: 34

TEC Assessed: Has associated TEC

TEC List: Listed BC Act,CE: Cumberland Plain Woodland in the Sydney Basin Bioregion (Part); Listed EPBC Act,CE: Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Part);

TEC Comments: (Comment TEC1) Relates to the NSW Cumberland Plain Woodland TEC. (Comment TEC2) Relates to the Commonwealth Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC where a patch satisfies key diagnostic characteristics and condition thresholds as per Sections 4 and 5 of the Listing Advice.

PCT Percent Cleared: 81.74

PCT Definition Status: Approved

Species By Growth Form Group

Growth Form Group	Species	Median cover score	Frequency
Unassigned (UA)	<i>Leptochloa asthenes</i>	3	2
Unassigned (UA)	<i>Wurmbea dioica</i>	2	1
Fern (EG)	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	2	48
Fern (EG)	<i>Cheilanthes distans</i>	2	25
Fern (EG)	<i>Pellaea falcata</i>	1	17
Fern (EG)	<i>Adiantum aethiopicum</i>	2	15
Fern (EG)	<i>Cheilanthes austrotenuifolia</i>	2	2
Fern (EG)	<i>Adiantum hispidulum</i>	2	1
Fern (EG)	<i>Blechnum spinulosum</i>	2	1
Forb (FG)	<i>Dichondra repens</i>	2	94
Forb (FG)	<i>Brunoniella australis</i>	2	76
Forb (FG)	<i>Oxalis perennans</i>	2	65
Forb (FG)	<i>Oxytes brachypoda</i>	2	55
Forb (FG)	<i>Asperula conferta</i>	2	53
Forb (FG)	<i>Wahlenbergia gracilis</i>	2	44

Forb (FG)	Einadia nutans	2	42
Forb (FG)	Solanum prinophyllum	1	42
Forb (FG)	Sida corrugata	2	38
Forb (FG)	Sigesbeckia orientalis subsp. orientalis	2	37
Forb (FG)	Plectranthus parviflorus	2	34
Forb (FG)	Einadia trigonos	2	31
Forb (FG)	Euchiton sphaericus	1	31
Forb (FG)	Einadia hastata	2	30
Forb (FG)	Plantago debilis	2	30
Forb (FG)	Galium leiocarpum	2	29
Forb (FG)	Geranium homeanum	2	28
Forb (FG)	Rumex brownii	1	28
Forb (FG)	Hypericum gramineum	1	24
Forb (FG)	Veronica plebeia	2	24
Forb (FG)	Ajuga australis	2	23
Forb (FG)	Commelina cyanea	2	23
Forb (FG)	Crassula sieberiana	1	23
Forb (FG)	Vittadinia cuneata	1	22
Forb (FG)	Arthropodium milleflorum	2	20
Forb (FG)	Geranium solanderi	1	19
Forb (FG)	Einadia polygonoides	2	18
Forb (FG)	Nyssanthes diffusa	2	18
Forb (FG)	Galium leptogonium	2	17
Forb (FG)	Lobelia purpurascens	2	15
Forb (FG)	Solanum pungetium	1	14
Forb (FG)	Cotula australis	2	13
Forb (FG)	Lagenophora gracilis	2	11
Forb (FG)	Poranthera microphylla	1	11
Forb (FG)	Senecio hispidulus	2	11
Forb (FG)	Lagenophora stipitata	2	10
Forb (FG)	Senecio quadridentatus	2	10
Forb (FG)	Calotis lappulacea	1	9
Forb (FG)	Galium gaudichaudii	2	9
Forb (FG)	Phyllanthus virgatus	2	9
Forb (FG)	Desmodium gunnii	2	8
Forb (FG)	Desmodium rhytidophyllum	2	8
Forb (FG)	Tricoryne elatior	1	8
Forb (FG)	Brunoniella pumilio	2	7
Forb (FG)	Cymbonotus lawsonianus	1	7
Forb (FG)	Dianella longifolia	1	7
Forb (FG)	Hypoxis hygrometrica	2	7
Forb (FG)	Oxalis exilis	1	7
Forb (FG)	Verbena gaudichaudii	1	7

Forb (FG)	Vernonia cinerea	1	7
Forb (FG)	Wahlenbergia communis	1	7
Forb (FG)	Daucus glochidiatus	2	6
Forb (FG)	Dichondra sp. Inglewood	2	6
Forb (FG)	Mentha satureioides	2	6
Forb (FG)	Plantago varia	1	6
Forb (FG)	Centella asiatica	2	5
Forb (FG)	Scutellaria humilis	2	5
Forb (FG)	Solenogyne bellioides	1	5
Forb (FG)	Wahlenbergia stricta	2	5
Forb (FG)	Goodenia hederacea	1	4
Forb (FG)	Portulaca oleracea	1	4
Forb (FG)	Stackhousia viminea	1	4
Forb (FG)	Stellaria flaccida	2	4
Forb (FG)	Veronica calycina	1	4
Forb (FG)	Caesia parviflora	1	3
Forb (FG)	Euchiton involucratius	2	3
Forb (FG)	Opercularia diphylla	1	3
Forb (FG)	Phyllanthus similis	1	3
Forb (FG)	Plantago gaudichaudii	2	3
Forb (FG)	Schenkia spicata	1	3
Forb (FG)	Sida cunninghamii	1	3
Forb (FG)	Wahlenbergia luteola	1	3
Forb (FG)	Alternanthera angustifolia	2	2
Forb (FG)	Alternanthera sp. A	1	2
Forb (FG)	Arthropodium minus	2	2
Forb (FG)	Cynoglossum australe	2	2
Forb (FG)	Dysphania carinata	1	2
Forb (FG)	Dysphania pumilio	2	2
Forb (FG)	Euphorbia drummondii	1	2
Forb (FG)	Hydrocotyle sibthorpioides	2	2
Forb (FG)	Hypericum japonicum	1	2
Forb (FG)	Mentha diemenica	2	2
Forb (FG)	Nyssanthus erecta	1	2
Forb (FG)	Polygala japonica	2	2
Forb (FG)	Pseuderanthemum variabile	1	2
Forb (FG)	Ranunculus pumilio	2	2
Forb (FG)	Scaevola albida	2	2
Forb (FG)	Senecio diaschides	1	2
Forb (FG)	Sigesbeckia australiensis	2	2
Forb (FG)	Trachymene incisa subsp. incisa	2	2
Forb (FG)	Vittadinia sulcata	2	2
Forb (FG)	Zornia dyctiocarpa var. dyctiocarpa	2	2

Forb (FG)	<i>Alternanthera denticulata</i>	1	1
Forb (FG)	<i>Alternanthera nana</i>	1	1
Forb (FG)	<i>Arthropodium</i> sp. South-east Highlands	1	1
Forb (FG)	<i>Bossiaea prostrata</i>	1	1
Forb (FG)	<i>Brachyscome angustifolia</i>	1	1
Forb (FG)	<i>Brachyscome spathulata</i>	2	1
Forb (FG)	<i>Cardamine paucijuga</i>	1	1
Forb (FG)	<i>Chrysocephalum apiculatum</i>	1	1
Forb (FG)	<i>Dianella caerulea</i>	1	1
Forb (FG)	<i>Eclipta platyglossa</i>	1	1
Forb (FG)	<i>Euchiton japonicus</i>	1	1
Forb (FG)	<i>Euphorbia dallachyana</i>	1	1
Forb (FG)	<i>Galium binifolium</i>	1	1
Forb (FG)	<i>Geranium potentilloides</i>	1	1
Forb (FG)	<i>Geranium retrorsum</i>	1	1
Forb (FG)	<i>Glossocardia bidens</i>	1	1
Forb (FG)	<i>Gonocarpus teucrioides</i>	1	1
Forb (FG)	<i>Hydrocotyle laxiflora</i>	1	1
Forb (FG)	<i>Hydrocotyle tripartita</i>	1	1
Forb (FG)	<i>Malvastrum coromandelianum</i>	1	1
Forb (FG)	<i>Opercularia aspera</i>	1	1
Forb (FG)	<i>Oxalis chnoodes</i>	1	1
Forb (FG)	<i>Oxalis rubens</i>	2	1
Forb (FG)	<i>Plantago cunninghamii</i>	1	1
Forb (FG)	<i>Plantago hispida</i>	1	1
Forb (FG)	<i>Poranthera ericifolia</i>	2	1
Forb (FG)	<i>Scaevola aemula</i>	1	1
Forb (FG)	<i>Schenkia australis</i>	2	1
Forb (FG)	<i>Scutellaria mollis</i>	1	1
Forb (FG)	<i>Solenogyne dominii</i>	1	1
Forb (FG)	<i>Stackhousia monogyna</i>	1	1
Forb (FG)	<i>Urtica incisa</i>	2	1
Forb (FG)	<i>Veronica brownii</i>	1	1
Grass & grasslike (GG)	<i>Microlaena stipoides</i>	3	86
Grass & grasslike (GG)	<i>Aristida ramosa</i>	2	77
Grass & grasslike (GG)	<i>Cyperus gracilis</i>	2	71
Grass & grasslike (GG)	<i>Carex inversa</i>	2	55
Grass & grasslike (GG)	<i>Chloris ventricosa</i>	2	55
Grass & grasslike (GG)	<i>Themeda triandra</i>	2	51
Grass & grasslike (GG)	<i>Sporobolus creber</i>	2	50
Grass & grasslike (GG)	<i>Eragrostis leptostachya</i>	2	43
Grass & grasslike (GG)	<i>Rytidosperma racemosum</i>	2	38
Grass & grasslike (GG)	<i>Bothriochloa macra</i>	2	37

Grass & grasslike (GG)	<i>Poa labillardierei</i> var. <i>labillardierei</i>	2	34
Grass & grasslike (GG)	<i>Oplismenus aemulus</i>	2	33
Grass & grasslike (GG)	<i>Echinopogon ovatus</i>	2	31
Grass & grasslike (GG)	<i>Lomandra filiformis</i>	2	30
Grass & grasslike (GG)	<i>Dichelachne micrantha</i>	2	28
Grass & grasslike (GG)	<i>Oplismenus imbecillis</i>	2	28
Grass & grasslike (GG)	<i>Cymbopogon refractus</i>	2	25
Grass & grasslike (GG)	<i>Scleria mackaviensis</i>	2	23
Grass & grasslike (GG)	<i>Chloris truncata</i>	2	17
Grass & grasslike (GG)	<i>Panicum effusum</i>	1	17
Grass & grasslike (GG)	<i>Sporobolus elongatus</i>	2	17
Grass & grasslike (GG)	<i>Aristida vagans</i>	2	14
Grass & grasslike (GG)	<i>Fimbristylis dichotoma</i>	2	13
Grass & grasslike (GG)	<i>Rytidosperma tenuius</i>	2	13
Grass & grasslike (GG)	<i>Panicum simile</i>	2	12
Grass & grasslike (GG)	<i>Austrostipa ramosissima</i>	2	11
Grass & grasslike (GG)	<i>Bothriochloa decipiens</i> var. <i>decipiens</i>	2	11
Grass & grasslike (GG)	<i>Cynodon dactylon</i>	2	11
Grass & grasslike (GG)	<i>Dichanthium sericeum</i>	2	11
Grass & grasslike (GG)	<i>Paspalidium distans</i>	2	11
Grass & grasslike (GG)	<i>Entolasia stricta</i>	2	8
Grass & grasslike (GG)	<i>Eragrostis brownii</i>	2	8
Grass & grasslike (GG)	<i>Eriochloa pseudoacrotricha</i>	2	8
Grass & grasslike (GG)	<i>Poa sieberiana</i>	2	8
Grass & grasslike (GG)	<i>Paspalidium criniforme</i>	2	7
Grass & grasslike (GG)	<i>Rytidosperma bipartitum</i>	2	7
Grass & grasslike (GG)	<i>Dichelachne parva</i>	2	6
Grass & grasslike (GG)	<i>Entolasia marginata</i>	2	6
Grass & grasslike (GG)	<i>Juncus usitatus</i>	1	6
Grass & grasslike (GG)	<i>Bolboschoenus caldwellii</i>	1	5
Grass & grasslike (GG)	<i>Chloris divaricata</i> var. <i>divaricata</i>	2	5
Grass & grasslike (GG)	<i>Cyperus imbecillis</i>	2	5
Grass & grasslike (GG)	<i>Elymus multiflorus</i>	2	5
Grass & grasslike (GG)	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	1	5
Grass & grasslike (GG)	<i>Rytidosperma caespitosum</i>	2	5
Grass & grasslike (GG)	<i>Carex breviculmis</i>	2	4
Grass & grasslike (GG)	<i>Carex longebrachiata</i>	2	4
Grass & grasslike (GG)	<i>Echinopogon caespitosus</i>	2	4
Grass & grasslike (GG)	<i>Elymus scaber</i>	1	4
Grass & grasslike (GG)	<i>Juncus homalocaulis</i>	1	4
Grass & grasslike (GG)	<i>Rytidosperma longifolium</i>	2	4
Grass & grasslike (GG)	<i>Austrostipa setacea</i>	2	3
Grass & grasslike (GG)	<i>Cyperus laevis</i>	2	3

Grass & grasslike (GG)	Lachnagrostis filiformis	1	3
Grass & grasslike (GG)	Leptochloa decipiens	1	3
Grass & grasslike (GG)	Lomandra confertifolia	1	3
Grass & grasslike (GG)	Rytidosperma pilosum	2	3
Grass & grasslike (GG)	Schoenus apogon	2	3
Grass & grasslike (GG)	Sporobolus laxis	1	3
Grass & grasslike (GG)	Aristida calycina	2	2
Grass & grasslike (GG)	Austrostipa pubescens	2	2
Grass & grasslike (GG)	Austrostipa scabra	2	2
Grass & grasslike (GG)	Austrostipa verticillata	2	2
Grass & grasslike (GG)	Cyperus enervis	2	2
Grass & grasslike (GG)	Digitaria brownii	2	2
Grass & grasslike (GG)	Digitaria parviflora	3	2
Grass & grasslike (GG)	Panicum decompositum	2	2
Grass & grasslike (GG)	Paspalidium gracile	2	2
Grass & grasslike (GG)	Austrostipa nodosa	2	1
Grass & grasslike (GG)	Austrostipa rudis	2	1
Grass & grasslike (GG)	Carex appressa	2	1
Grass & grasslike (GG)	Cyperus fulvus	1	1
Grass & grasslike (GG)	Dactyloctenium radulans	1	1
Grass & grasslike (GG)	Dichelachne rara	2	1
Grass & grasslike (GG)	Digitaria diffusa	3	1
Grass & grasslike (GG)	Digitaria ramularis	2	1
Grass & grasslike (GG)	Eleocharis acuta	2	1
Grass & grasslike (GG)	Enteropogon acicularis	2	1
Grass & grasslike (GG)	Imperata cylindrica	2	1
Grass & grasslike (GG)	Juncus subsecundus	1	1
Grass & grasslike (GG)	Lomandra gracilis	2	1
Grass & grasslike (GG)	Lomandra longifolia	1	1
Grass & grasslike (GG)	Paspalidium albobillosum	3	1
Grass & grasslike (GG)	Poa affinis	1	1
Grass & grasslike (GG)	Rytidosperma fulvum	2	1
Grass & grasslike (GG)	Rytidosperma laeve	1	1
Grass & grasslike (GG)	Rytidosperma setaceum	2	1
Other (OG)	Desmodium varians	2	77
Other (OG)	Glycine tabacina	2	59
Other (OG)	Glycine clandestina	2	42
Other (OG)	Pandorea pandorana subsp. pandorana	2	30
Other (OG)	Clematis glycinoides	2	27
Other (OG)	Glycine microphylla	2	25
Other (OG)	Cayratia clematidea	2	24
Other (OG)	Geitonoplesium cymosum	1	16
Other (OG)	Clematis aristata	1	13

Other (OG)	Hardenbergia violacea	1	9
Other (OG)	Convolvulus erubescens	1	8
Other (OG)	Amyema miquelii	1	5
Other (OG)	Trophis scandens subsp. scandens	1	5
Other (OG)	Celastrus australis	1	4
Other (OG)	Passiflora herbertiana subsp. herbertiana	1	4
Other (OG)	Eustrephus latifolius	1	3
Other (OG)	Stephania japonica var. discolor	1	3
Other (OG)	Amyema pendula	2	2
Other (OG)	Aphanopetalum resinosum	1	2
Other (OG)	Parsonsia straminea	1	2
Other (OG)	Polymeria calycina	1	2
Other (OG)	Cassytha glabella	1	1
Other (OG)	Glycine tomentella	2	1
Other (OG)	Gynochthodes jasminoides	1	1
Other (OG)	Kennedia rubicunda	2	1
Other (OG)	Marsdenia flavescens	2	1
Other (OG)	Marsdenia viridiflora subsp. viridiflora	1	1
Other (OG)	Smilax glycyphylla	2	1
Shrub (SG)	Bursaria spinosa	3	83
Shrub (SG)	Acacia implexa	2	57
Shrub (SG)	Rubus parvifolius	1	24
Shrub (SG)	Breynia oblongifolia	1	23
Shrub (SG)	Eremophila debilis	1	14
Shrub (SG)	Myoporum montanum	1	13
Shrub (SG)	Indigofera australis	2	9
Shrub (SG)	Melaleuca styphelioides	3	9
Shrub (SG)	Abutilon oxycarpum	2	8
Shrub (SG)	Olearia viscidula	1	7
Shrub (SG)	Melicytus dentatus	1	5
Shrub (SG)	Solanum cinereum	1	5
Shrub (SG)	Dodonaea viscosa	1	4
Shrub (SG)	Ozothamnus diosmifolius	2	4
Shrub (SG)	Calotis dentex	2	3
Shrub (SG)	Leucopogon juniperinus	2	3
Shrub (SG)	Notelaea venosa	1	3
Shrub (SG)	Solanum stelligerum	2	3
Shrub (SG)	Acacia falcata	1	2
Shrub (SG)	Acacia floribunda	1	2
Shrub (SG)	Dillwynia sieberi	2	2
Shrub (SG)	Exocarpos cupressiformis	3	2
Shrub (SG)	Myrsine variabilis	1	2
Shrub (SG)	Phyllanthus gunnii	1	2

Shrub (SG)	Pittosporum undulatum	1	2
Shrub (SG)	Acacia elongata	1	1
Shrub (SG)	Acacia irrorata	1	1
Shrub (SG)	Atriplex semibaccata	1	1
Shrub (SG)	Backhousia myrtifolia	4	1
Shrub (SG)	Cassinia uncata	1	1
Shrub (SG)	Coprosma quadrifida	3	1
Shrub (SG)	Duboisia myoporoides	1	1
Shrub (SG)	Gynatrix pulchella	1	1
Shrub (SG)	Hibbertia aspera	2	1
Shrub (SG)	Pimelea spicata	1	1
Shrub (SG)	Platysace lanceolata	2	1
Shrub (SG)	Trema tomentosa var. aspera	1	1
Tree (TG)	Eucalyptus moluccana	3	65
Tree (TG)	Eucalyptus tereticornis	3	53
Tree (TG)	Eucalyptus crebra	3	34
Tree (TG)	Clerodendrum tomentosum	1	21
Tree (TG)	Notelaea longifolia	1	12
Tree (TG)	Corymbia maculata	2	10
Tree (TG)	Acacia decurrens	1	8
Tree (TG)	Acacia parramattensis	3	8
Tree (TG)	Brachychiton populneus	1	7
Tree (TG)	Eucalyptus eugenioides	3	6
Tree (TG)	Melia azedarach	1	4
Tree (TG)	Acacia melanoxylon	1	1
Tree (TG)	Allocasuarina littoralis	1	1
Tree (TG)	Angophora floribunda	1	1
Tree (TG)	Angophora subvelutina	1	1
Tree (TG)	Casuarina glauca	2	1
Tree (TG)	Eucalyptus paniculata	1	1
Tree (TG)	Eucalyptus punctata	3	1
Tree (TG)	Ficus rubiginosa	1	1
Tree (TG)	Streblus brunonianus	1	1

Appendix 8.

Photographic record for plots in the Conservation Areas



BAM Plot 5 – looking north from start of tape.



BAM Plot 5 – looking north from start of tape: *Erythrina crista-galli* at left, *E. moluccana* at right.



BAM Plot 5 – looking forward from 10 mark on tape. Large tree is *E. moluccana*.



BAM Plot 5 – creek line.



BAM Plot 5 – looking forward from 20 mark on tape; small trees mostly *Ligustrum* spp.



BAM Plot 5 – Looking south to tall *E. moluccana*.



BAM Plot 6 – *Typha domingensis*, *Juncus acutus*, *Rubus anglocandicans*



BAM Plot 6 – *Typha domingensis*, *Juncus acutus*, *Rubus anglocandicans*, *Cynodon dactylon*



BAM Plot 7 – looking north at the end of tape with dense cover of *Lantana camara* and *Olea europaea* subsp. *cuspidata*



BAM Plot 8 – looking north from start of tape. *Eucalyptus moluccana* at centre, *E. tereticornis* at left, *Ligustrum lucidum* foreground, clump of *Cortaderia selloana* centre-left.



BAM Plot 8 – looking west from start of tape, *E. tereticornis* behind fence, *Ligustrum lucidum* in foreground.



BAM Plot 8 – looking south from 20 m on tape. Dominant weeds are *Lantana camara*, *Cenchrus clandestinus*, *Ligustrum lucidum*.



BAM Plot 8 – looking north from 20 m on tape. *E. moluccana* in centre.



BAM Plot 8 – looking northwest from near 20 m on tape, 2 trees of *E. moluccana* at left, further trees are *E. tereticornis*. Large mound of fill behind, extending toward Great Western Highway.



BAM Plot 8 – looking northwest across old fence from near 20 m tape, *E. tereticornis* on far side.



BAM Plot 8 – *Opuntia monacantha* near start of tape.



BAM Plot 8 – looking southwest from near middle of plot, across old fence and creek line towards Augusta Street. *E. tereticornis* with dense weed cover, mainly *Lantana camara* and *Anredera cordifolia*.



BAM Plot 8 – mound of demolition rubble around 30–40 m from start of tape extending along inside old fence, with dense growth of *Ligustrum* spp.



BAM Plot 8 – looking north from near 50 m on tape, showing east edge of rubble mound.



BAM Plot 9 – looking south from start of tape with *Lantana camara* in foreground and *Olea europaea* subsp. *cuspidata* in centre background.