CUMBERLAND COUNCIL

Lakewood Estate Riparian Corridor

Plan of Management

February 2023

Lakewood Estate Riparian Corridor

PLAN OF MANAGEMENT

Prepared For

Cumberland Council

By

Environmental Partnership NSW Pty Ltd

in association with
Ecological Consultants Australia
Gameraigal Group

February 2023

Issue	Date	Description	By
1	26.09.17	Preliminary work in progress	AH
2	28.10.17	Final Preliminary	AH
3	19.02.18	Final Draft	AH
4	02.03.18	Updated Final Draft	AH
5	25.07.18	Final POM	AH
6	26.09.22	Amended PoM for addition of Community Garden	AH
7	22/02/23	Updated Final POM	AH

Amendments for Issue 7 denoted by underlining in this document

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1 INTRODUCTION

1.1 Background

In accordance with the NSW Local Government Act of 1993, Local Councils are required to prepare Plans of Management for all Community Land, to ensure it is effectively planned and managed.

This Plan of Management (POM) was prepared by Landscape Architectural consultants, Environmental Partnership during May to October 2017.

An amendment to the Final PoM was undertaken in August- September 2022 to consider the development of a community garden in the area of the Gateway Park space.

This document is a specific POM for The Lakewood Estate Riparian Corridor Pemulwuy. The subject area is the northern zone of a south north running riparian corridor that has been upgraded and maintained to date by the land developer of the adjoining residential estate (refer Figure 1). The site was transferred back to Council for ongoing management and maintenance in 2016 in accordance with the Lakewood Estate development agreement.

The POM covers the area shown in Figure 1 and as listed in Section 1.2 Study Area at a Glance. Relevant property details for the park are listed under Council's asset register database.

The key objective of this POM is to guide future management and development of the Lakewood Estate Riparian Corridor within the legislative requirements of the Local Government Act, taking account of community expectations and the resources available to Cumberland Council (CC).

Community land as defined by the Local Government Act 1993, may be categorised as:

- Sportsgrounds
- Parks
- Natural Areas (including several sub categories)
- Area of Cultural Significance
- General Community Use Areas (including drainage reserves)

The Lakewood Estate Riparian Corridor is not covered by a current POM and has not to this time been categorised under the Local Government Amendment Act 1998.

This POM set outs the proposed categories for Lakewood Estate Riparian Corridor as Natural Area Wetland, Natural Area Watercourse, and Park (refer section 2.7.2).

Figure 1.1 The Lakewood Estate Riparian Corridor

1.2 Study area at a glance

The table following summarises existing features and management of the study area.

Item	Description
Site Name:	Lakewood Estate Riparian Corridor
Address:	Nijong Drive, Pemulwuy
Ownership:	Community land owned by Cumberland Council
Community land categorisation	Not currently categorised
Care, control, management:	Cumberland Council
Area:	Approximately 13.34 hectares (133,465.0 m2)
Zoning:	RE1 Public Recreation (Cumberland Local Environmental Plan 2013)
Conditions of park:	Drainage corridor– generally good condition – ongoing weed management required Wetland– generally good condition Deck / lookout – generally good condition Concrete paths – generally good condition Concrete seat furniture – varied condition Steel interpretive signage – varied condition Stone clad walling – varied condition – some stone missing Concrete walling – fair condition – some graffiti Deco granite paving – poor condition Timber bollards – generally fair condition – replacement required in next 10 years Fencing – varied condition – review chainwire fencing
Maintenance:	Cumberland Council Maintained park area • Mowing and edging • Tree planting and weeding of garden beds • Litter patrol/removal • Fence maintenance Wetland • Wetland corridor maintenance • Gross pollutant control maintenance / clearing Drainage corridor • Drainage corridor maintenance • Gross pollutant control maintenance / clearing

Item	Description
Assets:	• Maintained lawn (9,281 m2) • Planting / garden bed (2,475m2) • Native grass (28,590 m2) • Pond wetland (29,848 m2) • Tree sculpture artwork (3) • Std seat furniture (2) • Concrete base seat furniture (4) • Cycle Rack (3) • Bin stand (4) • Drinking fountain (2) • Shared concrete path (834m existing) • General concrete paths • Concrete steps • Stone clad blockwork wall (41 linm) • Concrete block wall (61 linm) • Stone wall (12 linm) • Timber deck 1 (34m2) • Timber deck 2 (28m2) • Balustrade 1.2m high (15 linm) • Timber bollards (44 linm) • Timber edge (357 linm) • Electric double BBQ's (2) • Interpretive signs (7) • Electrical switchboard
Condition of Buildings:	N/A
Existing Uses:	Public Reserve Passive recreation
Leases / licenses / bookings:	N/A
Caveats / easements:	Previous Caveats removed Stormwater and Sewer

Lakewood Riparian Estate Corridor comprises the following parcels of land (refer Figure 1.2 page 10):

Parcel Number	Street Name and Number
DP 1152946 PT 773	Nijong Drive, Pemulwuy

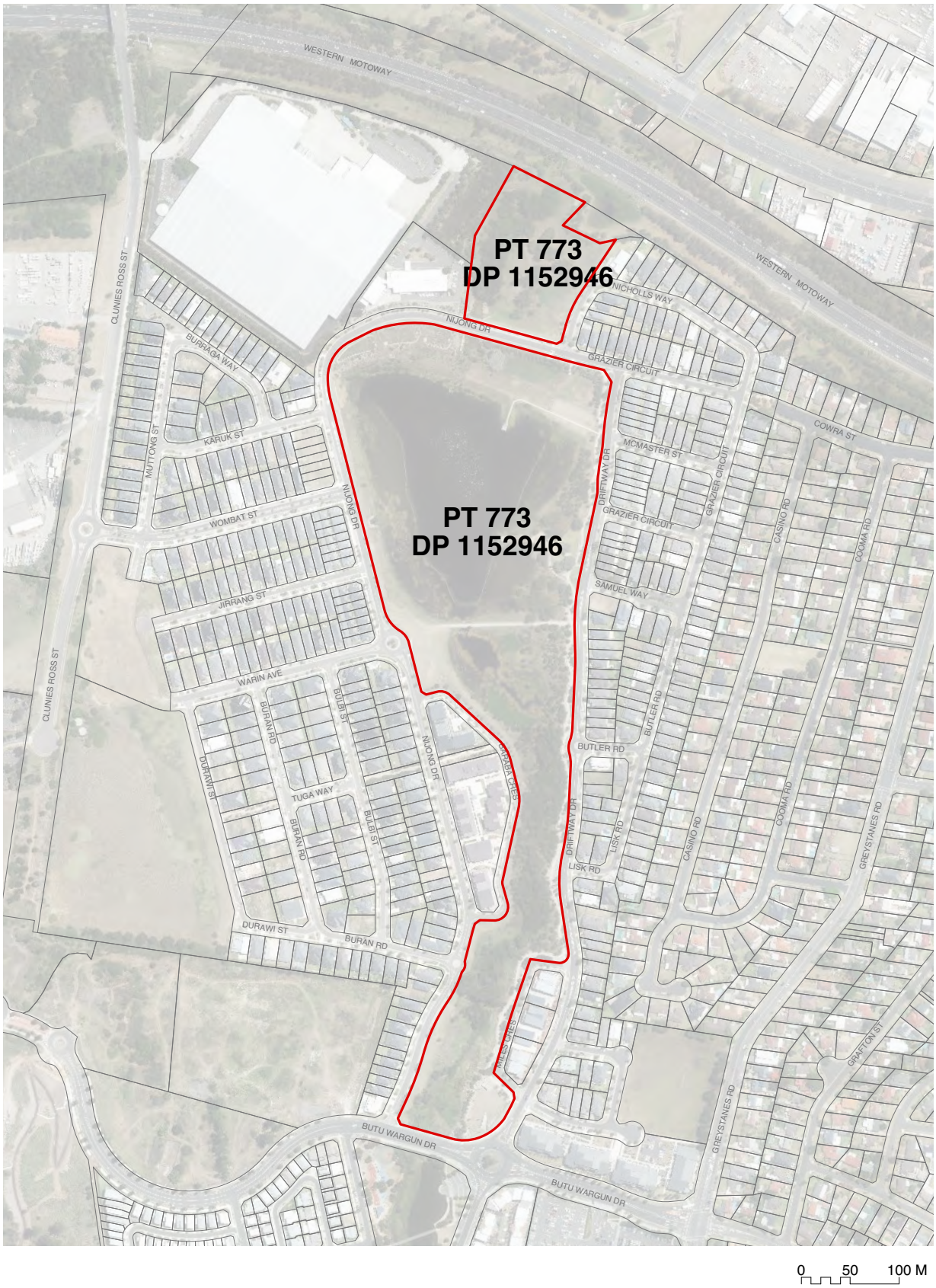


Figure 1.2 Land Parcels

1.3 Objectives of this Plan of Management

This POM has been prepared to provide a coordinated framework for decision-making for the enhancement and management of Lakewood Estate Riparian Corridor and therefore aims to integrate the vision and needs of the community (including the Aboriginal community) and Council.

Lakewood Estate Riparian Corridor was identified in the planning framework for the Pemulwuy community (as described in the Former CSIRO Site Pemulwuy Precinct Plan June 2007) as a multi-purpose open space corridor catering for conservation of the Girraween Creek tributary and related riparian curtilage, the wetland basin of the former CSIRO dam, access pathways, and several small parklands. Consultation with the Aboriginal and local community has identified a desire for the park to remain low key in its use and to serve the local community as a local park and "green corridor".

This plan has sought to define a sustainable direction for the park that combines both environmental and recreational roles ensuring that recreational use does not adversely impact the environmental and heritage values of the reserve

General objectives addressed in this plan include the programs and strategies that are expressed in documents such as Cumberland Council Policies and Codes including the Living Cumberland Community Strategic Plan and Code of Conduct. In addition to addressing the Local Government Act, Council's specific objectives of this POM are to:

- Improve the quality and amenity of the study area
- Guide future management
- Identify appropriate categorisation for the land
- Integrate with other relevant planning instruments
- Identify a name for the open space area in consultation with the Aboriginal community
- Identify existing assets, outstanding embellishments and maintenance requirements
- Incorporate values identified by the Aboriginal and local communities

1.4 Consultation

The Plan of Management has incorporated two community workshops in its development as outlined below. A public hearing was also provided during the public exhibition period.

Aboriginal Stakeholder Forum (22nd August 2017)

Aboriginal Community stakeholders were given the opportunity to review values and issues of the open space area and discuss future park naming. Feedback from attendees is summarised as follows (refer to Section 5 Attachments for full workshop notes):

Aboriginal cultural values

- Community view the area inclusive of Prospect Hill – it's all connected
- Cultural and environmental conservation – provides an umbrella framework for the area
- Protect the First Nations significance of the area including the relationship of the corridor with Prospect Hill
- Desire to connect all community to the area
- Educative use of the area – engage with schools etc

Opportunities

- Include the totem of the area (Possum)
- Brush tail Possum etc
- On signage
- Symbols on sandstone blocks
- Reconciliation Stone – moved to the area and placed in a secure location below Prospect Hill
- Walk way – loop around the lake and connection to Prospect Hill
- Interpretive signage
- Gardens – bush tucker and medicine
- Re-vegetate the area – research original plant community
- Cultural and spiritual significance of area
- *Scar Trees* – potential to create new ones – living culture – additional interpretive signage
- Cultural Keeping Place
- Education
- Lesson design – lesson plans – teacher involvement – school activities – invite resident participation
- Connecting people to place
- Living heritage and historical heritage
- Recreational Use
- Nature
- Picnics
- Rest & peaceful spaces – step out of the rat race
- Gardens
- Rest spots
- Sitting places – benches
- Swimming / water use might not be possible – subject to water quality
- Provide small Playground area
- Potential involvement of Juvenile Justice programs to work on the site
- Cat proof the area – hidden fences within vegetation
- Tourism
- Ferry from Sydney – Parramatta – travel to area
- Lakewood/Prospect Hill – Place of Reconciliation / Pemulwuy

Community Land categorisation

- Combination of
- Natural Area Wetland
- Natural Area Watercourse
- Park

Agreed as appropriate. Group wished to have some further time to consider potential for the area to be Area of Cultural Significance based on its Aboriginal connections.

Community Stakeholder Forum (5th October 2017)

Community stakeholders were given the opportunity to review existing park issues and discuss criteria for park development and management.

Key Values

Habitat

- Area has a high habitat value
- Promote native species
- Need balanced approach to amount of natural setting to manicured

Recreation

- Lake is a good focus for informal recreation and for walking and fitness
- Open space draws users from the local area as well as from further afield
- Path access for walking and fitness – could be improved by completion of loop around lake

Community

- Strong community connections and affection for reserve

Aboriginal cultural values

- Aboriginal history in the area
- Opportunity for interpretation

Key Issues

Water quality

- Algae spread is a problem – AH noted that the current plan includes an assessment of the Alligator Weed issue and will identify management strategies. Initial feedback is that maintained grass up to waters edge is a problem

Habitat

- Domestic and feral animals (eg Foxes) are a big problem in the area

Maintenance

Maintenance of the open space is challenging given extent of area and amount of vegetation – Key issues:

- Dumping of garden waste and rubbish
- Vandalism of signage
- Vandalism of fencing
- Weeds
- Mowing of grass and slashing of native grasses does not appear regular enough
- Native grasses slashed so low they are taken over by weeds and lost
- Potential for community involvement in planting days – Bushcare Groups
- Concrete seats are vandalised
- Management of Ibis
- Consider dog waste bins reflecting amount of dog use

Use

- Uses of platforms after hours / dark – some anti-social activities
- Quite a bit of use from outside area – feeling by locals that much of the vandalism and littering happens with people from outside the area
- Tree canopy can limit views and surveillance around decks and picnic tables – however it is recognised trees are also good for shade – balanced approach required
- Lack of a playground in the open space – it was noted there are play facilities to south – but residents noted you have to cross Butu Wargan Drive to get to them
- Insufficient path access limits degree of use
- Need to improve visibility and surveillance to BBQ's
- Lack of toilets – may detract from some users – however some felt lack of toilets discouraged a lot of use from outside area
- Need to review role of floodway open space to north of lake (below dam) – Council noted that this has a floodway role – and uses are limited
- Could there be community gardens within area ? potential to cater for residents in higher density housing
- Improve use of the "sunken area" – review access and shade
- Potential for a kiosk facility near site to serve recreational use – meeting noted that a permanent building would be maintenance and vandalism issue – but potential for "pop up" eg weekend use can be looked into

Access

- Path loop needs to be completed as per original plans for area – this would enhance use
- Residents noted traffic calming is yet to be implemented – This is not a POM issue but Council agreed to follow up (note traffic calming now implemented)
- Cars from outside area park at night on dark road areas (eg below dam) – causes residents concerns

Public Hearing

A public hearing was provided during the public exhibition period in accordance with the Local Government Act. The public hearing provided an opportunity for the community to discuss the proposed categorisation of community lands. There were no changes to the plan arising from the public hearing. A further public hearing was held in December 2022 for the Draft Plan of Management amendment. There were no changes to the plan arising from the public hearing for the POM amendment.

Public Exhibition

The plan was placed on public exhibition for 28 days plus a 14-day ongoing response period (42 days total) in accordance with the Local Government Act. The exhibition period allowed for interested parties to comment on the Draft Plan. Council considered all comments and the final document was amended where appropriate.

An amendment to the PoM was undertaken in August 2022 for the proposed integration of a community garden in the Gateway Park space off Miles Crescent. The revised Plan of Management sections relating to the proposed community garden were placed on public exhibition in late 2022 to February 2023.

There were two submissions received at the completion of the exhibition period, which addressed the following matters:

Submission 1 – resident from Pemulwuy

- Supports community Garden proposal – will serve apartment dwellers and encourage community interaction
- Suggest the fencing needs to go in early – there is anti-social behaviour in the area
- The management model is important – suggest it could be like the Wenty Garden

Submission 2 – resident from Pemulwuy

- Great plan
- Can there be some safety measures with regards to snakes
- Could there be CCTV surveillance to assist in preventing vandalism
- Some visitors leave rubbish and even light fires
- Kangaroos move from Marrong Reserve to Lakewood Reserve and are a wonderful sight – but some safety / waring measures would be desirable
- Clean of lakes would be great

In response to the above comments it is recommended that no changes are required to the plan of management in finalising the plan for adoption. In relation to the issues raised in the two community submissions received in February 2023 the following considerations are noted:

- Snake signage is already present throughout the parks in Pemulwuy.
- The dumping and vandalism mentioned in feedback is at a different location not covered by the Lakewood ERC PoM.
- While road signage for kangaroos may be an appropriate measure, actioning it is not within the remit of parks management. Therefore it is proposed that Council officers will address this issue with Council's Roads Teams as a separate matter.

2 CONTEXT

2.1 Significance

District and Regional Significance

At a district level the Lakewood Estate Riparian Corridor is part of the Girraween Creek catchment draining north to Toongabbie creek which in turn joins the Parramatta River just north of Parramatta Park. The riparian corridor and the wetland zones within it will play an ongoing role in water quality management and flood mitigation for this catchment. The drainage and access connections potentially afforded by these creek corridors are recognised in the NSW Governments Green Grid initiative, where Sydney is envisioned interconnected by the "green and blue" grid of vegetation and water that the corridors provide. Whilst not directly on one of the grid links the corridor can provide part of the support network that links neighbourhoods to the broader grid, with quality shared path access and the facilities that can make these a rewarding experience (for example: interpretation, rest points and the like)

Consultation with Aboriginal community representatives during the development of the draft POM identified that the site is also an important piece of open space curtilage to the landscape of Prospect Hill which has long associations with Aboriginal habitation in the area and is also significant for its role in the cessation of hostilities between Darug people of the area and colonial settlers; a landmark in Aboriginal – European relations. The community sees the riparian corridor as a place that provides opportunities to conserve natural vegetation and habitat and through interpretation to celebrate the Aboriginal communities of the area.

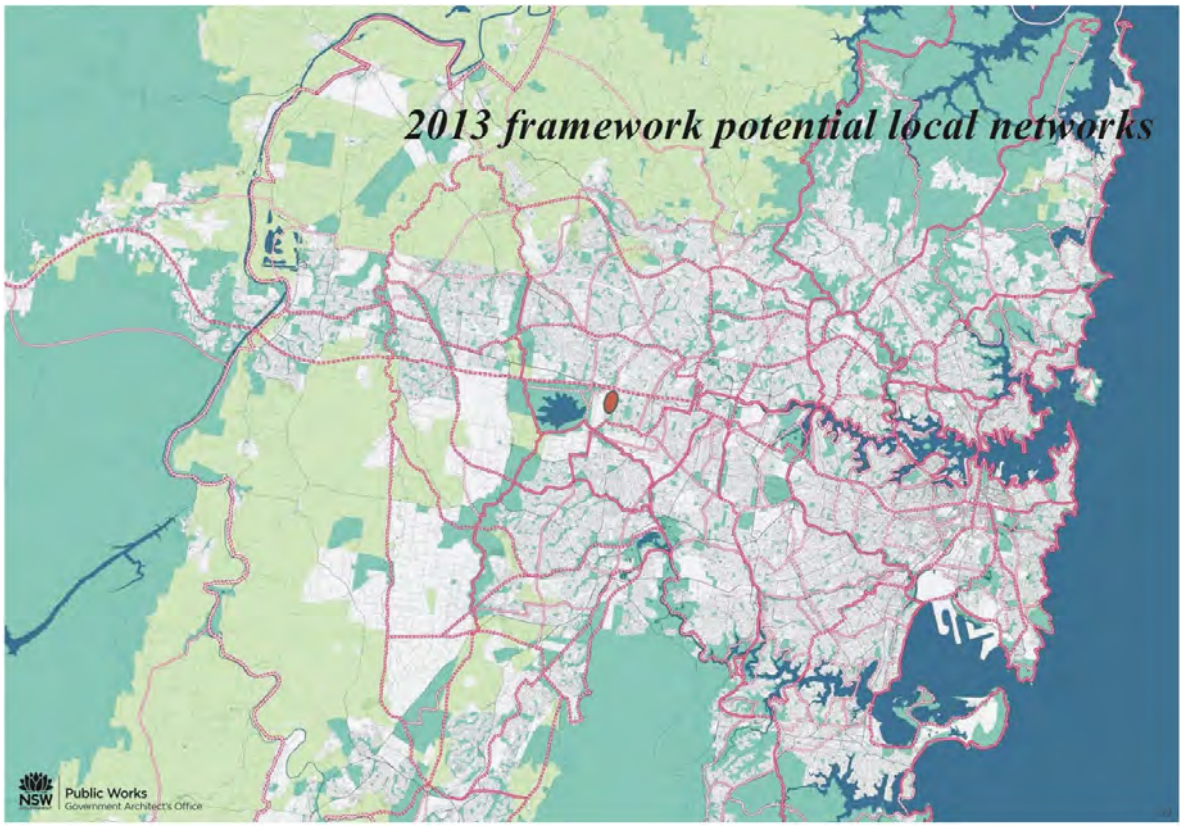


Figure 2.1 District Context The Sydney Green Grid – the location of the riparian corridor highlighted in red

Local Significance

Covering an area of over 13 hectares the reserve has road frontages to all edges. The reserve is a focal heart of the adjoining residential communities with the wetland water body providing a green visual buffer and low key recreational focus. As per Figure 2.2 Local Context below, adjoining communities are primarily focussed to the east and south with the M4 Motorway (north) and Prospect Reservoir Lands (west) defining the day-to-day user catchment. Figure 2.1 also indicates distance from the corridor as a series of 1km radii. The corridor and local road systems provide access onto a broader network of shared pedestrian and cycle access providing a variety of loops and connections. Completion of the shared path loops to the western side of the corridor as proposed in the Former CSIRO Site, Pemulwuy Precinct Plan 2007 would enhance the role of the corridor for recreational access.

To the south the corridor links the residents immediately living to the west and east to the Pemulwuy Marketplace via Nelsons Square.

The details of recreational use and role of the park are discussed in more detail in Section 2.5 of this Plan.

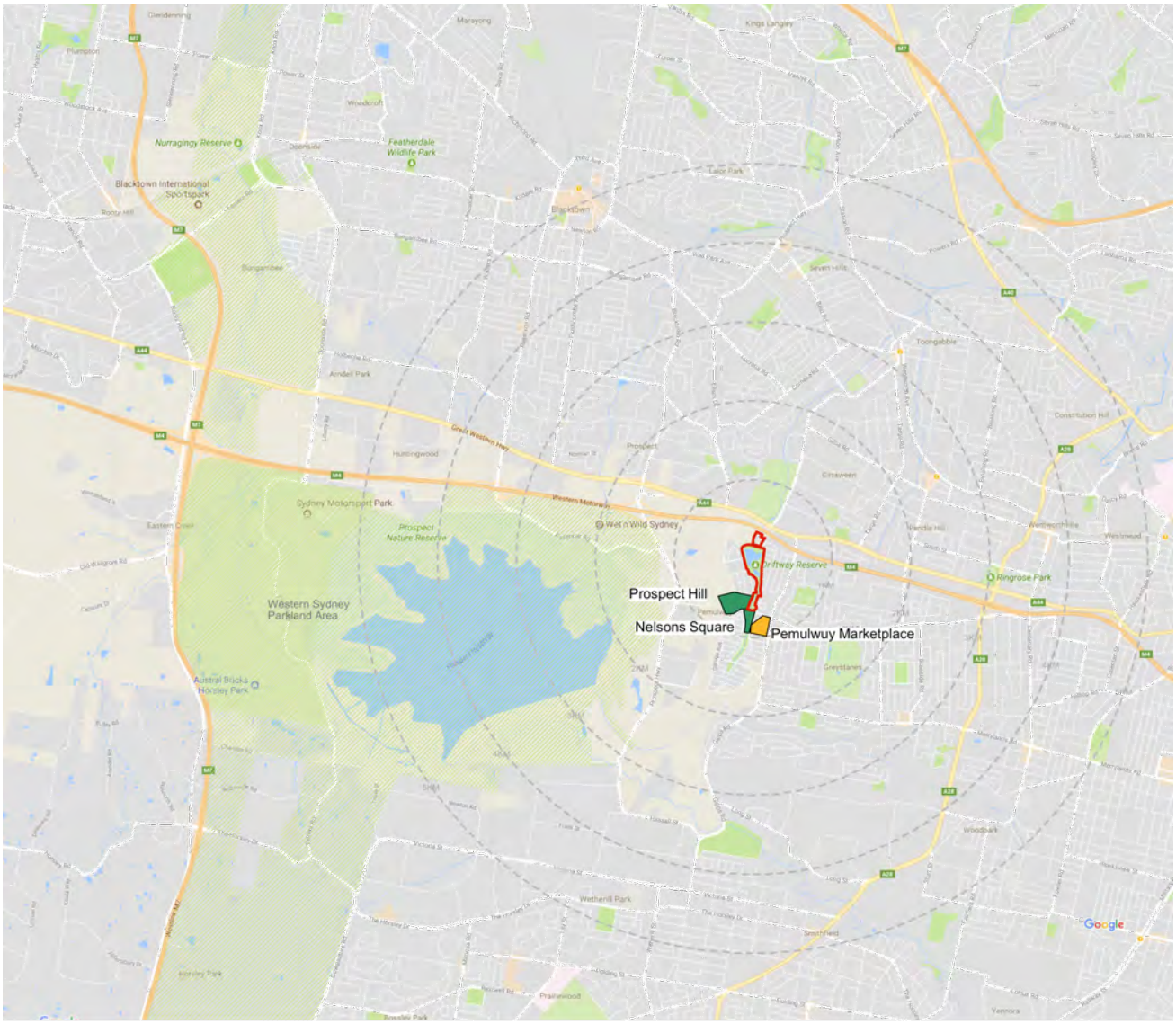


Figure 2.2 Local Context

2.2 Cultural and Historical Significance

2.2.1 Aboriginal heritage

The Cumberland Council Local Government Area was inhabited by people of the Darug Nation. The Darug people consisted of many clans and were united by a common language, strong ties of kinship and survived as skilled hunter–fisher–gatherers in family groups or clans scattered throughout much of what is modern-day Sydney.

The Aboriginal population for the Sydney region in 1788 has been estimated as being between 5000 and 8000 people, of which about 2000 belonged to the inland Darug people: 1000 between Parramatta and the Blue Mountains and 1000 between what are now Liverpool and Campbelltown.

The Darug people were thought to have lived in bands or communities of around 50 members each. Each band retained its own hunting district, and each lived a semi-nomadic lifestyle, regularly changing location within this district. The Cennemegal or Weymali (or Warmuli) clan occupied Prospect and Greystanes while the Bidjigal clan occupied the Merrylands and Bankstown area. The Bidjigal tribe included the famous warrior Pemulwuy who fought a guerrilla war against white settlement from 1797 to 1802. The Burramattagal clan of Parramatta/Granville were the western Eora clan. Eora land extends from Sydney Harbour to Parramatta.

These quiet and peace loving Darug peoples were present in the region well into the 1840's. It is thought that Aboriginal people did not camp within this area of Pemulwuy for long periods of time, but possibly passed through on their way to surrounding areas, such as Prospect Hill. On occasions they established campsites near the Girraween Creek, possibly in summer and autumn, when the stream contained sufficient water and foods, such as edible plants, yabbies and fish.

The Cumberland Local Government Area includes many areas of historical importance including Prospect Hill which is located approximately 1.5 kilometres from Lakewood Estate Riparian Corridor. Consultation with Aboriginal community representatives during the development of the draft POM identified that the site provides an important open space curtilage to the landscape of Prospect Hill which has long associations with Aboriginal habitation in the area. Prospect Hill was the site of the first recorded attempt of reconciliation between the Darug Aboriginal people of western Sydney and European settlers in NSW. On 3 May, 1805, a group of Aboriginal women from the area, the Kennedy family and Parramatta judge Samuel Marsden facilitated a meeting between Aboriginal leaders and European settlers at Prospect Hill. It was the first step towards the eventual end of ongoing conflict in Parramatta and Prospect as Aboriginal women offered and shared food with the men whom they believed responsible for killing their husbands and sons.

The Aboriginal Stakeholder Forum undertaken in August 2017 (refer Appendix for full forum summary) identified that conservation of the creek tributary and related wetland habitats are a symbolic reference to the past natural environment of the area and the habitation and stewardship of the Darug peoples. As such the riparian corridor is important to todays Darug descendants and Aboriginal people generally.

2.2.2 European heritage

European occupation of these lands including the subject site over the past 200 years has seen it used for agriculture, a US army camp during WWII and more recently as a CSIRO animal research laboratory. Figure 2.3 Recent Timeline, identifies key milestones in the post European history of the site where the most significant change has occurred.

The Lakewood Heritage Interpretation Report 2016 for Stockland identified that for the majority of the 19th century the lands in the area of the Lakewood Estate development area was divided into two precincts. The west side comprised the early land grants bordered by a central driftway (a common right of way for cattle) while the land on the east was wholly owned by the Wentworth family. The original grants in the west awarded to the emancipated convicts Butler Lisk Parish and Nichols were sold and on-sold numerous times. The eastern portion remained uncleared woodland until October 1819 when the original Wentworth grants were made – the smaller of these extending westwards to Girraween Creek. By the 1820's most of the land had been fully cleared and used for pastoral proposes. By the 1870's the growth and production of cereal crops across the Cumberland Plain had ceased as better lands had been cultivated to the north and south. From this time the Lakewood area was primarily used for grazing livestock. The Lakewood Heritage Interpretation Report 2016 provide a detailed tabulation of the land ownership history from 1791 to 2000.

Quarrying was another local landuse in the area from as early as the 1820's as the dolerite outcrops of Prospect Hill were won. More extensive quarrying started in the 1880's when the Prospect Reservoir was constructed. The quarrying activities don't appear to have extended further north into the Riparian Corridor site.

Between 1942 and 1945 the US Army occupied a large area at Prospect which included the Lakewood area. This formed a staging zone from which troops and supplied were assembled and camped. The Lakewood Estate development area was totally encompassed by the camp but no physical remains have been identified.

CSIRO acquired 48 hectares in the Lakewood area in 1948 and a further 15 hectares in 1963. 6 hectares were resumed for the construction of the M4 motorway in 1990. CSIRO used the property until the early 1990's for research into animal behaviour. Initially the site acted as a field station for the sheep biology laboratory of the then division of animal health and production. In 1959 it was renamed the Ian Clunies Animal Research Lab and became the headquarters for the division of animal production.

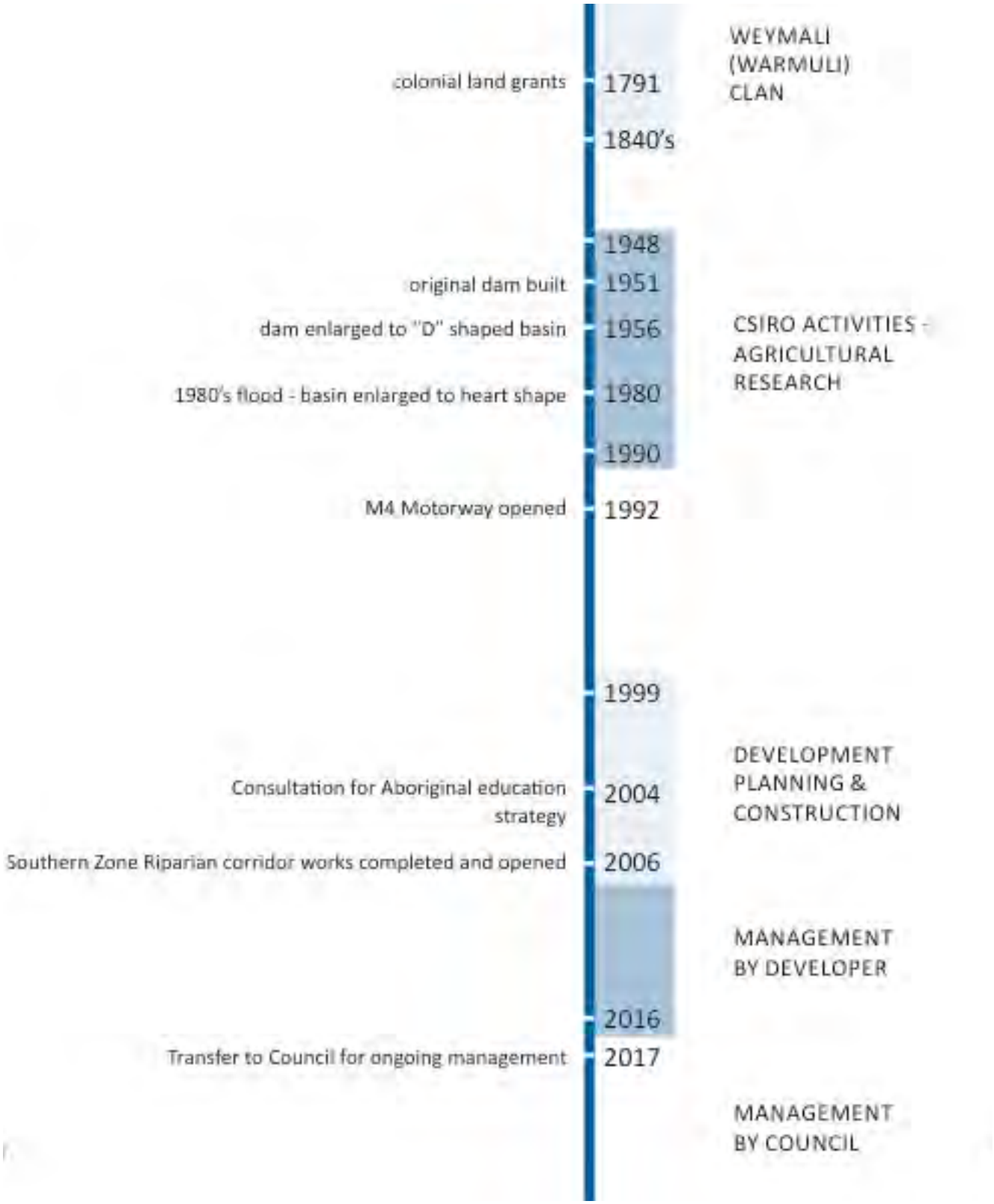


Figure 2.3 Recent time line (post European)

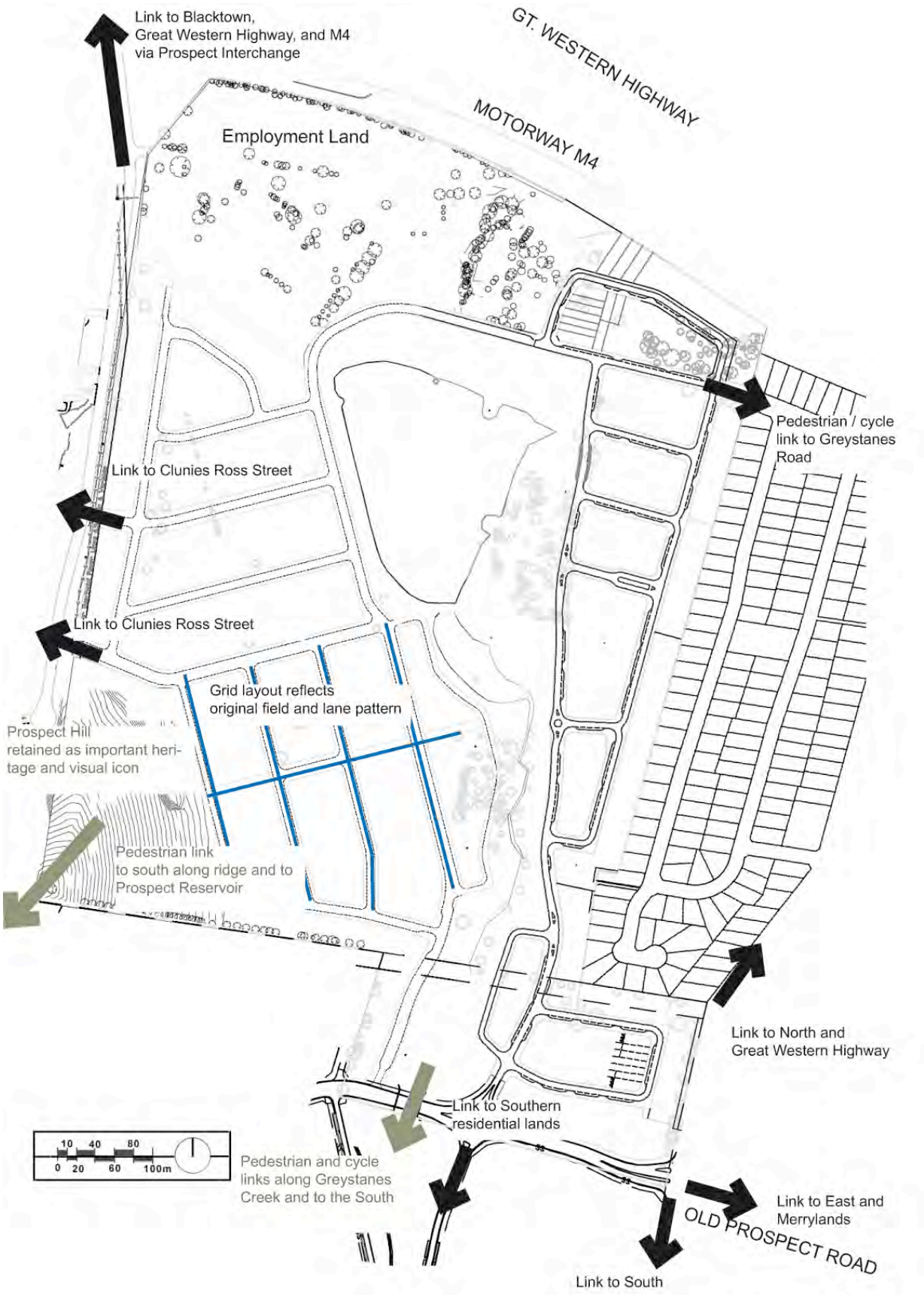


Figure 2.4 "Links to surroundings and the past"
Source: Former CSIRO Site, Pemulwuy Precinct Plan 2007

2.2.3 Interpretation of heritage values

The Aboriginal Heritage at Lakewood Prospect – Plan of Management May 2004 (AHLP POM) prepared by ERM identified that interpretation of the former CSIRO site will take into account both Aboriginal and historical occupation and heritage, but that the focus for Aboriginal interpretation would be the "Riparian Corridor Area" the subject site of this plan of management. The consultation at that time identified that interpretation of the site may take the form of "commissioned art works integrated with Aboriginal knowledge of the ecology heritage and significances of the place".

Street signage

Input into naming for streets parks and waterways – confirmed in the Lakewood Heritage Interpretation Report 2016

Interpretive signage

Devised in collaboration with Aboriginal stakeholders

The Lakewood Heritage Interpretation Report 2016 identifies recommendations for a number of interpretive signs developing key heritage themes for the site including:

- Aboriginal heritage and archaeology
- Ecology of the Cumberland Plain
- Contact history and first land grants
- Local quarries and railways
- WW II history and
- Former CSIRO

The document provides text and images collated for use in this signage

Existing interpretive signage installed on site

2.3 Physical Site Factors

2.3.1 Climate

The Vegetation Management Plan (VMP) for Girraween Creek identifies that the climate of the area is characterised by warm to hot summers (average summer temps 17.1-27.7 degrees C and cool to cold winters average winter temps 6.9-17.8 degrees C with average annual humidity of 62.9%.

Rainfall is consistent throughout the year with highest rainfalls occurring on average from January to March and lowest rainfalls on average from July to September. Average rainfall is 860mm per annum and frosts are common during the winter months.

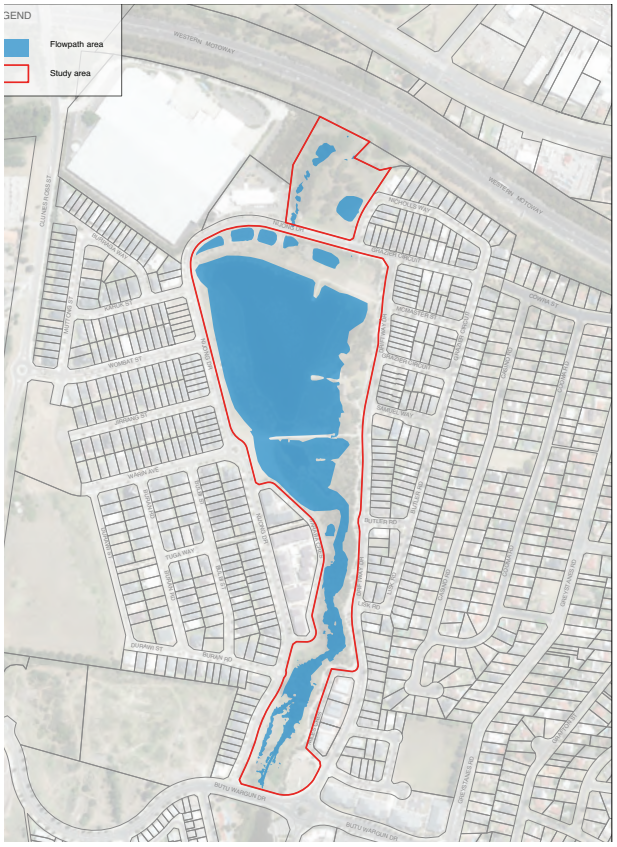
2.3.2 Landform and drainage

The study area is typified by generally undulating topography rising gently from north to south towards Prospect Hill. Prospect Hill is a major landform in the local area rising to 117m above sea level and provides views across the Sydney Basin significant to both Aboriginal and European cultural heritage.

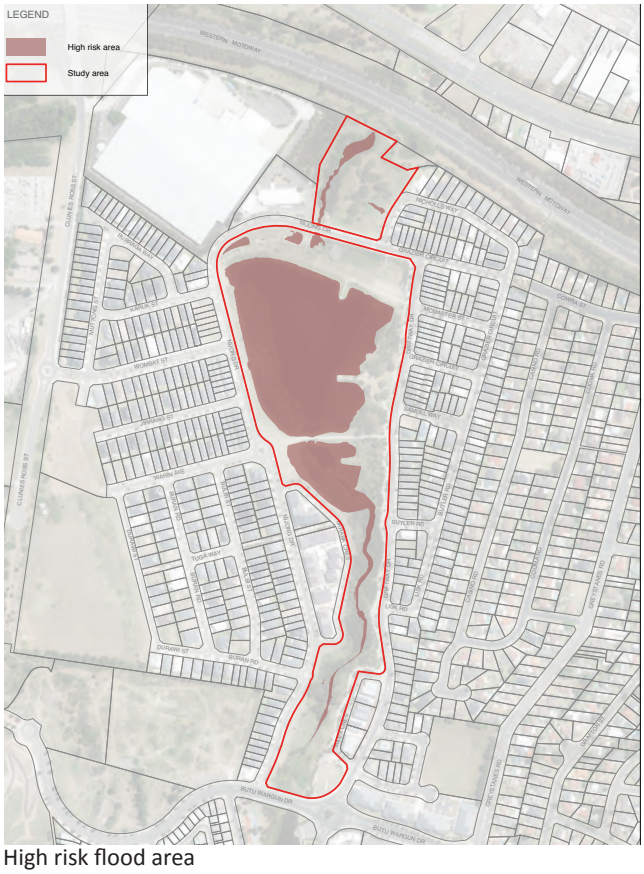
The site is located in the upper reaches of the Girraween Creek catchment. Locally the creek flows from south to north through the riparian corridor as largely a natural watercourse before forming into a large farm dam. The construction of the stock dam during the CSIRO era blocking a branch of Girraween Creek collecting water in a broad basin was a significant influence on the landscape of the site. The dam was initially constructed in 1951 with a small rectangular basin which was enlarged in 1956 to a larger D shaped basin. The creek flowed down the east side of the water body and was diverted into or out of the basin as required. A flood in the 1980's was the catalyst for the dam being enlarged to a heart shaped lake which entirely blocked the Girraween Creek. In 2005 the lake was revegetated with native vegetation, and enlarged so that on the northern margin a small detention basin was enabled which controls water flow during high rainfall events.

Overflow from the dam continues north beneath the M4 motorway flowing into Toongabbie Creek a tributary of the Parramatta River approximately 7 kilometres downstream.

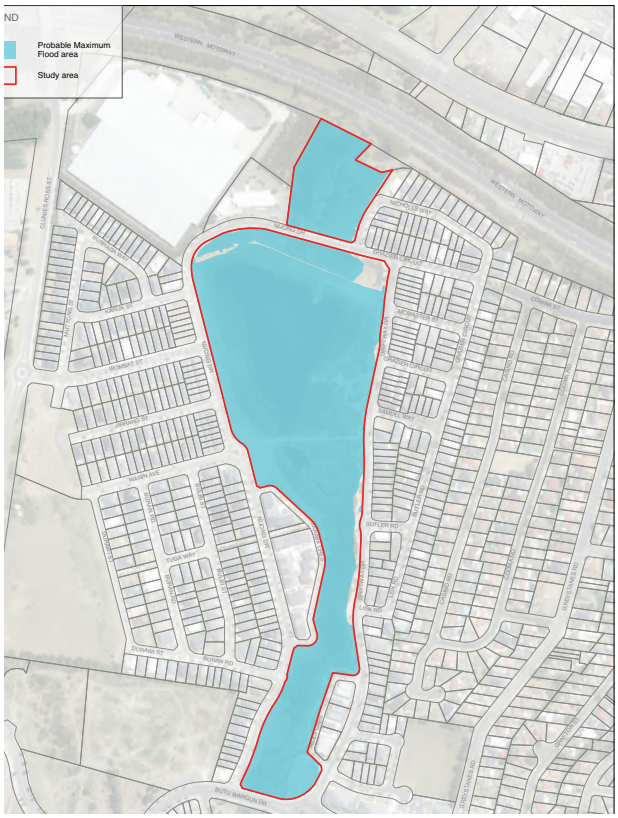
View from the north west corner of the main wetland back to the south east



Flow path



High risk flood area



Probable maximum flood extent

Flood Storage

Source: Cumberland Council Flood Mapping 2017

Figure 2.5 Stormwater Mapping
Source: Cumberland Council

2.3.3 Soils

The Vegetation Management Plan (VMP) for Girraween Creek identifies the soils landscape for the subject site as the fluvial South Creek Landscape. This typically comprises deep Quaternary Alluvium derived from the Wianamatta Group Shales and Hawkesbury Sandstone. It is also typified by high erosion hazard, low strength and generally lies on flood pone lands.

The VMP notes that test pits on the site indicated localised areas of moderate salinity, moderate to high erodibility, and elevated pH levels within the subject site. It adds that the vicinity of the subject site groundwater has been identified below depths of 1.4 to 2.05m which is slightly to moderately saline. Within the creek wet weather flow was assessed to be non saline however dry weather conditions would likely result in an increase in creek water salinity levels. Overall the report notes that there appears to be little surface evidence of salinity issues on the site, however that salinity amelioration works may be required when exposing B and C horizon soils, and excavated soils must be replaced in original order to avoid bringing salts to the surface

Various studies have indicated that the soils have been impacted by years of pastoral activities and are subject to high levels of weed propogule storage from pastoral crops and grasses.

2.3.4 Vegetation

The Spackman Mossop Vegetation Management Report (VMP) 2003 relates to the open space areas to the south of the subject site. The Linear park zones detailed in this report adjoin the riparian corridor to the south and are of relevance. The Vegetation Management Plan (VMP) for Girraween Creek prepared by PSB in 2004 outlines the vegetation management strategies adopted for the study area and which have been progressively implemented up until the present. A number of specific mapping studies have been undertaken on the flora and fauna of the study area which have informed the VMP documents including Hayes Environmental in 2002. The VMP for Girraween Creek 2004 provides a summary of the findings of these studies.

This document identified that the site was heavily impacted by past clearing for agricultural uses and ongoing pastoral uses. Although degraded the site did however support some significant areas of remnant native bushland including Sydney Coastal Riverflat Forest (SCRFF), – (endangered ecological community) adjacent to the creekline and Threatened Species Conservation (TSC) Act listed Cumberland Plain Woodland to the more elevated areas to the south. Other management zones identified included Disturbed terrestrial (DT) and Freshwater Wetland (FW – the stock dam).

The VMP notes the associated Bushland Management Plan recommended a series of restoration and rehabilitation works that were devised to redress the threatening and degrading processes currently impacting CPW and SCRFF. Refer to the Ecohort Bushland Management Plan for the reconstruction methodology and maintenance recommendations. The full species lists are provided in the Appendix to this POM. Restoration works have been implemented in accordance with the Bushland Management Plan – refer to section 3 – Management Strategies of this POM for related ongoing vegetation management strategies

Figure 2.6 Vegetation Strategy
Source: Former CSIRO Site, Pemulwuy Precinct Plan 2007

2.3.5 Fauna

As noted in 2.3.4 the site supports existing areas of Sydney Coastal Riverflat Forest (SCRFF) and Cumberland Plain Woodland (CPW). The Flora and Fauna Assessment for the Former CSIRO Site 2002 by Hayes Environmental identifies that the Grey headed Flying Fox is a "threatened species" on the Threatened Species Conservation Act (TSC) 1995, is known to occur in areas to the north south east and west of the site, and that the site may play a role in this species habitat. The report also noted that the following fauna was identified in field surveys in 2002:

- 54 vertebrate species
- 35 native bird species
- 6 introduced bird species
- 2 amphibian species
- 4 reptile species
- 2 native mammal species
- 5 introduced mammal species

Refer to the Flora and Fauna Assessment for the Former CSIRO Site 2002 by Hayes Environmental for species lists (Appendix 2)

2.3.6 Maintained grassland areas

The riparian corridor includes several planned areas of maintained grass generally as indicated on the Vegetation Strategy (figure 2.6). Additional maintained grass areas occur on the eastern side of the dam wall (adjoining the access path to the northern viewing deck) and along the western edge of the riparian corridor and wetland. These additional grassed areas have some benefits in providing additional passive recreational space (for example those adjoining the wetland – see photo below), however the areas adjoining the water basin are less desirable for any use. The area on the eastern side of the dam wall was proposed to be native grassed area but was not implemented during development works due to the developers embellishment limitations.

Maintained grassed area between Nijong Drive and wetland water body

Maintained grassed area between Nijong Drive and riparian corridor

These areas may be preferred by adjoining residents as providing a more manicured / controlled interface with roads / residences however in both cases the interface of maintained grass and natural vegetation or water edge is problematic for Council. The exotic grass species escape easily in to the riparian corridor and the definition of the edge becomes increasingly difficult and untidy. Opportunities to simplify these edge conditions should be explored. The mowing of grass in the park is undertaken by Cumberland Council.

2.3.7 Riparian zone

The riparian corridor adjoining the creekline was subject to a major revegetation project as part of the Pemulwuy development. The corridor was planted with native grasses and groundcover species and a range of mid storey and canopy trees. As noted above management of the edge of this zone to maintained grassed areas is challenging. In addition recent council maintenance activities within the creek alignment have revolved around bulk slashing (see photo following page) which will reduce the species diversity and enable weed species to take more effective hold

2.3.8 Wetland water body

The Dam constructed by CSIRO in 1951 was modified in 1956 and again in the 1980's to better manage flooding now forms a large heart shaped lake at the centre of the riparian corridor reserve. The lake has been the site of ongoing problems with Alligator Weed (Alternanthera philoxeroides) an emergent aquatic weed impacting on both aquatic and terrestrial environments. A management strategy has been developed for this serious weed issue (Refer 3.0 Management Strategies – full document included at Appendix D.)

Above and below: Creek alignment between Butu Wargun Drive and the main lake / wetland – bulk slashing of area has been recently carried out (June 2017)

2.4 Facilities

2.4.1 Buildings and structures

There are currently no buildings within the Lakewood Estate Riparian Corridor. There are however several structures.

Gateway Park

Picnic shelter:	-galvanised steel frame / and colourbond roof
Pergola structures:	-galvanised steel frame / and colourbond roof
Tree sculpture	-galvanised steel frame – timber insets

Riparian walk

Pergola structure:	-galvanised steel frame / and colourbond roof

Eastern Picnic Area

Lakeside lookout deck:	-stone clad walling
	-timber deck
	-galvanised steel frame / and colourbond roof
Picnic shelter:	-galvanised steel frame / and colourbond roof

Northern dam wall

Lakeside lookout deck:	-stone clad walling
	-timber deck
	-galvanised steel frame / and colourbond roof

The general condition of the structures is fair to good. Some steel and timber surfaces are subject to graffiti, whilst timber decking will require yearly maintenance to assist longevity, and annual monitoring to check condition and fixings.

Shelter deck to northern dam wall

Gateway Art Structures to gateway park

2.4.2 Park furniture

Each of the park nodes within the riparian corridor has furniture elements supporting recreational use:

Gateway park

Picnic table:	-aluminium frame and timber batten banquet table and benches
Custom seats:	-cast concrete custom seat – with timber edge strip and single concrete pedestal backrest
Sign plinth:	-cast concrete sign pedestal with aluminium sign panel
Cycle racks:	-stainless steel hoops
Bin enclosure:	-powder coated bin enclosure

Riparian walk / shared path

Custom seats:	-cast concrete custom seat – with timber edge strip and single concrete pedestal backrest
Sign plinth:	-cast concrete sign pedestal with aluminium sign panel
Distance markers:	-cast concrete sign pedestal with engraved distance
Drinking fountain:	-disabled access drinking fountain

Eastern Picnic Area

Picnic table:	-aluminium frame and timber batten banquet table and benches
Custom seats:	-cast concrete custom seat – with timber edge strip and single concrete pedestal backrest
Cycle racks:	-stainless steel hoops
Bin enclosure:	-powder coated bin enclosure
BBQ	-double electric BBQ facility

Northern dam wall

Lakeside lookout deck:	-stone clad walling
	-timber deck
	-galvanised steel frame / and colourbond roof

Typical custom seat and signage plinth to corridor as implemented by developer

2.5 Visual Character

The corridor is an important part of the amenity of the local residential neighbourhood. The corridor forms a green heart out onto which adjoining streets and residences overlook. The vegetated character of much of the corridor means that although it is as narrow as 50m (up to 260m at the lake) there are limited direct views across to residences on the other side of the corridor. This creates a sense that the corridor is larger than it is, contributing to a sense of being in a parkland setting.

Views across the lake water body are available once you move into the reserve through the fringing tree canopy and other vegetation. These are attractive outlooks with a diversity of outlooks available from various view points around the lake.

For the shared path system that passes north south along the corridor ongoing vegetation management will have a significant impact on the type of experience provided. At the time of preparation of this document the creekline section of the corridor has been subject to bulk slashing which exposed the creekline and opened up lower level views. This reduces somewhat the sense of being within a riparian corridor and needs to be considered going forward for the best balance between character and maintenance approaches by Council.

Vegetation limits direct views across the corridor between residential areas creating a sense of space and sense that the corridor is larger than it is

2.6 Current Recreational Usage

There are a number of small "pocket parks" through the corridor that are of different character and provide for varied uses by the community. These are reviewed in the table following:

Location	Facilities	Activities	Factors influencing use
Gateway park	- Picnic table - Custom seats - Sign plinth - Cycle racks - Bin enclosures - Level grassed area - Grassed slopes - Gravel pavements / paths	- Informal recreation - Picnics - sitting	- lower grassed area is significantly set down and isolated from street level with minimal outlook – may discourage some use - Flat grassed area for games etc is limited - Poor condition of stabilised gravel pavement areas
Riparian walk / shared path	- Custom seats - Sign plinth - Distance markers - Drinking fountain	- Walking / jogging - Cycling - Children biking / scooters	- The riparian walk is generally level and provides an excellent community resource - Completion of the full loops to the west side of the corridor will improve amenity
Eastern Picnic Area	- Lakeside lookout deck & shelter - Picnic table - Custom seats - Cycle racks - Bin enclosure - BBQ - Gravel pavements / paths - Maintained grassed areas adjoining picnic tables	- Informal recreation - Picnics - Sitting - Viewing from deck	- Is the major recreational space in the corridor providing the most amenity and facilities along with views to the lake - A good quality space that is well used - Gravel paths in poor condition and could be transitioned to better wearing / but "visually soft" surface (eg asphalt)
Northern dam wall	- Lakeside lookout deck & shelter - Maintained grassed zones adjoining path link to deck	- Viewing from deck	- Alternative viewpoint to lake – accessible from shared path - Future continuation of shared path to western shores below dam wall will provide through access and enhance use of shelter - Not defined as "park" area in Precinct Plan – desirable to provide native grassed cover
Western foreshore	- Maintained grassed zones adjoining lake edge		- Defined as Riparian Woodland in Precinct Plan currently – however maintained grassed foreshore - Future continuation of shared path to western shores will provide through access and increase use of this zone - Review vegetation strategy in light of these factors

2.6 Planning Considerations

2.6.1 Adjacent land use

The land surrounding the Lakewood Estate Riparian Corridor is largely zoned R3 – Medium Density Residential in the Holroyd Council LEP 2013 – which remains the standing control for the former Holroyd now Cumberland Local Government Area. There are two small pockets of R4 – High Density Residential to the east and west of the creek corridor. Refer to Figure 2.7 following page

2.6.2 Zoning and planning controls

The corridor is zoned RE1 – Public Recreation under Holroyd Council LEP 2013 and is classified as community land under the Local Government Act 1993.

The Holroyd LEP 2013 identifies the objectives of the RE1 Public Recreation zone as follows:

(a) To enable land to be used for public open space or recreational purposes.

(b) To provide a range of recreational settings and activities and compatible land uses.

(c) To protect and enhance the natural environment for recreational purposes.

Within these areas the following works can be undertaken without development consent:

- Environmental protection works

The following activities are only permitted with Council consent

- Child care centres; Community facilities; Environmental facilities; Information and education facilities; Kiosks; Recreation areas; Recreation facilities (indoor); Recreation facilities (major); Recreation facilities (outdoor); Respite day care centres; Roads; Signage; Water recreation structures

Any other works or activities other than those listed above are prohibited in areas zoned RE1 - Public Recreation.

In addition other prohibited activities for users in Lakewood Estate Riparian Corridor are communicated via signage and include: Golf practice, use of motorised vehicles, using firearms, flying model aeroplanes, horses and unleashed dogs, lighting of fires.

2.6.3 Access and circulation

The 2007 Precinct Plan for the Former CSIRO Site Pemulwuy indicated the intent of future access implementation through the Riparian Corridor (refer Figure 2.8 page 36). Access was to be provided north south along the length of the corridor linking to access systems beyond and connecting the "pocket parks" within. A series of loops around the corridor were earmarked with a central cross access. The continuation of links to the western side of the corridor are yet to be implemented.

The Holroyd DCP 2013 provided a local plan for cycle access. This identifies a north south link supported by the loops around the lake / corridor, and also indicates continuation of the cycle network to the south, including the connection to the Lower Prospect Canal corridor which links Prospect reservoir and the Western Sydney Parklands (west) with Guildford (to the east).

Figure 2.7 Zoning
Source: Former CSIRO Site, Pemulwuy Precinct Plan 2007

Figure 2.8 Uses including access and circulation
Source: Former CSIRO Site, Pemulwuy Precinct Plan 2007

2.7 Statutory Requirements

2.7.1 Local Government Amendment (Community Land Management) Act 1998

The Local Government Act and related amendments and guidelines provide the legislative framework for a council's day-to-day operation. The Act emphasizes through the Community Land Management amendments of 1998 a council's responsibility to actively manage land and to involve the community in developing a strategy for its management. Of particular relevance is the requirement for all council property classified as community lands to be categorised in accordance with the guidelines for the categorisation listed in the Local Government (General) Regulation (cl.6B-6JA).

2.7.2 Categorisation

The following table outlines the applicable community land categories for Lakewood Estate Riparian Corridor including the Guidelines for Categorisation as listed in the Local Government (General) Regulation 1999 Part 3 - Categorisation, use and management of community land

Category	Guidelines for Categorisation
Natural area wetland	The land include marshes, mangroves, backwaters, billabongs, swamps, sedgelands, wet meadows or wet heathlands that form a waterbody that is inundated cyclically, intermittently or permanently with fresh, brackish or salt water, whether slow moving or stationary.
Natural area watercourse	The land includes: a. any stream of water, whether perennial or intermittent flowing in a natural channel, a natural channel that has been artificially improved, or in an artificial channel that has changed its course, and any other stream of water into or from which it flows; b. associated riparian land or vegetation, including land that is protected land for the purposes of the Rivers and Foreshores Improvement Act or the Native Vegetation Conservation Act.
Park	The land is used or proposed to be, improved by landscaping, gardens or the provision of non-sporting equipment and facilities, for use mainly for passive or active recreational, social, educational and cultural pursuits that do not unduly intrude on the peaceful enjoyment on the land by others.
General Community Use	Land that may be made available for use for any purpose for which community land may be used, and does not satisfy the definition of natural area, sportsground, park or area of cultural significance

The multiple categorisations for the Lakewood Estate Riparian Corridor reflect the multiple physical conditions present and the way the community interact and use these areas. Fundamentally the categorisations underpin the core conservation role of the corridor for the community including its water management and flora and fauna habitat functions.

However within the strong character of the natural setting provided by the riparian corridor and lake, there are several defined opportunities for community recreation and other use.
These are all linked together by the shared access system which connects each of the park recreation areas and traverses the Natural Area Watercourse.

Figure 2.9 Proposed Categorisations

2.7.3 Core objectives for community land management

The following core objectives from the Local Government Act 1993 clauses 36E-N guide the management of community land by Councils.

Category	Core Objective
Natural area wetland	(a) to protect the biodiversity and ecological values of wetlands, with particular reference to their hydrological environment (including water quality and water flow), and to the flora, fauna and habitat values of the wetlands, and (b) to restore and regenerate degraded wetlands, and (c) to facilitate community education in relation to wetlands, and the community use of wetlands, without compromising the ecological values of wetland
Natural area watercourse	a) to manage watercourses so as to protect the biodiversity and ecological values of the in stream environment, particularly in relation to water quality and water flows, and (b) to manage watercourses so as to protect the riparian environment, particularly in relation to riparian vegetation and habitats and bank stability, and (c) to restore degraded watercourses, and (d) to promote community education, and community access to and use of the watercourse, without compromising the other core objectives of the category
Park	(a) to encourage, promote and facilitate recreational, cultural, social and educational pastimes and activities, and (b) to provide for passive recreational activities or pastimes and for the casual playing of games, and (c) to improve the land in such a way as to promote and facilitate its use to achieve the other core objectives for its management
General Community Use	a) promote, encourage and provide for the use of the land b) provide facilities on the land, to meet the current and future needs of the local community and of the wider public: • in relation to public recreation and the physical, cultural, social and intellectual welfare or development of individual members of the public, and • in relation to purposes for which a lease, licence or other estate may be granted in respect of the land (other than the provision of public utilities and works associated with or ancillary to public utilities).

2.8 Management

Cumberland Council has the statutory responsibility for the management of the Lakewood Estate Riparian Corridor. Aside from the standard regulations that apply to the site, groups using the park are generally regulated through Council. Large groups need to apply to Council in order to hold formal gatherings within the park.

Management responsibilities are discussed in more detail in Section 4.2. Under the Local Government Act 1993 Council is able to delegate some of its functions to a committee of Council. Council uses this delegation and appoints community people to manage its facilities or functions through a committee of management. There is no current committee for the Lakewood Estate Riparian Corridor.

2.9 Maintenance

The riparian corridor is currently being maintained in accordance with the Parks Asset Management Plan. As Cumberland Council consolidates and refines its parks management framework it is expected that the classifications may change, however it is unlikely that the maintenance framework applicable to this type of site would change significantly.

Maintenance Service Levels

Typically, cyclical maintenance activities are as follows:

Cumberland Maintenance Service Levels

Asset Group	Activity
Passive Parks and Reserves	• Three weekly maintenance cycle • Playground inspections and maintenance • Garden bed maintenance and regeneration • Tree maintenance
Streetscapes	• Landscaping and embellishment of council buildings, town centres and traffic islands • Street tree maintenance
Active Parks	• Fortnightly maintenance cycle • Annual renovation activities • Sports field preparations • Golf Course maintenance
Natural Areas	• Bushland regeneration and revegetation • Bushcare volunteer program • Asset protection zone maintenance
Premium Parks	• Botanic display design and maintenance • Event venues preparation and hosting • Fauna Park maintenance

Figure 2.10 Cumberland Council Maintenance Service Levels

Maintenance categories applicable to the Lakewood Estate Riparian Corridor would be:

- Natural Area
- Parks and Reserves

Routine maintenance of Parks and Recreation facilities comprises:

- Removal of unsafe trees and branches
- Maintenance of utility service e.g. irrigation, flood lighting
- Repair of minor defects within parks areas e.g. seats, play equipment
- Council's response to maintenance requests is based on staff experience, judgment and current industry practice.

Council's officers assess the requests or defects against the potential to cause harm to public property and life. High hazard defects are responded within 24 hours with a view to at least making the asset safe. Other defects requiring work are assessed against other operational priorities considering staff experience and judgement and responded within regular operational procedure. The groupings do not cater specifically for the hybrid landscape such as the riparian corridor which integrates stormwater function with natural area qualities. The reserve contains a number of customised elements including:

- Concrete and timber seating
- Concrete signage plinths
- 2 part timber bollards

As of 2017 these elements are starting to wear and age and will progressively require replacement over the next 5-10 years

There are no other agencies who have responsibilities related to the open space area.

Operations and Maintenance Manual

Prior to handover of the open space to Council an Operations and Maintenance Manual was prepared by Perfection landscapes (April 2015) for the developer Stockland. This plan outlined maintenance requirements for all landscape elements within the reserve. It also outlined the maintenance regime that had been undertaken in the reserve prior to handover. This regime was more intensive and comprehensive than Council's Parks and Reserves level of maintenance would be able to deliver

Buildings

There are currently no enclosed buildings within the park requiring maintenance.

2.10 Current Leasing Agreements

There are currently no leasing agreements.

2.11 Staffing

The maintenance of Lakewood Estate Riparian Corridor is currently carried out by Cumberland Council as identified in Section 2.9. If new facilities are developed then additional staff may be required to provide an acceptable standard of maintenance.

2.12 Community Involvement

The preparation review and updating of this Plan of Management has incorporated community input as outlined in section 1.4. An Aboriginal Stakeholder Forum and a Community Forum have been held to date with a Public Hearing to be held during the public exhibition period. Outcomes of these forums have and will continue to be integrated with the Plan of Management strategies.

The revised Plan of Management sections relating to the proposed community garden were placed on public exhibition in late 2022, and a Public hearing held on 13th December 2023. There were no changes to the plan arising from the exhibition period or public hearing.

2.13 Funding

The majority of funding for general maintenance and improvement works in the Lakewood Estate Riparian Corridor will come from rate revenue, Section 94 contributions for open space and partnerships with Government grant funding providers.

3 MANAGEMENT STRATEGIES

3.1 Introduction

The primary objective of this Plan of Management (POM) is to provide a framework for the future management of the open space. Decision making for the enhancement and management of Lakewood Estate Riparian Corridor aims to integrate the vision and needs of the community and Cumberland Council.

This Plan describes a basis for the ongoing care and development of Lakewood Estate Riparian Corridor in response to demand and the availability of funding. As such funding will be a major factor determining the timing of implementation of actions identified in the POM.

3.2 Management Philosophy

The management philosophy recognises the need for open space to be responsive and adaptable to ongoing and evolving community needs for passive recreational and active experiences. In addition the park must be sustainable in terms of its level of use and related maintenance demands.

3.3 Community Values, Roles, and Issues

Community values and roles have guided the development of the Plan of Management. In brief these are identified as:

- Environmental corridor providing for flora and fauna habitat
- Local informal recreational parkland including grassed spaces and recreational paths for the neighbourhood
- Open space and visual curtilage to Prospect Hill with its important Aboriginal cultural significance

Issues can be described as opportunities and constraints for consideration in the management and maintenance of open space areas. The main issues identified by stakeholders and the study team include:

- Incomplete path network – key priority is linking shared path around lake – residents suggested pedestrian only link was adequate to western side of corridor south of Baraba Crescent
- Rubbish dumping
- Aquatic weeds
- Feral and domestic animals and their impact on native animals and birds
- Maintenance of grassed areas and native grassed areas
- Secluded nature of some seating areas and the viewing decks can enable inappropriate use
- Lack of play equipment

Figure 3.1 on the following page illustrates some of these issues which need to be taken into account in future park management.

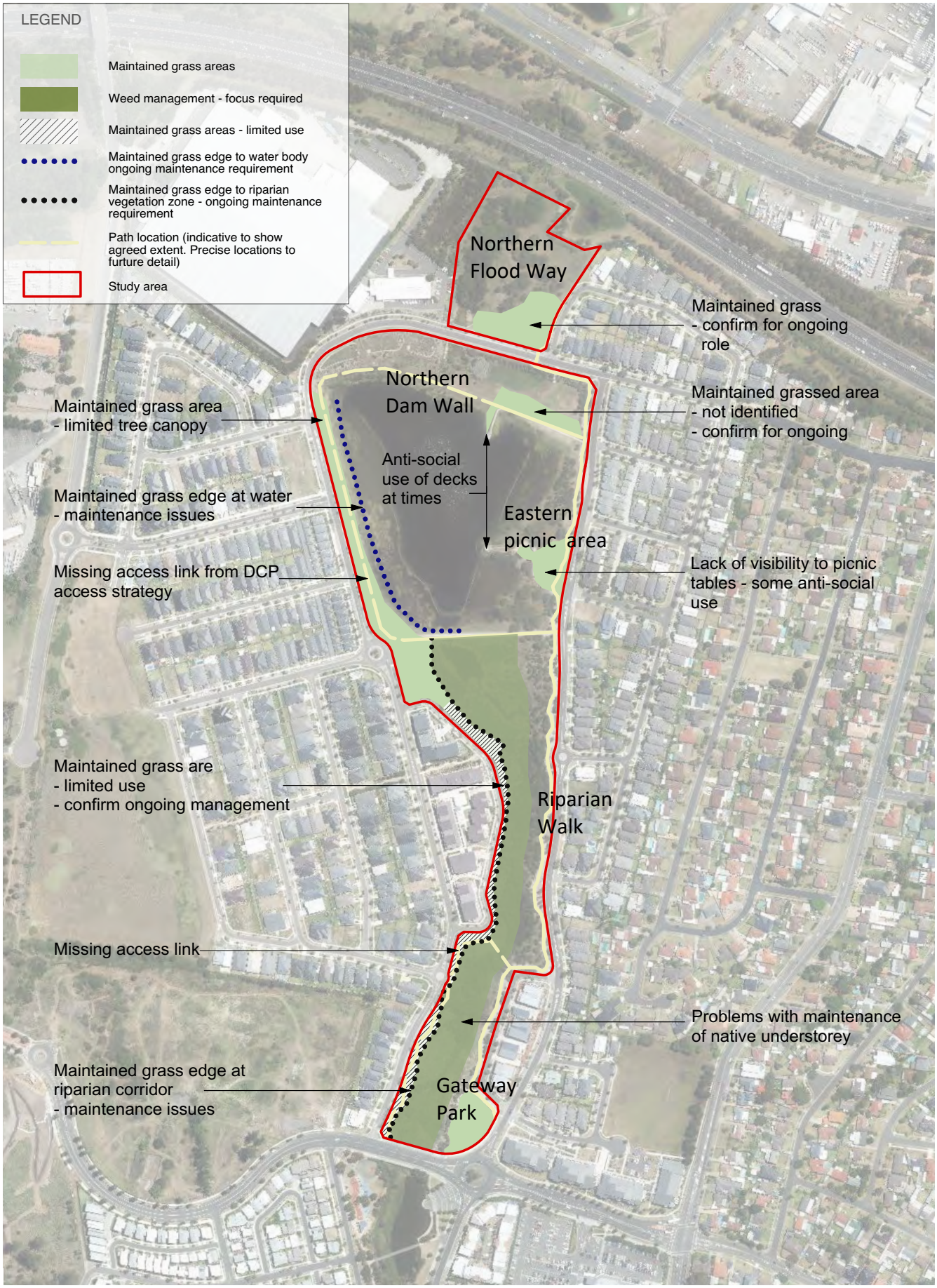


Figure 3.1 Issues

Facilities:

Gateway Park

- General level of provision adequate
- Need to address declining condition issues of existing facilities
- Need to address condition of stabilised gravel pavement – potential upgrade or replacement

Condition of existing facilities

Picnic shelter:	-good condition generally – some graffiti on posts
Pergola structures:	-good condition generally – some graffiti on posts
Tree sculpture	-good condition generally – steel frame discolouring in places
Picnic table:	-fair condition
Custom seats:	-poor condition – discoloured concrete / worn timber
Sign plinth:	-fair condition – some graffiti
Cycle racks:	-good condition
Bin enclosure:	-good condition

Riparian walk

- Potential for some additional interpretive elements as part of coordinated interpretive walk
- Need to address condition issues of existing facilities over next 5 years

Condition of existing facilities

Pergola structure:	-good condition generally – some graffiti on posts
Custom seats:	-poor condition – discoloured concrete / worn timber
Sign plinth:	-fair condition – some graffiti
Distance markers:	-fair condition – discoloured concrete
Drinking fountain:	-good condition

Eastern Picnic Area

- Need to address condition issues of existing facilities over next 5 years
- Need to address condition of stabilised gravel pavement – potential upgrade or replacement

Condition of existing facilities

Lakeside lookout deck:	-Good condition generally – timber requires treatment -Vandalised signage
Picnic shelter:	-good condition generally – some graffiti on posts
Picnic table:	-fair condition
Custom seats:	-poor condition – discoloured concrete / worn timber
Cycle racks:	-good condition
Bin enclosure:	-good condition
BBQ	-good condition

Northern dam wall

Lakeside lookout deck:	-Good condition generally – timber requires treatment

Western foreshores

- No facilities currently
- Potential for some seating integrated with pathway extension

Access and Circulation:

- The eastern side of the corridor has a continuous 2.5m wide shared path
- This was planned to extend as a loop to the western foreshores but is yet to be implemented – consultation identified that priority for shared path was to complete Lake loop. Continuous shared path access to western side south of Baraba Crescent was not essential – a pedestrian path within the verge was suggested by the community forum to be adequate
- Could be supported by continuation of any interpretive walk and by targeted seating
- Potential for additional creek crossing in south section of riparian walk

Recreation:

- East section of park caters well for local neighbourhood activities
- Usability of western foreshores could be increased

Landscape

- Introduction of shade tree planting to western foreshores would be desirable to enhance amenity for users

Maintenance:

Current maintenance issues include:

- Sustainability of ongoing native grass maintenance through southern section of riparian corridor
- Small zones and pockets of maintained grass add to recurrent maintenance demand but would need to be replaced by a lower maintenance treatment (eg native grass)

3.4 Planning and Management

The Action Plan outlined in section 4.5 of this document provides a prioritised list of the actions arising from this Plan of Management and is based on consultation, review of background information and site investigations. The proposed Action Plan is supported by the Landscape Concept Masterplan (refer Figure 3.2) in describing the recommendations of this Plan of Management. The Plan of Management seeks to guide ongoing improvement and maintenance of the park. The recommended actions are based on a sequence of tasks required to successfully complete the work. Council will seek to undertake those actions of high priority first as well as implement any investigations that are needed to inform detailed planning and design.

3.5 Access and Circulation

3.5.1 Recreational Access

The corridor is noted on Councils Bikeways planning as being integrated on north south off road corridors and can link to the west via Prospect Hill and Prospect reservoir to the Western Sydney Parklands corridor. Development of the reserve by the estate developer has provided a reasonable level of facilities although the proposed loop shared path has only been developed down the east side of the corridor and linking across Niljong Drive towards the M4. The continuation of the loop path around the northern edge of the lake and along the western foreshores was a recommendation of the undertaken in 2018.

3.5.2 Vehicular access and parking

There is no public vehicular access within the reserve. There is limited parallel parking available adjoining the riparian corridor to Driftway Drive and Nijong Drive being pockets of 2-3 spaces for use by residents. Parking availability should be considered when looking at potential for events in the area.

3.5.3 Maintenance and emergency access

Vehicular access will be restricted to lockable gates from Driftway Drive and Nijong Drive as occurs currently. Maintenance vehicles partially use the shared path system or otherwise move over grassed areas.

3.6 Grassed recreation areas

Original planning for the open space area identified three maintained grassed areas (refer Figure 3.2 below):

1. Gateway Park
2. Eastern Picnic Area
3. Small area to west foreshore adjoining weir walkway near Warin Avenue

In development of the reserve several additional zones of maintained grass have evolved:

4. Western Foreshores
5. North Dam wall
6. Barbara crescent / Niljong Drive verge south
7. North Floodway

Figure 3.2 Current maintained grassed areas

The retention of grassed areas should be based on their community benefit and use. A review of the areas through the plan of management and including input from the community workshops has identified the following recommendations for maintained grassed areas:

Areas to be retained / refurbished

1. Gateway Park: Limited use due to sunken position. Re-purpose as Community Garden to activate the space and complement range of activities and community benefits available to the community on the broader site.
2. Eastern picnic area: Part of the original planning concept for the riparian corridor. Developed to date with support facilities and well used by the community

3&4 Western Foreshore: Major part of west foreshore was earmarked on original planning concept as vegetated. Preferred to be maintained by community as maintained grass foreshore with a vegetated lake edge.

Areas to be transitioned to vegetated

5 Northern Dam Wall

Grassed area was not part of the original planning concept for the riparian corridor . Has limited potential for community use as maintained grassed area.

6. The maintained grass margins to the western side of the southern corridor create an ongoing demand for mowing and are of limited recreational value. Recommended to be transitioned to native grasses.
7. North Floodway

Part of the original planning concept for the riparian corridor although smaller. Community use is limited by flood potential- Recommended to be transitioned to native revegetation but retain small area of maintained grass with seating at corner recognising growing population and ease of access from street.

3.7 Provision of Facilities

3.7.1 Picnic facilities

Facilities through the riparian corridor have been previously implemented as part of open space development and cater for the communities day to day use. Generally the facilities are well located, fit for purpose, and in good condition. No new facilities are recommended arising from this plan of management.

3.7.2 Seating

Seating through the riparian corridor has been previously implemented as part of open space development and cater for the communities day to day use. Generally the seating is adequately located. As noted earlier precast concrete and timber seating is discoloured and

worn in places. Whilst it will need replacement in the medium term, short term high pressure cleaning and replacement of timbers should enable another 5-10 years of usable life.

Additional seating is recommended to targeted areas to complement community use as listed. Locations should cater for use in different positions and across the seasons and afford pleasant views across the reserve and the activities being undertaken:

- Western foreshores park seating using Councils standard park furniture

3.7.2 Pop up kiosk / cafe

The community stakeholder forum raised the possibility of a temporary kiosk / café facility on site during busy use times to support recreational use by the community. It is recommended that the concept be investigated further and be subject to a trial to confirm its suitability and viability on the site. The indicative sequence of required tasks is as listed:

i. Liaise with local business owners to determine interest / potential impacts
ii. Confirm vehicle setup to be used (no greater than standard parking bay (5x2.5m)
iii. Define parking space within grassed area for trial period
iv. Run trial and assess for feasibility and impacts on park use , residents and environment

3.7.3 Interpretation

A base level of interpretation was implemented as part of open space development of the riparian corridor. This is focussed on signage at select locations themed on Aboriginal archaeology and natural environment. Consultation with Councils Aboriginal and Torres Straight Islander Consultative (ATSIC) Committee identified a strong preference for the riparian corridor to be experienced and integrate with Prospect Hill, recognising the corridor provides an open space "curtilage" to the hill and is visually and functionally connected. The open space to Prospect Hill will be the subject of a separate plan of management process, and it is recommended that an integrated interpretive programme is planned and implemented that would include:

1. Interpretive "nodes" as part of a broader walk linking the corridor to Prospect Hill and to the trail network south of Pemulwuy Lookout
2. Educational packages for use of local schools potentially visiting the site
3. Community events on site that leverage off Darug culture and Pemulwuy history

3.7.4 Community Garden

It is recommended to re-purpose the Gateway Park space as a Community Garden. The proposal can bring greater activation and surveillance to this sunken park area and provide active usage of an area visually separated from the Lakewood water body. Facilities are proposed to include:

- Structured raised garden beds with wicking bed watering system
- Accessible garden beds
- Storage shed
- Palisade fence for night-time security
- New vehicular cross over to Miles Crescent for maintenance access to garden
- Indigenous native planting beds for growing of bush foods and connecting to local First Nations heritage
- Run irrigation off existing drinking fountain and tap

- Refurbish existing picnic shelter and picnic table – review potential for night lighting with sensor
- Refurbish existing pergola and seating
- Retain existing sculptures
- Provide 3 materials storage bays

3.8 Health & Safety Issues

The riparian corridor environment is maintained in accordance with Council's accepted maintenance and Work Health and Safety standards. Improvements may include:

- Visually permeable handrails to sections of retaining wall that exceed 1m
- Rubbish bins
- Accessible paths
- Clear sight lines to the street for user safety

Use of Gateway park

The Community Stakeholder Forum identified that use of the gateway park area may be affected by its isolated visual relationship to adjoining streets and resultant lack of passive surveillance. It is recommended to re-purpose the space as Community Garden to activate the space and complement the range of other activities and community benefits available to the community on the broader site. These include building community spirit, and providing activities for the elderly and less mobile

Mosquito Management

The Girraween Creek Vegetation Management Plan prepared by PSB in 2004 provided management strategies in relation to Mosquitoes. Then plan noted that the design of enhancements to the riparian corridor had been carried out so as to minimise mosquito breeding potential.

The VMP identifies that mosquito habitat is influenced by issues including quality depth and movement of water, nature and slope of edges, presence and density of edge vegetation presence of mosquito predators and proximity to residents. Strategies aim to limit habitat for mosquitoes and maximise habitat for suitable mosquito predators.

The VMP notes that pest level mosquito populations are unlikely if:

- Substantial areas of open water are maintained in the ponds
- Water flow through the creekline is maintained
- Mosquito larvae predators (Fish and invertebrate) are established and maintained.

The VMP notes that maintenance activities to assist mosquito management include:

- Ensuring vegetation or debris does not inhibit surface water movement
- Maintenance of high water quality
- Ensuring creek and pond margins are not clogged with emergent and floating plants which will trap pools of water when the water level rises in flood above normal water flows.
- Promotion of native fish to prey on mosquito
- Management of aquatic environment to maintain insect predators of mosquito larvae.

3.9 Landscape Improvement

3.9.1 Introduction

A revegetation programme through the riparian corridor has been previously implemented as part of open space development by the estate developer and in accordance with approved Vegetation Management Plans. As indicated on Figure 2.7 (page 24) "Vegetation Strategy as included in the Former CSIRO Site, Pemulwuy Precinct Plan 2007" the implemented works largely reflect the vegetation strategy with the exception of several areas where native revegetation was not implemented in favour of maintained grass. This includes the western foreshores of the lake water body, the western edge of the southern corridor and the northern dam wall.

Figure 3.3 below illustrates that the site was largely cleared through past agricultural practises and that the revegetation programme has been successful in re-establishing and consolidating native flora on the site.

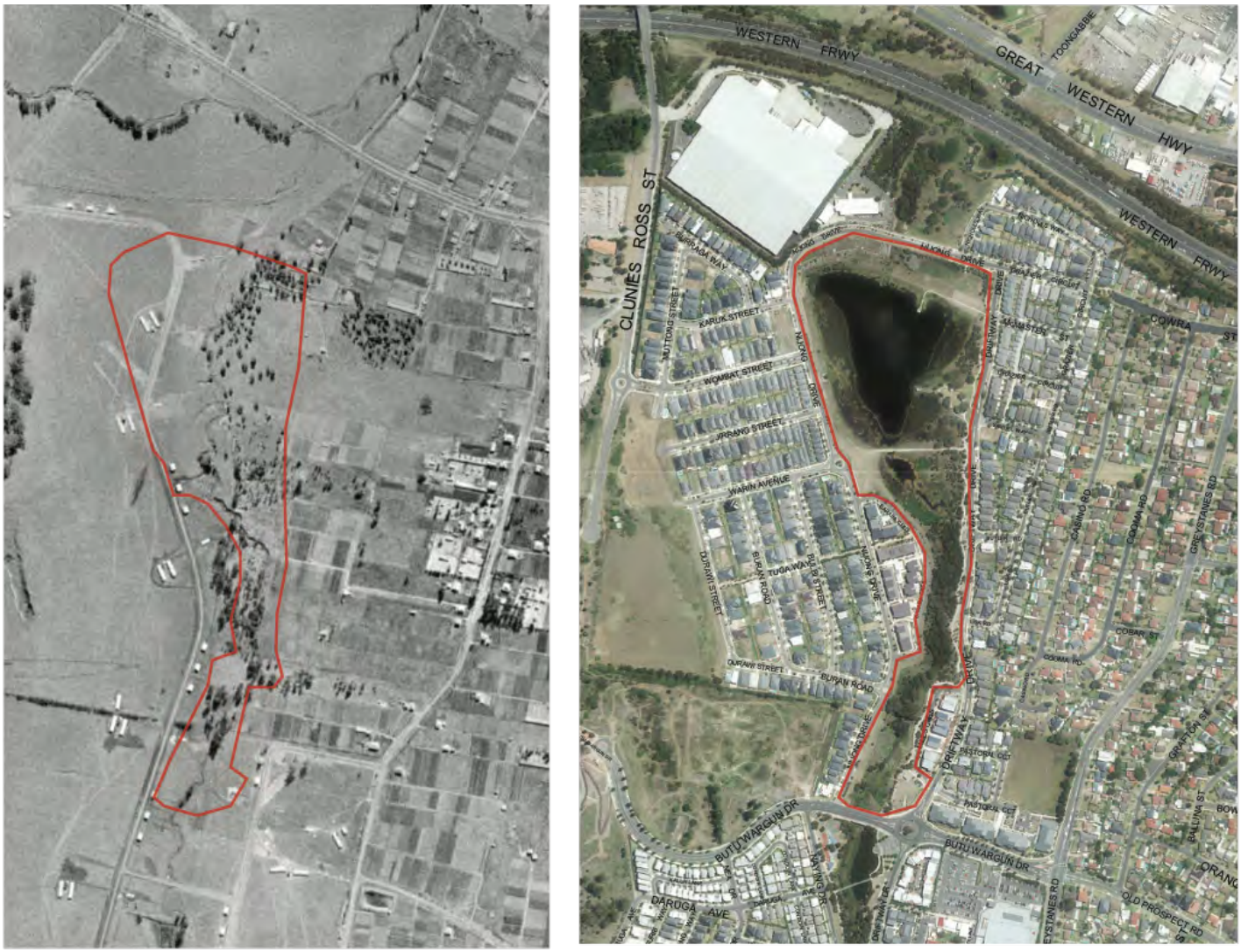


Figure 3.3 Approximate aerial photo comparison 1943 (left) and 2014 (right)
Source for 1943 aerial- Six Maps NSW

3.9.2 Vegetation Management

The Girraween Creek Vegetation Management Plan prepared by PSB in 2004 identified a series of ongoing strategies for vegetation management. These should be directly applied to ongoing Council decision making, planning and implementation of management and maintenance as the agreed basis for management for the riparian corridor. The strategies can be read in detail in the VMP appended to this Plan.

The following provides a quick reference to the VMP strategies. The strategies apply an adaptive management framework or loop where outcomes inform ongoing refinement and calibration of goals objectives and strategies:

VMP Ref	**Issue**	**Considerations addressed**	**Key Strategy areas Refer Girraween Creek Vegetation Management Plan**
6.2.3	Weed control		
		Terrestrial Weeds	
		Variety of sources: -disturbance of soil -imported soil -dumping -disturbance of veg'n -stormwater impacts -bird wind other dispersion -garden escape from neighbours	•Prevention through regular maintenance •Weed maintenance programme
		Weed and grass invasion of edges to water course	Refer to this POM section3.8.3
		Aquatic Weeds	
		Alligator Weed	Refer to this POM section3.9.3
		Salvinia	• Water Quality management • Monitoring • Education
		Water Hyacinth	As above
		Juncus acutus	As above
6.2.4	Vegetation management	*Generally*	
		Completed restoration works	•Bushland Management approach •Native veg left to natural form / habit •Mowing limited to turfed areas only •Manage grassed area edges
		Riparian zone	• Minimal disturbance of soil • Max weed cover 5% • Clean edge to turfed areas • Ongoing seeding • Manage scour at stream edge • Litter collection • Control feral pests
		Landscaped areas	• Mowing • Weeding • Litter collection

VMP Ref	Issue	Considerations addressed	Key Strategy areas Refer Girraween Creek Vegetation Management Plan
		Aquatic zone	• Manage creep of communities • Max weed cover 5% • Litter collection – floating / submerged • Remove algal growth and surface scum
		Herbicide use	• Limited use • Roundup Biactive if required
		Fertiliser use	• Limited use

3.9.3 Junction between maintained grassed areas and riparian vegetation

The existing conditions at the junction of maintained grassed areas and riparian vegetation are generally of high recurrent maintenance demand. There is a large degree of "soft" junctions between maintained grass such as timber or spade edges which are difficult to maintain without detailed regular attention. The preference would be that these soft edges are eliminated by:

- Providing a structured edge such as pathway separating native vegetation from maintained grass
- Revegetating the narrow edge strips of maintained grass to the western side of the south corridor

3.9.4 Streetscape to adjoining road corridors

The parkland vegetated and maintained grassed areas extend into the road reserve in places. These road reserve areas should continue to be maintained as part of recurrent park maintenance to provide continuity.

3.9.5 Vegetation management around facilities

The Community Stakeholder Forum identified that poor sight lines to the viewing deck and picnic tables at the eastern picnic area may contribute to issues of anti - social activity in the area. It is recommended to selectively trim lower branches and understorey to areas adjoining viewing decks and picnic tables to increase passive surveillance

3.10 Habitat management

The Girraween Creek Vegetation Management Plan prepared by PSB in 2004 identified a series of ongoing strategies for habitat management. These should be directly applied to ongoing Council decision making, planning and implementation of management and maintenance as the agreed basis for management for the riparian corridor. The strategies can be read in detail in the VMP appended to this Plan.

The following provides a quick reference to the VMP strategies. The strategies apply an adaptive management framework or loop where outcomes inform ongoing refinement and calibration of goals objectives and strategies:

VMP Ref	**Issue**	**Considerations addressed**	**Key Strategy areas Refer Girraween Creek Vegetation Management Plan**
6.2.5	Habitat management	*Edge*	• Logs in and around waters edge • Variety of water edge treatments • Avoid fauna disturbing maintenance / management practices
		Native fish stocking	• Undertake review of completed works to plan fish habitat enhancement • Modify designated areas of pond base for breeding and habitat • Priority to species that are predators of mosquito larvae such as Pacific Blue Eye and Fire Tailed Gudgeon
		Aquatic habitat	• Avoid herbicides and fertilisers near water • Monitor and maintain water quality • Monitor and control pest fauna eg carp mosquito fish and mosquitoes • Promote habitat complexity • Manage recreation
		Terrestrial habitat	• Limit access with formalised paths and boardwalks • Leave leaf litter and dropped branches • Maintain / enhance veg species diversity • Dense understorey layer • Control feral animals • Education
6.2.6	Pest fauna	*Waterbirds*	• Discourage feeding
		Domestic animals	• Encourage resident management of domestic pets
		Rabbits	• Rabbit control programme
		Mosquito Fish	• Monitor

3.11 Water quality management

The Girraween Creek Vegetation Management Plan prepared by PSB in 2004 identified a series of ongoing strategies for water quality management. These should be directly applied to ongoing Council decision making, planning and implementation of management and maintenance as the agreed basis for management for the riparian corridor. The strategies can be read in detail in the VMP appended to this Plan.

The following provides a quick reference to the VMP strategies. The strategies apply an adaptive management framework or loop where outcomes inform ongoing refinement and calibration of goals objectives and strategies:

VMP Ref	**Issue**	**Considerations addressed**	**Key Strategy areas Refer Girraween Creek Vegetation Management Plan**
6.2.1	Water Quality	Broader catchment water quality management -	•At source management
		Turbidity	•At source management •Development Management •Healthy riparian vegetation
		Nutrients	•At source management •Testing and monitoring •Education
		Volumes	•At source management
		Velocity	•Healthy riparian vegetation
6.2.2	Algae	Nutrient loading	•Establishment and maintenance of aquatic macrophytes and overhanging riparian vegetation •Monitoring and testing •As last resort treatments to remove excess Phosphorous from water column

3.12 Management and Maintenance

3.12.1 Maintained parkland areas - general recurrent reserve maintenance

Council will seek to provide an appropriate level of maintenance to the riparian corridor within the constraints of funding and with the inputs and assistance of organised user groups. Particular issues to be addressed in the future include:

Illegal rubbish dumping

- Ongoing police and ranger surveillance
- Maintain vehicular barriers and gates
- Remove rubbish dumping as soon as possible

Access and Open Space Equipment

- Ongoing management of graffiti and general vandalism of reserve furniture and structures is applicable
- Check fixings to reserve furniture and structures

Grass and planting bed maintenance

- Mow, weed and top up mulch regularly to provide a safe and enjoyable open space area

Ease of maintenance

Mulch is to be topped up on a regular basis not exceeding 75mm depth to ensure it continues to suppress weed regrowth with potential for establishment of native grass groundcover.

Rubbish Bins

Cumberland Council's rubbish bins are to be provided near the pedestrian entry access points to the riparian corridor and near the new playground. Siting will allow for easy access for rubbish removal.

3.12.2 Riparian Corridor maintenance

Refer to sections 3.9 to 3.11.

3.12.3 Aquatic vegetation management

An Alligator Weed Management Strategy was prepared as part of this Plan of Management and is attached to this Plan of Management at Appendix D. The following provides a summary of the key recommendations of the strategy:

Findings and Background

- Alligator Weed is present in the riparian area and has the potential to cover extensive areas of open water and grow amongst aquatic plants on the water's edge.
- Alligator Weed is present in open water and the wet/dry areas.
- Wet/dry interface areas are poorly defined and results in management issues in general. Alligator Weed flourishes in the wet/dry interface and spreads by pieces. Vegetation management such as mowing/slashing can spread this weed.

- Alligator Weed is a listed Noxious Weed. NB there is new noxious weed legislation and this should be checked for the specific requirements of the site (as the management agreements are developed)
- Alligator Weed is present in the catchment and spreads easily so continued re-infestation is likely in general and especially post medium level flood events.

Management Recommendations

- On-going management and surveillance is recommended. Frequent (seasonal) treatment of Alligator Weed will result in reduced annual cost of control and reduce the likelihood of it excessively expanding over open water areas. Seasonal work recommendations have been detailed in this plan.

Conclusions and Recommendations

- Alligator Weed management is recommended to occur on a seasonal basis. For best outcomes the timing and frequency of works would be in accordance with timing recommended in the plan.
- The aim of the works is to attempt to significantly reduce the current infestation. Works include the use of a high volume sprayer using Metsulfuron – Methyl to target any Alligator Weed seen in the area.
- Follow up works will be conducted 4-6 weeks later to target any re-emergence or regrowth. Follow up works will be conducted by thermal weeding, which has been used successfully in the past to control Alligator Weed. If conditions are not suitable for thermal weeding (e.g. too dry or too hot), backpack sprayers with Metsulfuron – Methyl will be used. All works will begin from the top of the catchment, heading down.
- Alligator Weed is often found in mown areas that are frequently inundated, such as the wetland batter where it is sometimes mown and may spread vegetatively. It is recommended that for works to be effective in control and eventual eradication of this Noxious Weed from the water basins, training in aquatic weed, identification and management is provided for those managing the open space area.
- It is recommended that the interface between wet and dry areas be well defined such that Alligator Weed habitat is reduced. This will also reduce the likelihood of it being spread through mowing / slashing etc. It is acknowledged that the site is flood prone and it's not possible to have clear boundaries in all areas however it is still recommended wherever practical.

3.12.4 Community Garden

The Community Garden will be managed by a Community body to facilitate use of the garden by registered participants. Council will resource and assist with day to day maintenance and labour resources to implement maintenance will be provided by Community Garden members.

The management of the community garden will be subject to a license or other form of operational agreement as seen as appropriate by Council.

The license or operational agreement conditions may include (but not be limited to) the following

a. The Community body will manage the gardens in a fair and equitable manner for the benefit of the community at large compatible with the arrangements for other community gardens within the Cumberland Council area

b. The perimeter of the community garden will be fenced to protect the garden from theft and vandalism after hours
c. The garden will have set opening hours for the week and weekends compatible with the arrangements for other community gardens within the Cumberland Council area
d. The general public will be able to access the gardens during those open hours for passive recreational purposes which do not disrupt the operation of the garden
e. Registered community garden participants will be able to access the garden after normal opening hours
f. Council will make a contribution to the ongoing operations and maintenance of the facility compatible with the arrangements for other community gardens within the Cumberland Council area
g. The Community body will be responsible for the maintenance of the gardens in a neat and tidy condition
h. The garden will be managed to prevent garden escape of any non native food plants into the riparian corridor.

3.13 Reserve naming

Consultation with Councils ATSIC Committee for the Plan of Management identified an opportunity to involve local schools in the naming process for selection of an appropriate Aboriginal language name.

The final process is to be refined with the input of the ATSIC Committee but in general is recommended to involve:

i. Preparation of information package for school groups to include:

   -background to local Aboriginal cultural heritage and current community

   -background to the reserve including its relationship to Prospect Hill and current features and characteristics

   -Aboriginal language name options and meanings (to be selected by ATSIC Committee)

   -Format requirements for submissions

ii. Potential open day for school groups to visit in presence of Aboriginal and receive briefing on why the riparian corridor and the general area is important

iii. Receipt and judging process involving ATSIC committee – award winner

iv. Initiate name change process in accordance with NSW State Legislation

v. Implement naming through signage and other elements on site

4 IMPLEMENTATION

4.1 Introduction

Future management decisions for Lakewood Estate Riparian Corridor will need to be addressed in the context of this Plan of Management. Implementation of improvement works within the open space will be an ongoing process in response to community expectations, user requirements, the availability of funding and other circumstances as they arise.

4.2 Management Structure

As the management and development of the open space involves the cooperation of several user groups it is essential to have a clear definition of management responsibilities as well as the involvement of a range of people with the necessary management skills and experience.

These groups and their respective responsibilities are summarised below. It should be noted that some of the responsibilities described below represent current management practices.

4.2.1 Cumberland Council

- Responsible for planning, development and management
- Budget allocation for development and maintenance
- Allocation of resources (financial, human and physical) for effective development
- Assessment of applications for development of commercial recreation facilities
- Maintenance of landscape works and passive recreation facilities
- Maintenance of grassed area, planted areas and associated facilities.
- Establishment guidance and monitoring of community garden Community management body

4.2.2 The Community

- Report maintenance requirements and vandalism to Cumberland Council
- Liaison with Council regarding use
- Written requests and proposals to Council for development or upgrading of facilities and submitted to Council for consideration.
- Establish Community Body to manage community garden under Council guidance and in accordance with Councils requirements

4.3 Funding

The timing for implementation of this POM will be directly dependent on the availability of funding. Such funding is required to cover capital expenditure as well as recurrent costs for repairs and maintenance. In allocating funds, Council needs to consider such expenditure within the context of its overall annual budget limits and priorities.

Cumberland Council provides funding for regular maintenance in its annual budget. Council's annual budget allocation is aimed at achieving a satisfactory level of maintenance and facility provision for all Community Land areas.

Funding grants are available upon application to the relevant Government Departments. The submission of an application for government funding is to be based on the prioritised schedule of actions.

4.4 Priorities

In order to provide guidance to commencement of implementation of the Plan of Management, a prioritised schedule of actions has been prepared. Prioritisation of works assists Council in allocating the financial, human and physical resources required for implementation of the Plan.

The following list of criteria has been used as a guideline when determining the priority rating for each action:

4.4.1 High priority (short-term)

- Stage 1 capital works improvements with current funding
- Safety issues where there is high probability of injury occurring
- Work needed to ensure the essential function of the reserve is not compromised
- Work needed to eliminate/reduce severe environmental problems, eg. erosion, water pollution, vegetation pests and diseases.
- Develop community garden license or operational agreement conditions in line with other compatible facilities in the Cumberland Council area
- Establish community garden Community management body
- Implement Community Garden to facilitate use of external grant funding

4.4.2 Moderate priority (medium-term)

- Other capital works improvements
- Ongoing preventative and remedial maintenance of existing assets
- Work needed to ameliorate adverse environmental conditions, (eg. insufficient shade, visual and noise intrusion, poor circulation and access)
- Works aimed at reducing ongoing maintenance costs

4.4.3 Low priority (long-term)

- Works aimed at improving aesthetic quality
- Works aimed at enhancing habitat value

The above criteria may require modification over time in response to special circumstances as well as changing community attitudes and expectations.

4.4.4 Implementation schedule

The following schedule lists each proposed management action, giving it a priority rating as determined from criteria listed earlier (High, Medium or Low). Each activity is also listed against a performance indicator and its current status is noted. These activities are described in more detail in section 3 Management Strategies.

The status rating is as follows:
O - Ongoing - this denotes activities that take place as part of the normal maintenance routine of the reserve.
P - Proposed - these activities have been proposed by the Plan of Management, but work on these activities has not been commenced.
Co - Commenced - this refers to proposed activities for which work has already begun.
Cp - Complete - this refers to activities that have been completed (their performance indicators have been fulfilled) since the last Plan of Management Review.

Index for symbols

CC	Cumberland Council
H	High priority
M	Medium priority
L	Low priority

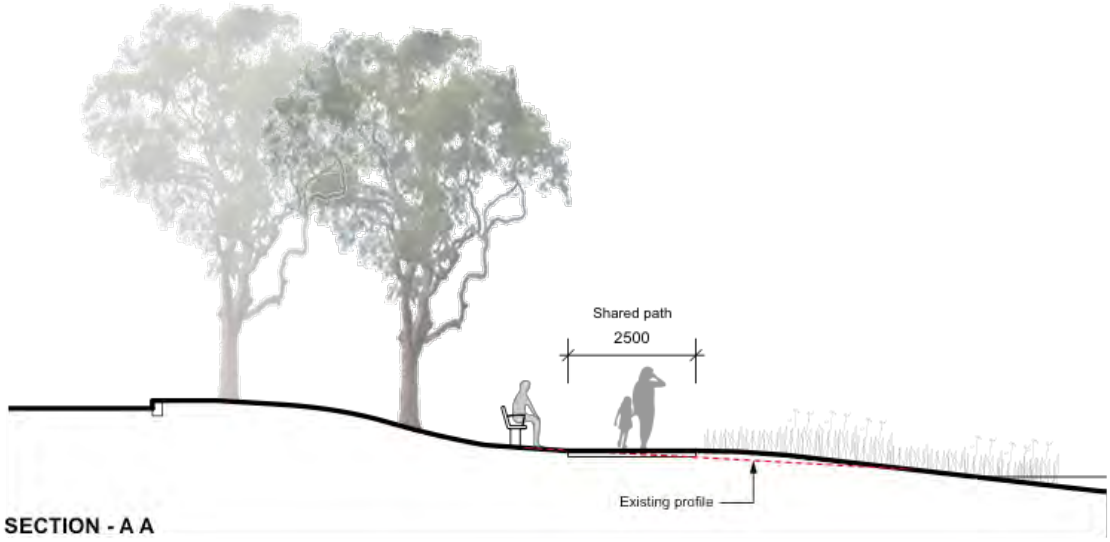
The following schedule should be reviewed annually for the purpose of scheduling works for inclusion in Council's annual works program, as well as for monitoring of performance indicators.

4.5 Concept Masterplan

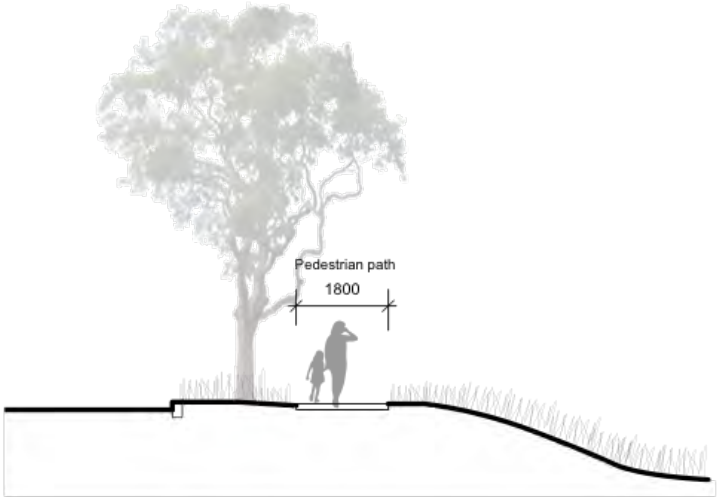
The following Concept Masterplan illustrates the key physical improvement actions recommended by this Plan of Management. These supplement and should be read in conjunction with the Action List provided in section 4.6.

	Masterplan Recommendation	Action Plan reference
1	Completion of shared path loop to north of lake and western side of lake	3.1
2	Pedestrian pathway linkage from Baraba Crescent to Butu Wargon Drive	3.2
3	Stepping stone access linkage across creekline swale linking east and west sides of corridor maintaining creek flow	3.3
4	Convert to native grass groundcover the existing grassed embankments down from Niljong Dve to creek	2.2
5	Shade tree planting to western edge of lake with strategically placed park seating for use	1.1 2.3
6	Convert maintained grass edge to lake to native vegetated shoreline to abut new shared path	2.1
7	Trim lower branches and understorey to areas adjoining viewing decks and picnic tables	2.4
8	Provide maintained grass parklet at corner of floodway with seating and shade tree planting	2.5
9	Maintained grass edge to shared path at low height to provide maintained margin transition	2.6
10	Maintained grass zone to native grass / low plantings	n/a
11	Setup zone for mobile kiosk / café on lawn	1.3
12	Community Garden: develop community garden in sunken gateway park space, to address community need and activate sunken / isolated space	1.8 & 2.8

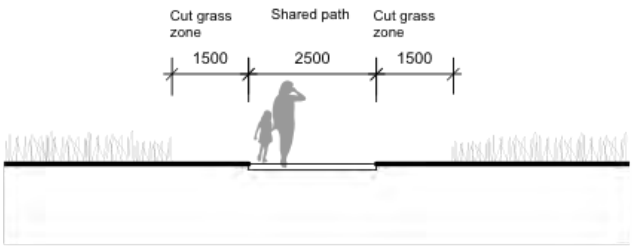
Figure 4.1 Concept Masterplan



SECTION - A A



SECTION - B B



SECTION - C C

Figure 4.2 Concept Masterplan cross sections

Figure 4.3 Community Garden Concept

4.6 Action List

4.6.1 Lakewood Estate Riparian Corridor

No.	ACTIVITY	PRIORITY	RESPONSIBILITY	PERFORMANCE INDICATOR	STATUS
0.0	**Planning & Management**				
0.1	Use POM to source funding for capital works improvements	H	CC	Budget for capital works improvements	P
0.2	Prepare design development and construction documentation plans for access and furniture improvements including tree planting to western foreshores to enable tendering and construction (potentially in stages following allocation of funding)	H	CC	Brief prepared. Detailed drawings prepared.	P
0.3	Community consultation integrated to development of designs	H	CC	Consultation provided	P
0.4	Maintenance programme developed for Natural Area Bushland areas including full strata vegetation through to native grasslands	H	CC	Bushland maint'ce is sustainable & effective	P
0.5	Plan and execute a reserve naming project involving local school groups as recommended by Councils ATSIC Committee	H	CC	Aboriginal based naming of reserve completed	P
0.6	Develop an integrated interpretation plan covering Prospect Hill and the riparian corridor as an integrated landscape and cultural experience	M	CC	Integrated interpretive plan completed	P
0.7	Facilitate conduct of community events as part of implementation of integrated interpretation plan noting that parking is limited	L	CC	Integrated interpretive plan implemented	O
0.8	Facilitate community planting days on site	M	CC	Planting days provided	O
0.9	Undertake audit of chainwire fencing across site. Identify programme for rationalisation of fencing where possible and replacement of poor quality fencing where needed	H	CC	Audit completed	P
0.10	Maintain cooperative approach between police and local residents to monitor and act on anti social behaviour in park (several local residents have direct contact with police)	H	CC	Anti social behaviour reduced	O
0.11	Establish Community Body to manage community garden under Council guidance and in accordance with Councils requirements	H	CC	Community body established and operational	P
1.0	**Site Facilities**				
1.1	New park seating to western foreshores as per item 0.2 supported by shade tree planting (refer 2.3)	M	CC	Seating implemented	P
1.2	Implement integrated interpretation plan recommendations as determined through item 0.6 Include information about not feeding the birds in the park	M	CC	Interpretation implemented	O
1.3	Review playspace provision in the local neighbourhood to best serve the local community - the location of the playspace is not to be prescribed in this PoM rather reviewed and coordinated with the draft Prospect Hill PoM to ensure an even distribution of playspace facilities in Pemulwuy	L	CC	Implementation of playspace	O
1.4	Provide fitness nodes along the shared path	L	CC	Implementation of fitness nodes	O
1.5	Investigate and implement if feasible "pop up" kiosk facility in park during peak times – refer to indicative list of required tasks in section 3.7.2	L	CC	Implementation of trial of pop up kiosk	O
1.6	Improve regulatory signage In key locations to deter consumption of alcohol and other anti-social	H	CC	Implementation of signage	O
1.7	Implement BBQ shut off to prevent after dark use	H	CC	Reduction of anti social use after dark	O

No.	ACTIVITY	PRIORITY	RESPONSIBILITY	PERFORMANCE INDICATOR	STATUS
1.8	Develop community Garden with required support facilities	H	CC	Increase in park use and security	P
2.0	**Landscape / Open space**				
2.1	Replace maintained grassed areas adjoining lake edge with native emergent vegetation within the regularly inundated zone to assist reducing spread of Alligator Weed	H	CC	Natural vegetation at water edge	P
2.2	Transition existing maintained grassed areas adjoining Nijong Drive to west side of corridor to native grassing	M	CC	Grass replaced by native grassing Maintenance demands reduced	P
2.3	Transition existing maintained grassed areas adjoining Driftway Drive / northern wall to native grassing	M	CC	Grass replaced by native grassing Maintenance demands reduced	P
2.4	Provide shade tree planting to western foreshores of lake supported by park seating	H	CC	Passive recreational use increased	P
2.5	Selectively trim lower branches and understorey to areas adjoining viewing decks and picnic tables to increase passive surveillance	H	CC	Anti social activities reduced	P
2.6	Consolidate a grassed area "parklet" at the south east corner of the northern flood way zone to the north of Nijong Dve / Nicholls Way	M	CC	Passive recreational use increased	P
2.7	Slash grasses and establish a low grassed margin either side of shared path through riparian corridor to improve sight lines and comfort of use	H	CC	Neater visual appearance Less ad-hoc grass slashing of full corrior	P
2.8	Develop Community Garden in Gateway Park space	H	CC	Increased use and benefit from space	P
2.9	Implement rationalisation of chainwire fencing around the main water basin inlet / outlet structure	H	CC	Reduced visual impact Effective security and Safety	P
2.10	Implement rationalisation of chainwire fencing in other areas as defined by fence audit	M	CC	Reduced visual impact Effective security and Safety	P
3.0	**Access & Circulation**				
3.1	Extend shared path from north dam wall lookout deck west below dam wall and around the western foreshores of the lake as per item 0.2	H	CC	Path Loop implemented	C
3.2	Provide pedestrian path link from Baraba Cres to Butu Wargan Drive along verge of Nijong Drive	H	CC	Path access implemented	C
3.3	Provide Stepping stone access linkage across creekline swale linking east and west sides of corridor ensuring that water flow is not impeded	M	CC	Access implemented	P
3.4	Upgrade existing compacted gravel surface and related edging to: -Gateway Park picnic area -eastern foreshore picnic area	M	CC	Gravel path and edging upgrade completed	P
3.5	Replace bollard barriers to Baraba Crescent and Nijong Drive when existing timber barriers are no longer functional	L	CC	Car barriers and maintenance access implemented	P
3.6	Liaise with Fauna expert to determine optimum locations for "waterfowl crossing" signage to alert vehicular traffic – install signage	M	CC	Birds hit be vehicles reduced	P
4.0	**Maintenance**				
4.1	Preventative maintenance to park areas	H	CC	Park adequately maintained	O

No.	ACTIVITY	PRIORITY	RESPONSIBILITY	PERFORMANCE INDICATOR	STATUS
4.2	Remedial maintenance to park areas	H	CC	Park adequately maintained	O
4.3	Implement maintenance programme for Alligator Weed in accordance with Management Plan (app D)	H	CC	Alligator weed issue is progressively reduced	O
4.4	Implement Mosquito management actions on required basis	H	CC	Mosquito populations managed to acceptable levels	O
4.5	Implement maintenance programme for Natural Area Bushland areas including full strata vegetation through to native grasslands	H	CC	Timber life is prolonged	O
4.6	Preventative maintenance to timber deck structures – oil treatment every two years	M	CC	Timber life is prolonged	O
4.7	Sustainable maintenance costs	H	CC	Maintenance costs monitored	O
4.8	Maintenance of community garden – formalise arrangements and responsibilities for maintenance as part of community garden license or operational agreement and implement	H	CC	Effective involvement by community Maintenance costs monitored	O

4.7 Staffing

The park will be maintained by Council staff undertaking rolling maintenance for parks as defined by operational plans. Council will establish a Community Body to manage and maintain the community garden under license or operational agreement and in accordance with Council guidance and requirements.

4.8 Commercial Development Opportunities

Cumberland Council has no current plans for development of commercial facilities within the riparian corridor. Cumberland Council is not currently considering any applications by private or community organisations to develop commercial facilities.

4.9 Leases and Licenses

4.9.1 What are leases, licences and other estates?

Clause 46 (Leases, licences and other estates in respect of community land-generally) of the Local Government Act 1993 states

(1) A lease, licence or other estate in respect of community land:

(a) may be granted for the provision of public utilities and works associated with or ancillary to public utilities, or

(a1) may be granted for the purpose of providing pipes, conduits or other connections under the surface of the ground for the connection of premises adjoining the community land to a facility of the council or other public utility provider, or

(b) may be granted, in accordance with an express authorisation in the plan of management and such provisions of the plan of management as apply to the granting of the lease, licence or other estate:

(i) for a purpose prescribed by subsection (4), or for a purpose prescribed by any of sections 36E to 36N as a core objective of the categorisation of the land concerned, or

(ii) for a purpose prescribed by the regulations, if the plan of management applies to several areas of community land, or

(iii) for a short-term, casual purpose prescribed by the regulations, or

(iv) for a residential purpose in relation to housing owned by the council, or

(c) may be granted in order to allow a filming project to be carried out, whether or not the project is in accordance with the plan of management or is consistent with the core objectives of the categorisation of the land concerned, but may not otherwise be granted.

(2) Despite subsection (1), a lease, licence or other estate in respect of community land may be granted for a purpose mentioned in subsection (1) (b) only if the purpose for which it is granted is consistent with the core objectives of its categorisation.

(3) A council must not grant a lease or licence for a period (including any period for which the lease or licence could be renewed by the exercise of an option) exceeding 30 years.

(4) The following purposes are prescribed for the purposes of subsection (1) (b) (i):

(a) the provision of goods, services and facilities, and the carrying out of activities, appropriate to the current and future needs within the local community and of the wider public in relation to any of the following:

(i) public recreation,

(ii) the physical, cultural, social and intellectual welfare or development of persons,

(b) the provision of public roads.

(5) Purposes prescribed by subsection (4) in relation to the matters mentioned in subsection (4) (a) (ii) include, but are not limited to, maternity welfare centres, infant welfare centres, kindergartens, nurseries, child care centres, family day-care centres, surf life saving clubs, restaurants or refreshment kiosks.

(5A) A council must grant an application under subsection (1) (c) for a lease, licence or other estate in respect of community land in order to allow a filming project to be carried out on the land unless:

(a) the community land is land referred to in section 47AA (1), or

(b) the plan of management for the land expressly prohibits use of the land for the purposes of filming projects, or

(c) the council is satisfied that there are exceptional circumstances that warrant refusal of the application.

(5B) Before refusing an application on a ground referred to in subsection (5A) (c), the council must consider whether any concerns it has could be addressed by imposing conditions on the grant.

(5C) If the council refuses an application, it must:

(a) inform the applicant in writing of its decision as soon as practicable after it is made, and

(b) give the applicant reasons in writing for its decision within 3 business days after it is made.

(6) A plan of management is void to the extent that it purports to authorise the grant of a lease, licence or other estate in contravention of this section.

Licences allow multiple and non-exclusive use of an area. A licence may be required where intermittent or short-term use or control of all or part of the park is proposed. A number of licences for different users can apply to the same area at the same time, provided there is no conflict of interest.

The definition of "estate", under Section 21 of the Interpretation Act, 1987, includes other rights over land, such as easements, including "interest, charge, right, title, claim, demand, lien and encumbrance, whether at law or in equity".

4.9.2 Existing and proposed usage agreements (leases, licences and other estates)

Existing usage agreements: There are no existing leases for Lakewood Estate Riparian Corridor

Proposed usage agreements : Community Garden - license or operational agreement for management and maintenance of community garden area in accordance with license conditions and requirements

4.9.3 Authorisation of future leases, licences and other estates

To comply with the Local Government, 1993, this Plan of Management must clearly specify the leases, licences and other estates that are authorised on community land within the park. Occupation of community land by leases, licences and other estates that apply to the park are set out in Sections 46, 46A, 47, 47A, 47C and 47D of the Local Government Act, 1993.

Council may also consider leases or licences for uses that are compatible with the recreational values of the reserve.

Operation of such uses must be on the condition that fees / profits gained contribute to the park maintenance and enhancement.

These and any other applications for granting of lease or license or for conducting of a temporary activity on site not addressed expressly by this plan must be assessed by Council in accordance with the Local Government Act.

Generally leasing or licensing other than that addressed will require revision and re-exhibition of this Plan of Management.

4.10 Plan of Management

As noted in Section 4.4, priority works will be considered by Council each year for budgeting and setting of implementation targets as well as for consideration of other works as needed or determined.

Reviews of the Plan of Management will be undertaken as determined by Council.

5 APPENDIX

5.1 A. Consultation Notes

LAKEWOOD RIPARIAN CORRIDOR

ABORIGINAL STAKEHOLDER FORUM

Held on
Tuesday 22nd August 2017, 6.00pm – 7.30pm,
Cumberland Council Administration Centre Centre, Memorial Street, Merrylands

Attendees				
ATSI Committee		***Other***		
Margaret Gong	**MG**	**Lexodius Dodd**		**LD**
Julie Nixon	**JN**			
Rex Sorby	**RS**	***Cumberland Council***		
Wayne Trindall	**WT**	Adrian Burns (Group Manager Parks and Recreation)		AB
David Williams	**DW**	**Susan Miles**	**(Senior Landscape Architect)**	**SM**
		Adam Ford	**(Landscape Architect)**	**AF**
		Project Team		
		Susan Moylan Coombs	**Gameraigal Group**	**SMC**
		Adam Hunter	**Environmental Partnership**	**AH**

No.	Item
1.0	**INTRODUCTION**
1.1	SMC Welcomed all to the forum, and invited all to introduce themselves and their involvement with the ATSI committee
1.2	LD provided a Smoking Ceremony in the courtyard outside to complete the welcome
2.0	**STUDY TEAM PRESENTATION**
2.1	Adam Hunter (Environmental Partnership) gave a short presentation that included: • Aim of the workshop • What is a plan of management • Requirements for a plan of management • Categorisation of community land
2.2	**Study Area** The Lakewood Riparian Corridor is the central open space corridor through the Lakewood Estate in Pemulwuy. The southern zone of the riparian corridor was transferred to Council in 2006. The northern zone of the riparian corridor (study area) was transferred to Council in November 2016.
2.3	**Aim of the workshop** The forum (tonight) is to provide stakeholders the opportunity to discuss future management of the riparian corridor and to input into key decision making that must be included in the plan
2.4	**Recent time line shaping the site** Ah outlined recent site history that has shaped the current form of the site: -CSIRO 1948-1990 -M4 Motorway 1992 -Development Planning 1999-2006
2.5	**What is a Plan of Management** A Plan of Management is a report outlining how Council proposes to manage a park for the benefit of the community. Plans of Management usually derive their management recommendations from the following criteria established by Council and stakeholders: • Roles and values • Desired outcomes (objectives) • Issues (opportunities and constraints) • Local Government Act requirements

No.	Item
	A Plan of Management is a requirement of the local Government Act 1993 to ensure community land is effectively planned and managed. The main objective of a POM is to guide the future management and development of parks in the HCC LGA, taking into account community expectations. The draft plan will be subject to a public exhibition period where the Draft Plan of Management is on exhibition for 28 days with public comment for up to a period of 42 days. This will include a "Public Hearing" meeting which will be held during the public exhibition for all interested community to attend.
2.6	**Categorisation of Community Land** A Plan of Management is required for all community land. The plan will identify the categorisation of the community land, which will guide its management. Community Land categories include: Community Land Categories: • Natural Area Bushland • Natural Area Foreshore • Sportsground • Park • Area of Cultural Significance The Lakewood Riparian Corridor Reserve has to date not yet been categorized by Council.
3.0	**WORKSHOP DISCUSSIONS** SM and AH requested feedback from stakeholders present and facilitated a forum discussion. The aims of the discussions were to 1. Recap / discuss the key values of the site 2. Discuss key opportunities 3. Discuss LGA community land categorisations 4. Discuss ongoing interpretation 5. Discuss naming of the corridor reserve 6. Discuss any other issues / concerns **Recap of key values**
3.1	**Aboriginal cultural values** • Community view the area inclusive of Prospect Hill – it's all connected • Cultural and environmental conservation – provides an umbrella framework for the area • Protect the First Nations Significance of the area including the relationship of the corridor with Prospect Hill • Desire to connect all community to the area • Educative use of the area – engage with schools etc
3.2	**Opportunities** • Include the totems of the area - Brush tail Possum etc - On signage - Symbols on sandstone blocks • Reconciliation Stone – moved to the area and placed in a secure spot – below Prospect Hill • Walk way – loop around the lake and to Prospect Hill - Interpretive signage - Gardens – bush tucker and medicine - Re-vegetate the area – research original planet/native plants - Cultural and spiritual significance of area - Scar Trees – potential to create new ones – living culture – interpretive signage • Cultural Keeping Place – Education - Lesson design – lesson plans – teacher involvement – school activities – invite participation of residence - Connecting people to place - Living heritage and historical heritage

No.	Item
	• Recreational Use o Nature o Picnics o Rest & peaceful spaces – step out of the rat race o Gardens o Rest spots o Sitting places – benches o Swimming / water use might not be possible because of water quality • Better Playground area • Potential involvement of Juvenile Justice programs to work on the site • Cat proof the area – hidden fences within vegetation • Tourism o Ferry from Sydney – Parramatta – travel to area o Lakewood/Prospect Hill – Reconciliation Place & Pemulwuy
3.3	**Community Land categorisation** Combination of o Natural Area Wetland o Natural Area Watercourse o Park Agreed as appropriate. Group wished to have some further time to consider potential for the area to be Area of Cultural Significance based on its Aboriginal connections.
3.4	**Interpretation** • Honour Pemulwuy – last standing place - Link to Parramatta – Battle of Parramatta - Blacktown - Signage • Wider community interested in Darug history of area • Caring for Country – layering of history and human existence and involvement in the site
3.5	**Naming of the reserve** • Naming - Language o Council has list of words – signed off by Elders o Discussion around young people playing a role in naming. o Involvement of schools to be investigated – choose favourite Aboriginal name ?
3.6	**Other issues** • General community consultation and First Nations Consultation – feedback brought together to get clear picture of community needs and desire for area
4.1	**WHERE TO FROM HERE?** • Conduct Community Stakeholder workshop • Combine feedback from both workshops • Draft Plan's of Management developed for public exhibition • Public Hearing(information session) at commencement of public exhibition. The Public Hearing will be confirmed by the Council Calender. The community can submit comments to Council for a period of 42 days. • Council review comments on Draft POM • Council finalises POM • POM goes to Council for approval • Any major facilities development subject to separate development application

Meeting Closed at 8:30pm

LAKEWOOD RIPARIAN CORRIDOR RESERVE

COMMUNITY STAKEHOLDER FORUM

Held on

Thursday 5th October 2017, 6.00pm – 7.30pm,

Allan G Ezzy Community Hall, Pemulwuy

Attendees		
Community	***Cumberland Council***	
John Azzopardy	Adrian Burns (Group Manager Parks and Recreation)	AB
Connie Cukman	Susan Miles (Senior Landscape Architect)	SM
William Cukman	Adam Ford (Landscape Architect)	AF
Yvette Ho		
K & J Morrisey	***Project Team***	
Frances Mentisin	Adam Hunter Environmental Partnership	AH
Zaria Narayan		
David Newman		
Raffaeli Nicolai		
Brian Ready		
Pamela Rincu		
Sunny Yap		
Carlos Viasus		
David Williams		
Margaret Zello		
Charlie Zello		

No.	Item
1.0	**INTRODUCTION**
1.1	AF Welcomed all to the forum, and invited all to introduce themselves and their interest in the plan of management
2.0	**STUDY TEAM PRESENTATION**
2.1	Adam Hunter (Environmental Partnership) gave a short presentation that included: • Aim of the workshop • What is a plan of management • Requirements for a plan of management • Categorisation of community land
2.2	**Study Area** The Lakewood Riparian Corridor is the central open space corridor through the Lakewood Estate in Pemulwuy. The southern zone of the riparian corridor was transferred to Council in 2006. The northern zone of the riparian corridor (study area) was transferred to Council in November 2016.
2.3	**Aim of the workshop** The forum (tonight) is to provide stakeholders the opportunity to discuss future management of the riparian corridor and to input into key decision making that must be included in the plan
2.4	**Recent time line shaping the site** Ah outlined recent site history that has shaped the current form of the site: -CSIRO 1948-1990 -M4 Motorway 1992 -Development Planning 1999-2006
2.5	**What is a Plan of Management** A Plan of Management is a report outlining how Council proposes to manage a park for the benefit of the community. Plans of Management usually derive their management recommendations from the following criteria established by Council and stakeholders:

No.	Item
	• Roles and values • Desired outcomes (objectives) • Issues (opportunities and constraints) • Local Government Act requirements A Plan of Management is a requirement of the local Government Act 1993 to ensure community land is effectively planned and managed. The main objective of a POM is to guide the future management and development of parks in the HCC LGA, taking into account community expectations. The draft plan will be subject to a public exhibition period where the Draft Plan of Management is on exhibition for 28 days with public comment for up to a period of 42 days. This will include a "Public Hearing" meeting which will be held during the public exhibition for all interested community to attend.
2.6	**Categorisation of Community Land** A Plan of Management is required for all community land. The plan will identify the categorisation of the community land, which will guide its management. Community Land categories include: Community Land Categories: • Natural Area Bushland • Natural Area Foreshore • Sportsground • Park • Area of Cultural Significance The Lakewood Riparian Corridor Reserve has to date not yet been categorised by Council.
3.0	**WORKSHOP DISCUSSIONS** AH requested feedback from stakeholders present and facilitated a forum discussion. The aims of the discussions were to 1. Discuss the key values of the site 2. Discuss key opportunities 3. Discuss key challenges
3.1	**KEY VALUES** **Habitat** • Area has a high habitat value • Promote native species • Need balanced approach to amount of natural setting to manicured **Recreation** • Lake is a good focus for informal recreation and for walking and fitness • Reserve draws users from the local area as well as from further afield • Path access for walking and fitness – could be improved by completion of loop around lake – preferred that loop goes across dam **Community** • Strong community connections and affection for reserve **Aboriginal cultural values** • Aboriginal history in the area • Opportunity for interpretation
3.2	**ISSUES** **Water quality** • Algae spread is a problem – AH noted that the current plan includes an assessment of the Alligator Weed issue and will identify management strategies. Initial feedback is that maintained grass up to waters edge is a problem

No.	Item

Habitat

- Domestic and feral animals (eg Foxes) are a big problem in the area

Maintenance

- Maintenance of reserve is challenging given extent of area and amount of vegetation – Key issues:
- Dumping of garden waste and rubbish
- Vandalism of signage
- Vandalism of fencing
- Weeds
- Mowing of grass and slashing of native grasses does not appear regular enough
- Native grasses slashed so low they are taken over by weeds and lost
- Potential for community involvement in planting days – Bushcare Groups
- Concrete seats are vandalised
- Management of Ibis – need to look at potential strategies
- Consider dog bins reflecting amount of dog use

Use

- Uses of platforms after hours / dark – some anti-social activities
- Quite a bit of use from outside area – feeling by locals that much of the vandalism and littering happens with people from outside the area
- Tree canopy can limit views and surveillance around decks and picnic tables – however it is recognised trees are also good for shade – balanced approach required
- Lack of a playground in reserve – AF noted there are play facilities to south – but residents noted you have to cross the road to get to them
- Insufficient path access limits degree of use
- Need to improve visibility and surveillance to BBQ's
- Lake of toilets – may detract from some users – however some felt lack of toilets discouraged a lot of use from outside area
- Need to review role of floodway open space to north of lake (below dam) – Council noted that this has a floodway role – so any uses would be limited by this
- Could there be community gardens within area ? potential to cater for residents in higher density housing
- Improve use of the "sunken area" – review access and shade
- Is there potential for a kiosk facility near site to serve recreational use – meeting noted that a permanent building would be maintenance and vandalism issue – but potential for "pop up" eg weekend use can be looked into

Access

- Path loop needs to be completed as per original plans for area – this would enhance use
- Residents noted traffic calming is yet to be implemented – This is not a POM issue but Council will follow up
- Cars from outside area park at night on dark road areas (eg below dam) – causes residents concerns

3.3 **COMMUNITY LAND CATEGORISATION**

Study team will review categorisation based on the community values.

Likely Combination of

- Natural Area Wetland
- Natural Area Watercourse
- Park

Study team and Council to consider further.

No.	Item
4.1	**WHERE TO FROM HERE?** • Conduct Community Stakeholder workshop • Combine feedback from both workshops • Draft Plan of Management developed for public exhibition • Public Hearing(information session) at commencement of public exhibition. The Public Hearing will be confirmed by the Council Calender. Draft Plan of Management will be exhibited for a minimum of 28 days. The community can submit comments to Council for a period of 42 days. • Council review comments on Draft POM • Council finalises POM • POM goes to Council for approval • Any major facilities development subject to separate development application

Meeting Closed at 8:30pm

PUBLIC HEARING

29th March at Merrylands Administration Centre
7th May at Allan G Ezzy Community Hall Pemulwuy

MEETING NOTES

Attendance Community	**Council / Project Team**	
Thursday 29th March		
Ken Morrisey	Adam Ford	Cumberland Council
John Hunter	Susan Miles	Cumberland Council
	Adam Hunter	Consultant
Monday 7th May		
Allan Byrnes	Mayor, Clr Greg Cummings, Greystanes Ward	
Carmel Byrnes	Clr Suman Saha, Wentworthville Ward & resident of Pemulwuy	
David Williams	Adam Ford	Cumberland Council
Barry McCardle	Susan Miles	Cumberland Council
Narelle McCardle	Adam Hunter	Consultant
Zaria Newman		
David Newman		
Sue Hoy		
Devika Pulle		
John Pulle		

No	Item	Action / Response
1.0	**WELCOME**	
1.1	Adam Hunter (consultant- Environmental Partnership) welcomed all to the Forum	
1.2	David Williams provided an Acknowledgment of Country on behalf of the Cannemegal-Warmuli Clan of the Darug Nation	
1.3	Adam Hunter outlined that two sessions were to be provided for the public hearing: - 29th March at Merrylands Administration Centre - 7th May at Allan G Ezzy Community Hall Pemulwuy	
1.4	AH outlined the purpose of the Public Hearing and processes to adopt the Plan of Management (POM). • to discuss any queries with proposed categorisations as defined by local govt act • to outline the draft POM on public exhibition • to discuss any questions or queries on the draft plan	
2.0	**PLAN OF MANAGEMENT RECAP**	
2.1	Adam Hunter summarized the previous consultation forums undertaken for the POM including 1. Aboriginal Stakeholder Forum - 22nd August 2017 2. Community Stakeholder Forum - 5th October 2017	
2.2	Key issues identified by attendees included: - access - extent of paths - water quality - habitat - enhancing community use / facilities - maintenance	
2.3	AH outlined that The Local Government Act requires all community land to be covered by a Plan of Management which must identify: - the category of land; - objectives and outcomes for the land; - the means by which Council proposes to achieve objectives - and outcomes; and - the way by which council proposes to assess its performance. - The nature and use of community land may not change without - an adopted Plan of Management	

No	Item	Action / Response
2.4	AH outlined that to POM identifies 3 categorisations across the park: - Natural Area Wetland - Natural Area Watercourse - Park	
2.5	AH outlined the POM Action Plan and identified the key masterplan recommendations: 1. complete path loop to west side of basin 2. verge pedestrian path link from Baraba Cres to Butu Wargun Dr 3. stepping stone link across creek maintaining water flow but controlling erosion from random crossings 4. convert maintained grass along steep embankment to Nijong Dr near Butu Wargun Dr to low native grasses 5. provide shade tree planting to west side of basin 6. Provide native grass and emergent planted edge to basin to west side between basin and new path link 7. trim lower branches to trees near viewing decks to increase surveillance 8. keep maintained grass "parklet" area at corner of floodway space at junction of Brazier Cres and Nijong Dr 9. provide low growing native grasses adjoining shared path through riparian corridor 10. transition existing maintained grassed zone to east zone of dam wall to low native grasses 11. identify zone near south west corner of basin for possible future mobile kiosk / coffee cart setup 12. consider long term removal of stone clad wall above Gateway Park adjoining Driftway Drive verge to increase visibility into park	
3	**DISCUSSION**	
3.1	**Toilets**	
3.1.1	The question of whether toilets could be provided at the reserve was queried at both forums.	It was outlined that at this time toilets were not deemed appropriate at the reserve because: - the major proportion of users of the reserve were expected to be locals - Councils resources for toilet construction and then maintenance should be focussed on high use open spaces There is high potential for vandalism of a toilet structure – or other anti-social use given the reserves low intensity of use and sense of isolation
3.2	**Shade / Shelter**	
3.2.1	It was commented that shade and shelter over picnic tables and additional shade within the park would be desirable.	It was noted that a number of existing picnic tables have shelters over It was also noted that additional shade tree planting was recommended to the western foreshores of the basin.
3.3	**Reserve maintenance**	
3.3.1	It was commented that maintenance in the reserve had declined since the handover to Council	It was noted that the plan of management will reinforce the need for a varied approach including a range of approaches from wetland and bushland management to standard park maintenance
3.3.2	It was commented that rubbish in native grasses and at edge of pond basin was common	As above a specific approach to manage these areas which "catch" windblown rubbish is required and recommended in the POM
3.3.3	It was commented that tall grasses along eastern side of the corridor – are these a potential fire issue	Council will advise its maintenance divisions about this issue and ask them to review on site

No	Item	Action / Response
3.3.4	It was commented that it appears current slashing of native grasses is possibly over the top and may not be supporting plant health	Council will advise its maintenance divisions about this issue and ask them to review
3.4	**Interpretive signage**	
3.4.1	It was commented that existing interpretive signage is in poor condition.	It was noted that the POM recommends that interpretive signage is subject to a replacement programme integrating natural and cultural heritage and connecting to the Prospect Hill open space
3.5	**Other signage**	
3.5.1	It was commented that regulatory signage including no consumption of alcohol is lacking.	POM to be supplemented for regulatory signage provision recommendations
3.6	**Bird habitat**	
3.6.1	It was commented that the Swan family had a chick during the last 12 months but it had not been sighted recently – it was unclear what had happened	It was noted that the POM recommends for domestic pet controls to be enforced
3.6.2	It was commented that Cockatoos had been active in park in recent times, and had been "shredding" small branches and leave matter from trees	It was noted that Cockatoos will do this but generally won't stay in one area for extended period – No action required in POM
3.6.3	It was commented that feeding of birds by community does occur and that this is a potential problem for bird health	It was agreed that POM should be supplemented to add recommendation for interpretive and regulatory signage to include information to discourage bird feeding
3.6.4	It was commented that Ibis are present in the area	It was noted that Ibis are a general urban issue now across a range of different types of parks. Councils are liaising with NPWS and other bodies on best approaches to discourage this species – at the same time the POM recommends strategies to enhance the preferred habitat types of native species (eg. protective reeds etc. at water's edge)
3.7	**Anti-social activity**	
3.7.1	It was commented that there had been gatherings of people making noise and other loutish behaviour in the park as late as 2.30am Mayor Councillor Cummings noted that had been made aware of this and had liaised with Local Area Police Command – several local residents have agreed to contact police on special number if activity occurs and police will attend.	It was noted that this will be an ongoing Council / police / community cooperation effort to monitor the problem POM to note this cooperative approach
3.7.2	Use of BBQ's after midnight – this appears to be happening as part of issue at 3.7.1	It was noted there may be potential for BBQ's to have control that disables them from use after a certain hour – POM to add review of this option
3.8	**Dog walking**	
3.8.1	It was commented that the park is a popular dog walking location – but there are no dog waste bag dispensers in area	It was noted that Council have a strategic approach to provision of dog waste facilities generally focussed on designated off leash areas. Section 2.6.2 of the POM identifies the Riparian Corridor Reserve as "on leash"

No	Item	Action / Response
		The POM currently recommends consideration of dog waste bins in the open space
3.9	**Water Quality**	
3.9.1	It was commented that water quality in the POM area is impacted by water quality further upstream	It was noted that the creek corridors further to the south are covered by separate Plan of Management and Vegetation Management Plans that address targets for water quality. The Riparian Corridor Reserve POM does note the need for a corridor wide approach to these issues
3.10	**Tree management**	
3.10.1	It was commented trees that were planted to Driftway Drive in recent times appear not to have survived	It was noted technically the road reserves are outside the POM area – however this issue will be relayed to Councils maintenance staff to review
3.11	**Play equipment**	
3.11.1	It was commented that it would be desirable to have some play equipment in the park	It was noted that the POM recommends the medium to long term provision of a small play space facility in the open area to the south west corner of the water basin (pond)
3.12	**Reserve Naming**	
3.12.1	It was noted by the study team that the POM includes a recommendation identified through the Aboriginal Stakeholder liaison for the POM for a reserve naming process that will engage local schools to participate in the selected of an Aboriginal name for the open space	This was greatly supported by the meeting group
3.13	**Web Based Information**	
3.13.1	Council noted that there appears to be issues currently with the accessibility on line of current POM's for open spaces (including those to the south of the site)	Council will review this with the aim of current POM's being available on line
4	**WHERE TO FROM HERE**	
4.1	Adam Hunter outlined the POM process from here: - study team to review with Council the findings from the - Public Exhibition and the public hearing sessions - finalise Plan of Management - report to Council - Council ratify POM	

Lakewood Riparian Corridor Plan of Management
Amendment for Community Gardens 2022

PUBLIC HEARING REPORT

Held Tuesday 6th December at Allan G Ezzy Community Centre Hall
Report prepared 13th December 2022

Name	Role
Community	
4 Community Members	
Council	
Adam Ford	Landscape Architect
Lisa Ivicevic	Urban and Open Space Planner
Facilitator	
Adam Hunter	Consultant: Environmental Partnership (NSW) Pty Ltd

1.0 Introduction

The Lakewood Riparian Corridor Plan of Management (PoM) was prepared by Landscape Architectural consultants, Environmental Partnership during May to October 2017.

An amendment to the Final PoM was undertaken in August 2022 to consider the development of a Community Garden in the area of the Gateway Park space. This Amendment Summary includes the pages from the PoM that have been subject to amendment for the integration of the proposed community garden.

Background to Amendment
The community garden was the subject of local community interest and a successful application for grant funding under the Places to Roam Program 21-22 from the NSW Department of Planning and Environment.

A concept has been developed with community input and is provided in this summary report.

The area of the Riparian Corridor that will accommodate the proposed community garden, and known as Gateway Park is currently categorised as Park under the community land categories as defined by the Local Government Act (1993) (LG Act) and Local Government (General) Regulation 2005. The amendment proposes that the categorisation of this pocket space be revised from Park to General Community Use to facilitate the use and management of the space as a community garden.

This amendment summary focusses on the relevant sections of the PoM that have been revised to facilitate this amendment and are provided on the following pages as listed in the table of contents. The text that forms part of the proposed amendment has been highlighted by underlining for ease of reference.

Public Exhibition and Public Hearing
The Draft PoM amendment is on public exhibition in accordance with the requirements of section 38 of the Local Government Act 1993. The Public Exhibition commenced on Tuesday 22nd November and receipt of community submissions will extend until Monday 13th February 2023 .

Submissions from the community will be received, and Council will consider these submissions before adopting the PoM.

The Public Hearing was held in accordance with Section 40A of the LG Act as a categorisation is proposed to be amended, after which this public hearing report was provided to Council, and made available for public inspection.

2.0 Purpose of the public hearing

A public hearing is required by Section 40A of the LG Act for Council owned Community Land if the draft plan of management would have the effect of categorising, or altering the categorisation of, community land as follows:

40A Public hearing in relation to proposed plans of management

(1) The council must hold a public hearing in respect of a proposed plan of management (including a plan of management that amends another plan of management) if the proposed plan would have the effect of categorising, or altering the categorisation of, community land under section 36(4).

(2) However, a public hearing is not required if the proposed plan would merely have the effect of altering the categorisation of the land under section 36(5) (that is applying a sub-categorisation under the Natural Area category).

(3) A council must hold a further public hearing in respect of the proposed plan of management if--

(a) the council decides to amend the proposed plan after a public hearing has been held in accordance with this section, and

(b) the amendment of the plan would have the effect of altering the categorisation of community land under section 36(4) from the categorisation of that land in the proposed plan that was considered at the previous public hearing.

With regards to Crown Reserves, the Crown Land Management Regulation 2018 was amended in 2021. Under Clause 70A, Council Crown land managers are not required to hold a public hearing under Section 40A of the LG Act if the categories assigned in a plan of management were amended from those initially assigned prior to the preparation of a plan of management.

3.0 The proposed re-categorisation

As noted previously the amendment proposes that the categorisation of the pocket space known as the gateway park in the 2018 Plan of Management be revised from Park to General Community Use to facilitate the use and management of the space as a community garden.

Confirmation of the location of the proposed re-categorisation is provided on Figure 1 on the following page.

4.0 Conduct and reporting of the public hearing

An independent chairperson is required to conduct the public hearing and provide a report to Council with any recommendations arising.

Under Section 47G of the LG Act, the person presiding at a public hearing must not be:

a) A Councillor or employee of the Council holding the public hearing, or

b) A person who has been a Councillor or employee of that Council at any time during the 5 years before the date of his or her appointment.

Council must make a copy of the report regarding the outcomes of the public hearing available for inspection by the public at a location within the area of Council no later than 4 days after it has received the final report from the person presiding at the public hearing.

The public hearing report is to be presented to Council for its information when it considers the draft Plan of Management.

Figure 1 – Proposed re-categorisation

5.0 Public hearing

The public hearing was held from 6-7pm on Tuesday 6th December and was notified through Council's Your Say webpage, advertisements in the Auburn Review and Parra News on 22 November 2022, letterbox drop of 360 flyers in mailboxes directly surrounding the area where the change is proposed (including the Nelson's Grove Retirement Village), a flyer emailed to Allity Aged Care and a flyer placed on the noticeboard at Pemulwuy Marketplace.

The public hearing was opened by Council at 6pm on Tuesday 6th December. Four community members were in attendance along with two Council Staff and one consultant preparing the Public Hearing Report.

Adam Ford welcomed attendees to the meeting, and gave an acknowledgment of Country. Adam Hunter made a brief presentation on the reasons for and aims of the public hearing noting that its key focus was to address questions and comments on the proposed re-categorisation.

It was noted that submissions on the Draft Plan of Management Amendment will be received up until 13th February and general comments on the proposed community gardens and its management will be received up until this time. Attendees were encouraged to make a submission through this process if they have any comments to make on the community gardens design and management.

Adam Ford gave a brief presentation on Councils Community garden proposals which will include (refer Figure 2 Community Garden Masterplan):

- Storage and hardstand area
- Raised garden beds in grassed area
- Raised garden beds in hardstand suitable for disabled access and use
- Native "bush tucker' garden area
- Garden materials storage areas
- Re-use of park seating and shelter
- Perimeter Fencing

Adam Ford noted that a grant had been received for $75k from the NSW Department of Planning & Environment, 2021-2022 Places to Roam Community Gardens Program and that initial works on development of the community garden would need to focus on high priority tasks to enable the gardens to be established and then further develop and evolve over ensuing years.

Existing Site Conditions

Palisade Fence

Site Plan - 1:500

Location Plan

Masterplan Features	
1	Typical Garden Beds - concrete sleeper raised (0.5m) beds - wicking bed water system - 16 x rectangular - 2 x pentagonal
2	Accessible Garden Beds - concrete sleeper raised (0.7m) beds - wicking bed water system - 2 x rectangular - 1 x pentagonal
3	Storage Shed - lockable metal tool storage (3.1m²) - skylight, adjustable shelving and double hinged doors - existing landing pad
4	Palisade Fence - tubular steel rod top and bottom (2.0m high) - sliding gate vehicular x 1 (3.2m wide) - sliding gate pedestrian x 2 (3.2m wide) - remove x 1 section of blade wall
5	Vehicular Crossover - concrete pavement (3.2m wide) - continuous over utility and accessible areas
6	Native Garden Beds - edible and specimen planting - concrete sleeper steps
7	Existing Drinking Fountain and Hose Tap Retained - connect drip line irrigation
8	Existing Picnic Table and Shelter Set Retained - review lighting provision with sensor activation
9	Existing Pergola and Seating Retained
10	Existing Sculptures x 3 Retained
11	Existing Feature Stairs Retained - remove lower level section of blade wall
12	Material Storage Bays x 3

CUMBERLAND CITY COUNCIL
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PROJECT : **PEMULWUY COMMUNITY GARDEN**
Corner Driftway Drive and Butu Wargun Drive, Pemulwuy

TITLE : **LANDSCAPE MASTER PLAN**

DRAWN :	CHECKED :	FILE :	SCALE : As shown @ A3	DRAWING N
DESIGNED :	APPROVED :	DATE : March 2022	SHEET : 1/1	A3-LMP-01

N

Figure 2 – Community Garden Masterplan proposal by Cumberland Council

6.0 Public hearing comments

No comments were received at the public hearing regarding the re-categorisation of open space in the draft Plan of Management Amendment. General comments on the community gardens proposals will be received up until 13th February 2023) and considered by Council in finalisation of the Plan of Management amendment.

7.0 Recommendation

No changes are recommended to the proposed re-categorisation as listed in the draft Plan of Management Amendment as a result of the public hearing held on 6th December 2022.

As noted above Council may undertake amendments to the draft Plans of Management Amendment following a review of the submissions received during the public exhibition.

Public Hearing Report prepared by:
Adam Hunter, Director
Environmental Partnership (NSW) Pty Ltd
13th December 2022

5.2 B. Flora and Fauna assessment existing species lists Hayes Environmental 2002

CSIRO CLUNIES ROSS RESEARCH STATION, PROSPECT

FLORA & FAUNA ASSESSMENT

APPENDIX 1

Inventory of flora species recorded

July 2002

APPENDIX 1 cont Flora species recorded on the subject site at Prospect during the recent (Hayes 2002) and previous (GECon 1997) field investigations.

Status	SCIENTIFIC NAME	COMMON NAME
	Casuarinaceae	
	Casuarina glauca	Swamp She-oak
	Chenopodiaceae	
	Einadia hastata	-
	Clusiaceae	
	Hypericum gramineum	Small St John's Wort
	Convolvulaceae	
	Dichondra repens	Kidney Weed
	Euphorbiaceae	
*	*Euphorbia prostrata*	Red Caustic Weed
*	*Euphorbia* sp.	Poinsettia
	Fabaceae: Faboideae	
	Glycine clandestina	Love Creeper
	Hardenbergia violacea	False Sarsparilla
	Kennedia rubicunda	Dusky Coral Pea
*	*Medicago* sp.	Medic
*	*Trifolium repens*	White Clover
*	*Vicia* sp.	Vetch
	Fabaceae: Mimosoideae	
*	*Acacia baileyana*	Cootamundra Wattle
	Acacia parramattensis	Sydney Green Wattle
*	*Acacia* sp.	Wattle
	Gentianaceae	
*	*Centaurium tenuiflorum*	-
	Geraniaceae	
*	*Erodium cicutarium*	Common Storksbill-
	Lamiaceae	
*	*Westringia fruticosa*	Westringia
	Lauraceae	
*	*Cinnamomum camphora*	Camphor Laurel
	Lobeliaceae	
	Pratia purpurascens	White Root
	Loranthaceae	
	Amyema gaudichaudii	Mistletoe
	Lythraceae	
*	*Lagerstroemia indica*	Crepe Myrtle
	Malvaceae	
*	*Hibiscus* sp.	Hibiscus
*	*Modiola caroliniana*	Red-flowered Mallow
	Sida rhombifolia	Paddys Lucerne
	Meliaceae	
	Melia azedarach	White Cedar
	Moraceae	
*	*Ficus elastica*	Rubber Tree
*	*Ficus* sp.	Fig
*	*Maclura pornifera*	Osage Orange
*	*Morus alba*	White Mulberry
	Myrtaceae	
	Callistemon salignus	Willow Bottlebrush
*	*Callistemon* sp.	Bottlebrush
*	*Eucalyptus cinerea*	Argyle Apple
*	*Eucalyptus citriodora*	Lemon-scented Gum
	Eucalyptus moluccana	Grey Box

APPENDIX 1 cont Flora species recorded on the subject site at Prospect during the recent (Hayes 2002) and previous (GECon 1997) field investigations.

Status	SCIENTIFIC NAME	COMMON NAME
	Myrtaceae cont	
*	*Eucalyptus globulus*	Tasmanian Blue Gum
	Eucalyptus resinifera	Red Mahogany
	Eucalyptus robusta	Swamp Mahogany
	Eucalyptus parramattensis	Parramatta Red Gum
	Eucalyptus sideroxylon	Red Ironbark
	Eucalyptus tereticornis	Forest Red Gum
*	*Leptospermum polygalifolium*	Lemon-scented Teatree
*	*Lophostemon confertus*	Brush Box
*	*Melaleuca armillaris*	Bracelet Honeymyrtle
*	*Melaleuca linearifolia*	-
	Melaleuca styphelioides	Prickly-leaved Paperbark
	Oleaceae	
*	*Ligustrum lucidum*	Large-leaved Privet
*	*Ligustrum sinense*	Small-leaved Privet
*	*Olea europaea* ssp *africana*	African Olive
	Oxalidaceae	
*	*Oxalis corniculata* var. *repens*	Yellow Wood-sorrel
	Phytolaccaceae	
*	*Phytolacca octandra*	Inkweed
	Pittosporaceae	
	Bursaria spinosa var. *spinosa*	Blackthorn
	Plantaginaceae	
*	*Plantago lanceolata*	Plantain
	Polygonaceae	
	Persicaria lapathifolium	Knotweed
	Rumex brownii	Mud Dock
*	*Rumex crispus*	Curled Dock
	Primulaceae	
*	*Anagallis arvensis*	Scarlet Pimpernel
	Proteaceae	
*	*Banksia integrifolia*	Coast Banksia
*	*Banksia* sp.	Banksia
*	*Grevillea robusta*	Silky Oak
*	*Grevillea* sp.	Grevillea
	Ranunculaceae	
*	*Ranunculus repens*	Creeping Buttercup
	Rosaceae	
*	*Cotoneaster glaucophyllus*	Cotoneaster
*	*Prunus* sp	Fruit trees
*	*Rosa* sp.	Roses
N *	*Rubus fruticosus* species aggregate	Blackberry
	Rubiaceae	
*	*Gardenia* sp.	Gardenia
	Rutaceae	
*	*Disoma* sp.	Diosma
*	*Murraya paniculata*	Orange Jessamine
	Salicaceae	
*	*Populus* sp.	Poplar
N *	*Salix fragilis*	Crack Willow
	Solanaceae	
N *	*Cestrum parqui*	Green Cestrum
*	*Lycium ferocissimum*	African Boxthorn
*	*Solanum mauritianum*	Wild Tobacco

APPENDIX 1 cont Flora species recorded on the subject site at Prospect during the recent (Hayes 2002) and previous (GECon 1997) field investigations.

Status	SCIENTIFIC NAME	COMMON NAME
	Solanaceae cont	
*	*Solanum nigrum*	Black Nightshade
*	*Solanum pseudocapsicum*	Madeira Winter Cherry
	Strelitziaceae	
*	*Strelitzia* sp.	Bird of Paradise
	Theaceae	
*	*Camellia* sp.	Camellia
	Verbenaceae	
N *	*Lantana camara*	Lantana
*	*Verbena bonariensis*	Purple Top
*	*Verbena officinale*	Common Verbena
	Violaceae	
	Viola hederacea	Native Violet
	Vitaceae	
	Cissus hypoglauca	Water Vine
	MAGNOLIOPSIDA: MONOCOTYLEDONS	
	Agavaceae	
*	*Agave americana*	Century Plant
	Alismataceae	
*	*Alisma plantago-aquatica*	Water Plantain
	Araceae	
*	*Zantedeschia aethiopica*	Arum Lily
	Asparagaceae	
*	*Myrsiphyllum asparagoides*	Wildenow
*	*Protasparagus densiflorus*	Asparagus Fern
	Commelinaceae	
*	*Tradescantia fluminensis*	Wandering Jew
	Cyperaceae	
*	*Cyperus eragrostis*	-
	Cyperus gracilis	-
	Eleocharis gracilis	Slender Spike-rush
	Schoenoplectus validus	River Club-rush
	Dasypogonaceae	
*	*Lomandra longifolia*	Spiny-fruited Mat-rush
	Juncaceae	
	Juncus pallidus	Pale Rush
	Juncus usitatus	Common Rush
	Juncaginaceae	
	Triglochin procera	Water Ribbons
	Lemnaceae	
	Spirodela pusilla	Duck Weed
	Liliaceae	
*	*Agapanthus* sp.	Agapanthus
	Poaceae	
*	*Andropogon virginicus*	Whisky Grass
	Aristida vagans	Three-Awn Speargrass
*	*Avena fatua*	Wild Oats
*	*Arrhenatherum elatius* var. *africanus*	Bulbous Oatgrass
	Bothriochloa macra	Red Grass
*	*Briza maxima*	Quaking Grass
*	*Briza minor*	Shivery Grass

APPENDIX 1 cont Flora species recorded on the subject site at Prospect during the recent (Hayes 2002) and previous (GECon 1997) field investigations.

Status	SCIENTIFIC NAME	COMMON NAME
	Poaceae cont	
*	*Bromus catharticus*	Prairie Grass
*	*Bromus diandrus*	Great Brome
*	*Chloris gayana*	Rhodes Grass
	Chloris tuncata	Windmill Grass
N *	*Cortaderia selloana*	Pampas Grass
	Cynodon dactylon	Common Couch
	Danthonia linkii var. *linkii*	-
*	*Digitaria didactyla*	Blue Couch
*	*Echinochloa crus-galli*	Barnyard Grass
	Entolasia stricta	-
	Eragrostis brownii	Brown's Love Grass
*	*Eragrostis curvula*	African Love Grass
	Imperata cylindrica var. *major*	Blady Grass
*	*Lolium perenne*	Perennial Rye Grass
*	*Melinis repens*	Red Natal Grass
	Microlaena stipoides var. *stipoides*	Weeping Meadow Grass
*	*Nassella neesiana*	Chilean Needlegrass
*	*Paspalum dilatatum*	Paspalum
*	*Pennisetum clandestinum*	Kikuyu
*	*Phalaris minor*	Lesser Canary Grass
*	*Piptatherum miliacea*	Rice Grass
	Poa affinis	-
*	*Setaria pumila*	Pigeon Grass
*	*Sporobolus indicus* var. *capensis*	Parramatta Grass
*	*Stenotaphrum secundatum*	Buffalo Grass
	Stipa pubescens	Tall Speargrass
	Themeda australis	Kangaroo Grass
	Potamogetonaceae	
	Potamogeton tricarinatus	Floating Pondweed
	Typhaceae	
	Typha orientalis	Cumbungi

CSIRO CLUNIES ROSS RESEARCH STATION, PROSPECT

FLORA & FAUNA ASSESSMENT

APPENDIX 2

Inventory of fauna species recorded

July 2002

APPENDIX 2 Fauna species recorded on the subject site at Prospect during specific field investigations.

KEY	
*	Introduced species
V	Species listed as 'vulnerable' on Schedule 2 of the *NSW Threatened Species Conservation Act 1995.*
A	Species recorded during recent surveys conducted on the subject site for this report (2002).
B	Species recorded during previous surveys conducted on the subject site (GECon 1997).

Status	COMMON NAME	SCIENTIFIC NAME	A	B
	BIRDS			
	Anatidae			
	Australian Wood Duck	*Chenonetta jubata*		✓
	Pacific Black Duck	*Anas superciliosa*	✓	✓
	Podicipedidae			
	Australasian Grebe	*Tachybaptus novaehollandiae*	✓	✓
	Phalacrocoracidae			
	Little Pied Cormorant	*Phalacrocorax melanoleucos*		✓
	Ardeidae			
	White-faced Heron	*Egretta novaehollandiae*		✓
	Threskiornithidae			
	Straw-necked Ibis	*Threskiornis spinicollis*	✓	
	Rallidae			
	Spotless Crake	*Porzana tabuensis*		✓
	Dusky Moorhen	*Gallinula tenebrosa*		✓
	Eurasian Coot	*Fulica atra*	✓	✓
	Purple Swamphen	*Porphyrio porphyrio*	✓	✓
	Charadriidae			
	Masked Lapwing	*Vanellus miles*		✓
	Columbidae			
*	Rock Dove	*Columba livia*	✓	
	Crested Pigeon	*Ocyphaps lophotes*		✓
*	Spotted Turtle-dove	*Streptopelia chinensis*	✓	✓
	Cacatuidae			
	Sulphur-crested Cockatoo	*Cacatua galerita*		✓
	Galah	*Cacatua roseicapilla*		✓
	Psittacidae			
	Eastern Rosella	*Platycercus eximius*	✓	✓
	Red-rumped Parrot	*Psephotus haematonotus*		✓
	Cuculidae			
	Common Koel	*Eudynamys scolopacea*		✓
	Halcyonidae			
	Laughing Kookaburra	*Dacelo novaeguineae*		✓
	Maluridae			
	Variegated Fairy-wren	*Malurus lamberti*		✓
	Meliphagidae			
	Noisy Miner	*Manorina melanocephala*	✓	
	Little Wattlebird	*Anthochaera chrysoptera*		✓
	Dicruridae			
	Willie Wagtail	*Rhipidura leucophrys*	✓	✓
	Restless Flycatcher	*Myiagra inquieta*	✓	
	Australian Magpie-lark	*Grallina cyanoleuca*	✓	✓

APPENDIX 2 cont Fauna species recorded on the subject site at Prospect during specific field investigations.

Status	COMMON NAME	SCIENTIFIC NAME	A	B
	Campephagidae			
	Cicadabird	*Coracina tenuirostris*		✓
	White-winged Triller	*Lalage sueurii*		✓
	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		✓
	Artamidae			
	Australian Magpie	*Gymnorhina tibicen*		✓
	Corvidae			
	Australian Raven	*Corvus coronoides*	✓	✓
	Motacillidae			
	Richard's Pipit	*Anthus novaeseelandiae*		✓
	Passeridae			
*	House Sparrow	*Passer domesticus*	✓	✓
	Hirundinidae			
	Fairy Martin	*Hirundo ariel*		✓
	Welcome Swallow	*Hirundo neoxena*	✓	✓
	Pycnonotidae			
*	Red-whiskered Bulbul	*Pycnonotus jocosus*		✓
	Sylviidae			
	Tawny Grassbird	*Megalurus timoriensis*		✓
	Clamorous Reed Warbler	*Acrocephalus stentoreus*		✓
	Zosteropidae			
	Silvereye	*Zosterops lateralis*		✓
	Sturnidae			
*	Common Starling	*Sturnus vulgaris*	✓	✓
*	Common Myna	*Acridotheres tristis*	✓	✓
	AMPHIBIANS			
	Myobatrachidae			
	Common Eastern Froglet	*Crinia signifera*	✓	✓
	Hylidae			
	Peron's Tree Frog	*Litoria peronii*		✓
	REPTILES			
	Chelidae			
	Long-necked Tortoise	*Chelodina longicollis*		✓
	Scincidae			
	Eastern Water Skink	*Eulamprus quoyii*		✓
	Garden Skink	*Lampropholis delicata*		✓
	Elapidae			
	Red-bellied Black Snake	*Pseudechis porphyriacus*		✓
	MAMMALS			
	Phalangeridae			
	Common Brush-tailed Possum	*Trichosurus vulpecula*	✓	
	Pteropodidae			
V	Grey-headed Flying-fox	*Pteropus poliocephalus*	✓	✓
	Introduced Mammals			
*	Cat	*Felis catus*	✓	✓
*	Rabbit	*Oryctolagus cuniculus*		✓
*	Horse	*Equus caballus*	✓	
*	Fox	*Vulpes vulpes*	✓	
*	Sheep	*Ovus aries*		✓

5.3 C. Girraween Creek Former CSIRO Site Prospect Vegetation Management Plan Pittendrigh Shinkfield & Bruce 2004

PSB

Girraween Creek
Former CSIRO Site
Prospect, NSW

VEGETATION MANAGEMENT PLAN

Prepared for STOCKLAND

June 2004

PITTENDRIGH SHINKFIELD BRUCE
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | **F** 02 9212 4499 | **E** psb@psb.com.au | **W** www.psb.com.au

EXECUTIVE SUMMARY

The VMP provides an overview of major issues to be addressed, strategies and actions to facilitate the establishment and long-term management of the Girraween Creek restoration. Management issues include water quality and quantity, aquatic and terrestrial weeds, habitat, pest fauna, safety and public health.

The approach to the VMP is to guide both short-term and long-term management strategies and actions for Girraween Creek. Outcomes are then checked back against the restoration goals and objectives using performance indicators (s. 8.3).

An adaptive management approach is therefore essential so that management outcomes can be monitored and evaluated, and management actions adjusted as required to meet the goals and objectives.

Maintenance and/or monitoring requirements for before, during and post construction are summarised in an action plan within the VMP (s. 8.1).

DIPNR will be involved in a reporting process throughout the two-year Plant Establishment Period following the Practical Completion of works. Six-monthly monitoring / progress reports will be forwarded to DIPNR during that period. The VMP details requirements for monitoring and reporting throughout the Plant Establishment Period and additionally for the long-term management of the system.

EXECUTIVE SUMMARY

This Vegetation Management Plan (VMP) has been prepared for the riparian restoration of Girraween Creek in the former CSIRO Prospect development area, to provide a framework for the establishment and ongoing management of the riparian restoration zone.

The VMP has been undertaken in order to fulfil conditions for the granting of a permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948*, issued by the Department of Infrastructure Planning and Natural Resources (DIPNR). DIPNR require a minimum of two years maintenance and monitoring after the completion of construction. This will constitute the Plant Establishment Period.

The project involves the restoration of a one (1) km length of Girraween Creek from the southern boundary of the development site to the M4 Motorway, located in the Holroyd LGA (see Figure 3). The goal of the restoration works is to create a low maintenance, relatively self sustaining, ecologically diverse system in an urban environment that fulfils a number of functions, as below:

- stormwater pollution control;
- stormwater detention;
- erosion and sediment control;
- habitat provision;
- aesthetic amenity;
- passive recreation; and
- education / interpretation.

Remediation of the stream bank was undertaken in late 2003 and comprised selected earthworks and pulling back of creek batters to facilitate free passage of storm flows (PB & P 2002).

Remnant vegetation of the site comprises Sydney Coastal River Flat Forest and Cumberland Plain Woodland. Sydney Coastal River Flat Forest and Cumberland Plain Woodland are listed as endangered ecological communities under Part 3 Schedule 1 of the NSW *Threatened Species Conservation Act 1995* (TSC Act). Cumberland Plain Woodland is also listed on the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The corridor restoration aims to increase the diversity of native plant species from what exists now and improve habitat for native fauna over the existing situation. This will be achieved by providing a diverse range of both aquatic and riparian habitat types, including fully structured riparian vegetation communities and ground level connectivity for the length of the works, with the exception of A road crossing. The main pond will be stocked with native fish.

Objectives of the project are:

- to enhance the ecological functions of the creek corridor;
- to reinstate local indigenous aquatic and riparian vegetation;
- to provide a diversity of habitats for local aquatic, semi-aquatic and terrestrial native fauna;
- to provide a movement corridor for native fauna as part of a regional corridor network; and
- to provide high quality passive recreational and educational opportunities for the surrounding community without compromising ecological values.

Action Plan

Key: LA - Landscape Architect
LC – Landscape Contractor
MC – Main Contractor
SC – Specialist Consultant
SL – Stockland Limited
BRC – Bush Regeneration Contractor

Task/Method	Specification Clauses	VMP Section	Duration	Responsibility
Pre-Construction Phase - Stage 01				
Plant Procurement				
• Sourcing of propagative native plant material.	n/a	4.2 & 5.2	2 months	LA
• Finalisation of plant species and numbers.	n/a	5.2.5	1 month	LA
• Letting of propagation contract	tba	n/a	1 month	SL
• Plant propagation	tba	5.2.6	5-6 months	SL/Nursery
• Plant material inspections prior deliver	tba	n/a	1 month	LC
Baseline Monitoring				
• Set up monitoring points & take first photographic record from each point	n/a	7.1	1 day	LC
• Undertake benchmark monitoring of representative areas in both SCRFF and CPW and for both regeneration and reconstruction treatments	n/a		1-2 days	BRC/SC
Approval Process				
• Obtain license from NSW NPWS required under Section 91 of the TSC Act	n/a	2.6.1	2 months	LA
Construction Phase - Stage 01				
Sediment & Erosion Controls				
• Install sediment and erosion controls to protect riparian corridor from adjacent subdivision building works.	n/a	n/a	1 week	MC
• Install sediment and erosion controls to protect watercourse from adjacent riparian corridor works.	tba	n/a	1 week	LC
Irrigation				
Installation of meters, pipes and fittings	tba	5.8	1 week	LC/BRC
Riparian Corridor Restoration				
• Site preparation including				
- soil testing	tba	4.3	1 month	SC
- ecological burn treatments	tba	5.4	2 weeks	BRC
- soil preparation	tba	5.6	2 weeks	LC/BRC
- soil stabilisation (mulching or matting)	tba	5.7	2 weeks	LC/BRC
• Weed Control and Planting Program				
- primary weed eradication			1 month	BRC
- primary planting, seeding and translocation			2 weeks 2 weeks	BRC BRC
- secondary weed eradication			2 weeks	BRC
- secondary planting				

Task/Method	Specification Clauses	VMP Section	Duration	Responsibility
Construction Phase - Stage 01 *continued*				
Construction Works • Perimeter works, including: - Road kerb and guttering, - Stormwater infrastructure, including main stormwater outlets direct to Main and Inlet Ponds. • Constructed landscape features within the riparian corridor, including: - Perimeter walkway / cycleway system and cross-corridor pathway systems to the Main Bushland Reserve (2no. – the southern crossing will have a bridge.) and the Northern Bushland Reserve (1no. to M4 underpass) – (all stages), - Girraween Woodland Park, including shale access / pathway suitable for Sydney Water maintenance access, basalt maintenance edge, bollards, grassed viewing mound, picnic shelters / viewing mound shelter, and turfing – (Stage 1), - Main Pond Wall Lookout, including shale access / pathway suitable for Sydney Water maintenance access, boardwalk and lookout shelter (Stage 1), - Main Pond Boardwalk to western perimeter linking from near the Main Pond Wall to the Main Pond Formal Park, and including an extension to the water's edge - (Stage 2), - Northern Bushland Park, including activity nodes for a playground, and fitness equipment/sculpture/seating, shade structures and bollards – (Stage 3), - Interpretative Elements, including signage – (all stages).	n/a tba tba tba tba tba	n/a n/a n/a n/a n/a n/a	3 months (Stage 1) 3 months (Stage 2) 3 months (Stage 1) 3 months (Stage 2) 2 months (Stage 3)	MC LC
DIPNR Liaison Notify DIPNR in writing, one month prior to Practical Completion		4.11	-	LA
Practical Completion (PC) Inspection of works DIPNR certification re. meeting all 3A Permit requirements Photographic monitoring		4.11	-	LA

Task/Method	Specification Clauses	VMP Section	Duration	Responsibility
2 Year Plant Establishment Period (PEP)				
Plant Establishment Period				
• Establish the parkland works undertaking maintenance task as outlined in Landscape Works Specifications	tba	n/a	12 months	LC
• Establish / develop the corridor restoration works undertaking maintenance tasks as outlined within the VMP	n/a	5.10	2 years	LC/BRC
Native Fish Stocking				
• Work includes the undertaking of a downstream fish survey, assessment of suitability of water quality conditions re. fish release and follow-up monitoring.	tba	6.2.4	6 months	SL/SC
Bushfire Fuel Reduction Management				
• Landscape Contractor to consult specialist Bushfire Consultant (to include site inspections as necessary) in regards to managing accumulation of fuel within the OPZ.	tba	4.6	2 years	LC/ SC
Progress Reporting				
• Landscape contractor to prepare a maintenance program and keep a logbook for works undertaken during this phase		5.10	2 years	LC
• Six monthly progress reporting to be provided				
Inspection/Monitoring				
• Inspection and monitoring of riparian corridor every three months		7.2	2 years	LA
• Restoration works / plant species diversity			2 years	SC
• Water quality & aquatic habitat assessment monitoring			2 years	SC
• Mosquito monitoring (January to March by specialist if required)			2 years	SC
• Native fish establishment monitoring			2 years	SC
DIPNR Liaison				
• Reporting to DIPNR (6 monthly)		4.11	2 years	LA
• Notify DIPNR in writing, one month in advance of completion of the Post Construction Phase.				
Finalisation of PEP				
• Notify DIPNR in writing, one month in advance of completion of the Post Construction Phase.		4.11	1 month	LA
• Preparation of Riparian Corridor Operation & Maintenance Manual		5.11.1		LC

Task/Method	Specification Clauses	VMP Section	Duration	Responsibility
Handover				
• Inspection of works.		5.11	-	LA
• Maintenance Manual			-	SL
• Formal handover of the works to Holroyd City Council who will be responsible for on-going maintenance of all landscape and riparian corridor restoration works.			-	LA + SL
Maintenance Staff Training				
• Handover training workshop for key Holroyd City Council maintenance staff.		5.11	One month prior to Handover	LA + SL
On-going – Long-term Management (post contract)				
Maintenance Period				
• Maintain the bushland parks (Girraween Creek Bushland Park and Northern Bushland Park)	tba	6.0	On-going	Council
• Maintain / develop the riparian corridor restoration works	tba			
Restoration Monitoring				
• Restoration works		7.1.3	On-going	SC/Council
• Water quality & aquatic habitat assessment monitoring		7.1.4		SC/Council
• Mosquito monitoring (January to March by specialist if required)		7.1.5		SC/Council
• Native fish establishment monitoring		7.1.6		SC/Council
Maintenance Monitoring				
• Monitoring / maintenance inspections of the creek corridor to be carried out on a 3-monthly basis or following storm events; and	n/a	6.0	On-going	Council
• Monitoring via visual inspections to assess general health/diversity of vegetation, weed infestations, sediment accumulation, litter, algal blooms, erosion, and other issues				

PSB

Contents

1.1 Purpose of the Plan

This Vegetation Management Plan (VMP) has been prepared for the riparian restoration of the section of Girraween Creek within the former CSIRO Agricultural Research Station at Prospect. The VMP provides a framework for the establishment and ongoing management of the riparian restoration zone.

The VMP has been undertaken in order to fulfil conditions for the granting of a permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948*, issued by the Department of Infrastructure, Planning and Natural Resources (DIPNR).

1.2 Scope of this Plan

As agreed at the meeting between DIPNR and Stockland of 28 November 2003, this Plan addresses the entire riparian corridor. It has been agreed that on this basis, a 3A Permit will be issued for the entire corridor, with the Permit being valid on an 'in principle' basis for each subsequent stage, requiring only that the construction documentation demonstrate that it has addressed the requirements of the approved VMP.

This Plan meets the requirements of the DIPNR *Guidelines for the Preparation of a Vegetation Management Plan*.

1.3 Plan Objectives

The objectives of the VMP are to put in place management strategies and actions for the:

- establishment, on-going development and maintenance of a **healthy, ecologically productive riparian / aquatic corridor**;
- establishment and on-going maintenance of a corridor environment that is **readily maintainable, provides high quality aesthetic amenity**, and **recreational / interpretative facilities**.

1.4 Implementation of the Plan

Two parties will be responsible for the implementation of this Plan, as follows:

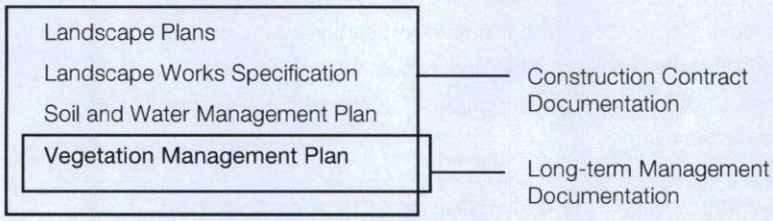
- The Landscape Contractor and Bushland Regeneration Contractor (as sub-consultant to the Landscape Contractor) will be responsible for management of the riparian zone for a formal two (2) year Plant Establishment Period (PEP) following Practical Completion (PC) of the works. At the end of the PEP, DIPNR will formally 'sign-off' on the works, and
- On completion of the ongoing maintenance phase by Stockland, the riparian corridor will be formally handed over to Holroyd City Council. Council will then manage the site in perpetuity, including implementation of the on-going management and monitoring strategies outlined in this document.

1.5 How to use the Plan

The VMP is to be used in two capacities:

- as a component of the contract documentation for the construction and plant establishment of riparian restoration works, and
- as the directing document for the long-term management of the riparian corridor

Relevant contract documentation comprises:



The VMP is interrelated, and to be used in conjunction with the Landscape Works Specification. The latter provides detailed specifications for landscaping tasks and materials within a site-wide context, including those areas outside the VMP's scope. The VMP provides detail at a finer resolution of the tasks and materials that are specific to the restoration process.

Where an anomaly exists between these two documents, the Landscape Works Specification will override, until such time as when the PEP is completed.

2.0 SITE DESCRIPTION

2.1 Background

The site is located within the Holroyd LGA, in the suburb of Prospect, west of Sydney CBD. Covering approximately 60 hectares of land, the site forms part of the old CSIRO Ian Clunies Ross Research Station, which extends south from the M4 Motorway to Old Prospect Road (Figure 1). The land to which this VMP applies is illustrated in Figure 2.

The proposed residential development occupies previously cleared and grazed pastoral lands, which formed part of the Animal Research Laboratory. Small areas of native vegetation persist at the site, primarily along Girraween Creek, which extends through the central portion of the site from south to north.

Past clearing of native vegetation, grazing practices and colonisation by exotic plant species has contributed to the current fragmented and degraded condition of Girraween Creek.

2.2 Catchment Context

The site is located within the upper reaches of the Girraween Creek catchment. Girraween Creek rises on adjacent property to the south, flowing through the site as a more or less natural creek line before forming into a large dam within the central northern portion of the property. Overflow from the dam continues north beneath the M4 Motorway and Great Western Highway, eventually flowing into Toongabbie Creek, a tributary of the Parramatta River (approximately seven kilometres downstream) (see Figure 1).

The greater Girraween Creek Catchment is located within the Holroyd, Blacktown and Parramatta Local Government Areas.

2.3 Geological Landscape

Soil landscape and geological maps of the area indicate the lower central portion of the site (or valley floor) to comprise the fluvial South Creek Landscape and most of the valley side slopes to comprise the residual Blacktown Soil Landscape underlain by the Wianamatta Group which comprises Ashfield Shale Laminate and dark grey Siltstone (Bannerman & Hazelton 1990).

The South Creek Landscape typically comprises deep Quaternary Alluvium derived from the Wianamatta Group shales and Hawkesbury sandstone. Its limitations include erosion hazard, low strength, and frequent flooding.

The Blacktown Landscape typically comprises shallow to moderately deep red and brown podsolic soils on crests grading to yellow podsolic soils on lower slopes. Its limitations include moderately reactive highly plastic subsoils and poor soil drainage.

Sediment and erosion controls during restoration works and in the development of the catchment will be implemented to reduce sediment transport into the creek system.

2.4 Soil and Water Chemistry

Draft salinity hazard mapping for Western Sydney (Network Geotechnics 2002) indicates the former CSIRO research site lies within an area of extensive salinity hazard. Test pits were sampled to characterise the natural soil profile at the site during spring of 2002, and additional salinity assessment was undertaken during the winter of 2003 (Network Geotechnics 2002, Network Geotechnics 2003).

In summary the investigations revealed the following issues:

Soil characteristic results from test pits, October 2002

- Localised areas of moderate salinity on the lower side slopes and valley floor;
- Moderate to high water erodibility of topsoils; and
- Elevated pH levels within the lower portion of the site.

Groundwater and Soil Sampling, August 2003

- Within the valley floor (near the creek), groundwater has been recorded below depths of 1.4m to 2.05m that was slightly to moderately saline, which is consistent with salinity levels of the B Horizon subsoil materials it is in contact with;
- Within the creek, wet weather flow is assessed to be non saline. Whilst this is consistent with non to slightly saline A Horizon topsoil which surface/subsurface water flows would drain over/through, it may also be attributed to flushing of the creek during recent wet weather;
- It is possible that dry weather conditions may result in an increase in creek water salinity levels;
- Groundwater samples obtained at 4.5m and 5.5m depth were highly saline and assessed to be as a result of contact with the lower B2 and C Horizon which reflects the trend of increasing soil salinity with depth; and
- There appears to be little surface evidence of salinity problems at the site. Whilst the underlying shale geology is an indicator of potential soil salinity, there appears to be no major concentration of salinity along the valley floor due to surface and/or subsurface flows (possibly due to good runoff to the valley floor and relatively deep groundwater beneath the mid slope areas).

In terms of site management, salinity amelioration works may be required when exposing B and C Horizon subsoils and excavated soils must be replaced in their original order to avoid bringing salts to the surface.

Earthworks, which distribute and expose only the upper topsoil (A Horizon) and red-brown or orange-brown clay (B1 Horizon), will not require salinity remediation. These soils are generally assessed to be non-saline, although the clays are highly sodic.

2.5 Climate

The area is characterised by warm to hot summers (average summer temperatures 17.1- 27.7°C) and cool to cold winters (average winter temperatures 6.9 – 17.8°C), with average annual humidity at 62.9%.

Rainfall is fairly consistent throughout the year with the highest rainfalls occurring on average from January to March and the lowest rainfalls on average from July – September. Average rainfall is 860mm per annum. Frost is common during the winter months (BOM, 2004).

2.6 Flora

Overview

The flora of the site has been described in studies undertaken by Hayes Environmental (2002) and GECon (1997) and more recently assessed by Ecohort for the development of a specific Bushland Management Plan (Appendix C).

Remnant vegetation of the site comprises Sydney Coastal River Flat Forest (SCRFF), associated with Girraween Creek, and Cumberland Plain Woodland (CPW) occurring on the more elevated areas surrounding the creek environment.

2.6.1. Legislation

Sydney Coastal River Flat Forest and Cumberland Plain Woodland are listed as endangered ecological communities under Part 3 Schedule 1 of the NSW *Threatened Species Conservation Act 1995* (TSC Act). Cumberland Plain Woodland is also listed on the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A statutory requirement for recovery of the endangered CPW and SCRFF ecological communities is being addressed as part of the Cumberland Plain Endangered Ecological Communities (CPEEC) Recovery Plan, which is currently being drafted by NSW NPWS. The draft plan suggests that relevant landholders undertake specific actions to assist in the recovery of CPEEC.

The implementation of restoration and rehabilitation works as recommended within the appended Bushland Management Plan (BMP) will contribute to abating the threatening and degrading processes that currently affect CPW and SCRFF, and improve their health and resilience to further degradation.

A scientific license for the purpose of science, education, and/or conservation is required under Section 91 of the TSC Act and Section 132c of the *National Parks and Wildlife Act 1974* (NPW Act), in order to implement the proposed bushland regeneration, seed collection and revegetation works.

2.6.2. Existing Situation

The existing remnant riparian vegetation is concentrated along Girraween Creek with occasional outlying patches of woodland. The site's vegetation has been divided into specific management areas based on community type and level of resilience (e.g. intactness, potential seed bank, degree of weed infestations) as outlined below and described in the BMP (Appendix C).

Sydney Coastal River-flat Forest (SCRFF)

- Variably weed affected riparian canopy and ground layer, shrub layer absent (low, medium and medium to high resilience); and
- Variably weed affected riparian ground layer, occasional or no canopy species, native shrub layer replaced by woody weeds (low and low to medium resilience).

Cumberland Plain Woodland (CPW)

- Mixed native and naturalised grasslands (low to medium resilience); and
- Variably weed affected woodland canopy and ground, shrub layer absent (low, and low to medium resilience).

Disturbed Terrestrial (DT)

- Native vegetation absent; and
- Recently planted with native species.

Freshwater Wetland (FW)

- Man made drains with native macrophytes and varying levels of resilience;
- Natural depressions with native macrophytes and varying levels of resilience; and
- Modified freshwater zones, e.g. modified dam and marsh plantings with remnant native macrophytes (medium resilience).

Small areas of primarily scattered, small and low quality remnant CPW and modified freshwater wetlands will be cleared as a result of the residential development. Relatively intact ground layer vegetation contained within those areas to be cleared will be translocated into the riparian corridor.

All remaining remnant SCRFF and CPW vegetation will either be rehabilitated and surrounding disturbed terrestrial areas will be reconstructed. The creek channel will be retained in its present form, with only bank /corridor rehabilitation works proposed.

The rehabilitation and enhancement of the riparian corridor will use local provenance plant materials and will significantly improve the remnant endangered ecological communities on-site. Additionally, the use of local provenance material will provide a larger seed source from which future propagation may be possible. This is of particular relevance as present collection sites for CPW and SCRFF provenance material is highly fractured and widely distributed.

2.7 Weeds and Weed Sources

A wide range of weed species is present within the riparian zone. Woody weeds include Blackberry (*Rubus fruticosus*), Lantana (*Lantana camara*), Green cestrum (*Cestrum parqui*), Broad and Narrow-leaf privet (*Ligustrum lucidum* and *L. sinense*), African boxthorn (*Lycium ferocissimum*) and African olive (*Olea europaea* ssp. *africana*).

Naturalised grasses and broadleaf weeds are widespread. Spiny Rush (*Juncus acutus*) is growing throughout the site (in the creek channel, along the northern dam wall, and within the northern bushland area). *Juncus acutus* is an environmental weed that out-competes native species and spreads quickly after establishing in waterways via in-stream seed dispersal.

Stormwater runoff introduces nutrients and undesirable propagules to the site. Other sources of weeds include dispersal by wind, dispersal by wildlife, and introduction by humans on footwear, on clothes, on car tyres and through dumping of garden refuse.

2.8 Fauna Habitat

The fauna of the site has been described in studies undertaken by GECon (1997) and Hayes Environmental (2002). The site provides habitat to a small suite of common native fauna, typically able to exploit land disturbed by human activity. The existing riparian zone is of limited habitat value to native fauna due to the degraded nature of the stream, and limited vegetation cover.

Habitat is provided by the riparian shrub-layer and blackberry thickets (e.g. smaller passerine bird species), while larger insectivorous/carnivorous species, which were evident, typically roost adjacent to the more open areas, occasionally foraging on ground and in open pasture.

Two native mammals were recorded using the site, the Common brush-tailed possum and Grey-headed flying fox. Five introduced mammals were recorded (horse, sheep, cat, fox and rabbit), all of which contribute to the degradation of native vegetation, and suppression of natural regeneration (Hayes 2002).

The open water zone within the modified dam provides habitat for a range of waterfowl, with further nesting habitat available when macrophyte plantings establish.

A number of amphibian (Common eastern froglet and Peron's tree frog) and reptile species (Long-necked tortoise, Eastern water skink, Garden skink and Red-bellied black snake) were evident, although the site is not considered to contain features or resources that would support threatened amphibians and/or reptiles.

It is possible that species using the shrub layer on a frequent basis will be displaced in the short term by the proposed works but will be able to re-colonise the reinstated riparian vegetation once works are complete. In order to minimise disturbance to wildlife, primary clearing of dense weed growth will be staged over two phases as described in s.5.5.1.

2.9 Threatened Species

One fauna species listed on the TSC Act, the Grey-headed flying fox (*Pteropus poliocephalus*) was recorded flying over the site (1997) and recorded foraging within the riparian remnant canopy trees (2002). An accompanying 8-part test indicated that the development is unlikely to significantly affect this species. This due to being principally a canopy dependent species, utilising trees for foraging and roosting, and the proposed development involves the retention of native canopy species.

No other threatened fauna species are considered likely to utilise the site regularly , or be significantly affected by the proposed development (Hayes 2002).

2.10 Corridor Values

The site provides negligible connectivity, or corridor, to other vegetated areas, due to widespread clearing of native vegetation for agricultural and development activities, including the construction of both the M4 Motorway and Great Western Highway. Connectivity of aquatic habitats downstream is also greatly constrained due to a number of road crossing culverts, damming of the creek and associated spillway, which prevents passage of aquatic fauna, in particular fish.

As part of the VMP process, the dam will be stocked with appropriate native fish. It is expected that in the order of 12 different native fish species should be suitable for the site.

2.11 Aboriginal Heritage

One Aboriginal scar tree is located within the riparian corridor, which is defined as an Aboriginal "object" under the NPW Act (refer Figure 4 for approximate location). The NPW Act requires that reasonable precautions be taken and due diligence is exercised to determine whether an action would, or would be likely to, impact on an Aboriginal object. Without being able to demonstrate due diligence a person risks prosecution if Aboriginal objects are impacted upon and a Heritage Impact Permit (HIP) has not been issued.

It is also an offence, under Section 86 of the NPW Act, to disturb or excavate land for the purpose of discovering an Aboriginal object, or disturb or move an Aboriginal object on any land, without first obtaining a permit under Section 87 of the NPW Act. In issuing a permit under Section 87, NPWS will take into account:

- The views of the Aboriginal community about the proposed activity;
- The objectives and justification of the proposed activity;
- The appropriateness of the methodology to achieve the objectives of the proposed activity; and
- The knowledge, skills and experience of the nominated person(s) to adequately undertake the proposed activity.

Other legislation affecting land containing Aboriginal objects is as follows:

- *Environmental Planning and Assessment Act 1979* (EP & A Act): requires that environmental impacts are considered in land use and planning and development approvals; and
- *Heritage Act 1977*: although Aboriginal Heritage is primarily protected under the NPW Act, an object may be subject to the provisions of the Heritage Act if the item is listed on the State Heritage Register or subject to an Interim Heritage Order (IHM).

Under the draft Guidelines for Aboriginal Heritage Assessment prepared by the then Department of Land and Water Conservation (un-dated), an assessment is not required for the proposed restoration works at the site.

However the restoration project does incorporate sufficient conservation measures to ensure the scar tree is adequately protected and preserved[1]. Such measures include, but are not be limited to:

- Conservation of landscape features;
- Restoration and/or enhancement of natural environmental processes;
- Sympathetic bush regeneration methods within the immediate area of the tree; and
- Ongoing management of the area and associated vegetation to prevent destruction by fire.

[1] Consultation with the Aboriginal Boards and Committees Coordinator, DIPNR is in progress at the time of preparing this report.

3.1 The Role of Riparian Vegetation

Riparian vegetation has a vital role in conserving and improving the health of waterways. Healthy, native riparian vegetation contributes to bank stability, control of erosion and sedimentation and water quality protection. It also provides habitat and a movement corridor for native fauna.

3.2 Restoration Goal

The goal of the restoration works is to create a low maintenance, relatively self-sustaining, ecologically diverse corridor within a highly urbanised environment. The long-term goal of ecological restoration is ultimately the self-perpetuation of plant communities, in this case those which approximate the available understanding of the pre-1788 structure (DIPNR, 2003). The intent is to carry out the restoration to the highest extent practicable. It has been estimated that the restoration of a complex vegetation structure and characteristics of a riparian community requires over a century to achieve (Lynch & Catterall *in* Price & Lovett 1999).

The corridor will comprise of both formal infrastructure components (e.g. the water quality control / stormwater detention pond) and restored bushland that fulfils the following functions:

- stormwater pollution control;
- stormwater detention;
- erosion and sediment control;
- prevention of salinity problems;
- reservoir of locally provenanced plant material;
- habitat for fauna;
- aesthetic amenity;
- passive recreation; and
- interpretation.

3.3 Restoration Objectives

The restoration objectives of the project are:

- to enhance the ecological functions of the creek corridor;
- to reinstate local indigenous aquatic and riparian vegetation;
- to provide a diversity of habitats for local aquatic, semi-aquatic and terrestrial native fauna;
- to make provision for a future downstream fauna movement / regional corridor network opportunity; and
- to provide high quality passive recreational and interpretative opportunities for the surrounding community, without compromising ecological values.

3.4 Values of the Project

Ecological

- Enhanced local biodiversity and ecological processes;
- Water quality control; and
- Soil erosion control.

Social

- Aesthetic amenity;
- Passive recreation provisions; and
- Interpretative provisions.

Economic

- Preventing soil erosion and river degradation;
- Preventing soil salinity problems; and
- Flood mitigation and asset protection.

4.1. Riparian Corridor Framework

Figure 2 shows the area covered by this Plan, within the context of the site prior to residential development. Figure 3 shows the area covered by this Plan within the context of the site masterplan. Figure 4 shows the designated corridor management zones. Figure 5 shows the detailed restoration treatment areas.

Broadly, the riparian corridor comprises two separate areas as follows:

- Core Riparian Zone (CRZ), which is to be fully rehabilitated with plant communities characteristic of the two remnant endangered ecological communities currently present on the site. Recreational access is not provided within this zone, with the exception of (refer Figure 4):
  - Two (2) pedestrian / cycle creek crossing points,
  - Two (2) small informal parkland areas (The Northern Bushland Park and Girraween Creek Bushland Park) (refer Figure 4 - Items E & L); and
  - Two (2) lookout points, being on the wall of the Main Pond (The Northern Viewing Mound) and on the eastern bank of the Main Pond (refer Figure 4 - Items I and K).

  Concept drawings of the above features are provided within Appendix E (Landscape DA Drawing Set) and Appendix G (Landscape CC Documentation, to be provided on a staged basis).
- Outer Protection Zone (OPZ), which acts as both a physical buffer to the CRZ from the adjoining urban development, and a combined parkland / bushland edge containing a corridor perimeter walkway / cycleway. The perimeter walkway / cycleway will act as a management edge between bushland / native grassland / forb ground layer treatments adjoining the CRZ and a more formally tended parkland treatment of locally endemic trees and a single species native grass cover (e.g. *Microlaena stipoides*) to the road boundary (refer Appendix E).

It is noted that a substantial improvement to the connectivity of the corridor over that shown in the Precinct Plan has been effected, between the wall of the Main Pond (refer Figure 4 - Item J) and the Northern Bushland Reserve (refer Figure 4 - Item C). This has been achieved by the introduction of the community type characteristic of Cumberland Plain Woodland across the full frontage of the dam wall, within and adjacent to the 1 in 100 year floodway between the dam spillway and the re-commencement of Girraween Creek (refer Figure 4).

Stream Bank Remediation

Design and implementation of stream bank remediation works were undertaken by others in late 2003 (PB & P 2002). In general the works comprised of selected earthworks and pulling back of creek batters upstream of the Inlet Pond, to facilitate free passage of storm flows.

4.2 Plant Procurement

As far as practicable, all plant material used within the riparian corridor will be of local provenance, i.e. collected from within a maximum 5 kilometre radius of the site (DIPNR, 2003). To facilitate this process, a seed collection contract was let over the 2003 / 2004 Christmas break period to collect a range of plant material both on and within close proximity to the site.

Greening Australia is able to provide the vast majority of the remaining plant propagative material for the site. Much of this material has been collected from within the nearby Prospect Reservoir site and other sources within a 5 km radius of the site. Additional material is also available from sources between 5 and 18 kms from the site (refer Appendix B for Schedule of Plant Species and Provenance).

An initial plant propagation contract is proposed to be let by no later than June 2004, in readiness for landscape implementation. On this basis, we expect to have appropriately sized plant material (e.g. Type A Cells: 0.02 – 0.035L size, e.g. Speedy-cell, Hiko Cells – 0.093L size) ready for the riparian corridor planting works by November / December 2004.

Street trees are proposed to be of local provenance where possible (including to the OPZ). These will be required in a reasonably advanced state at the time of planting.

It is expected that seed of local provenance will be available for all proposed street trees from Greening Australia, and that a pre-grow contract will be let to grow-on advanced stock of local provenance for street trees in later stages of the project.

Where it is not possible to procure all required species of local provenance, further collection of provenance propagative material will be undertaken during the 2004-05 flowering / seed bearing season to procure additional species for later stages of planting to the corridor.

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

4.3 Soil Testing

As part of the corridor restoration design process, a detailed soil testing assessment will be undertaken. Detailed recommendations for soil amelioration will be made, including the addressing of any salinity issues.

4.4 Implementation of Restoration

Restoration will be undertaken using two techniques (refer Figure 5), these being:

- **Assisted Natural Regeneration** - to mapped areas of existing remnant endangered ecological communities proposed for retention (including a variable width vegetative buffer around these), i.e. remnants of:
  - Sydney Coastal River-flat Forest (SCRFF); and
  - Cumberland Plain Woodland (CPW).
- **Reconstruction through Revegetation** - to the remaining areas of the proposed riparian corridor that are deemed to be wholly or severely depleted of regeneration potential.

A hierarchy of action will guide the choice of the appropriate approach, as follows (DIPNR, 2003):

1. **Retain** agreed remnant indigenous vegetation;
2. **Regenerate** where site resilience indicates potential for natural regeneration (assisted natural regeneration); and
3. **Revegetate** where there is no reasonable regeneration potential (reconstruction through revegetation).

A specialist Bushland Management Plan (BMP) has been prepared by a full member of the Australian Association of Bush Regenerators (AABR) NSW. The BMP provides a detailed description of the existing condition of remnant vegetation of the site and recommendations for those areas of the corridor proposed for assisted natural regeneration. The specialist has also provided input into the process of reconstruction through revegetation to the adjoining regeneration areas.

The specified approach, recommendations and mapping of vegetation zones developed within the BMP have been adopted and integrated into this VMP (refer Appendix C and Figure 5).

4.4.1 Staging of Planting

Where it is required to establish an initial planting framework as a protective structure for more shade dependent or vulnerable species (such as some groundcovers), the corridor regeneration / revegetation process will be staged. Staging of planting will be finalised with the Planting Schedule.

4.4.2 Species Diversity Goal

The restoration process will aim to achieve the establishment of 80 species of local provenance for each of the two CPW and SCRFF communities within the riparian corridor (propagative material for 85 species has been procured at the time of writing), with particular emphasis on achieving the greatest practicable diversity within the groundcover / forb layer.

The works will take place to the timetable nominated in s.8.1.

At the time of writing, total species numbers for each of the two communities are as follows:

- Cumberland Plain Woodland:
  - A total of 73 species available,
  - 65 of these species are either to be propagated and/or already exist on site,
  - eight (8) of these species are present on site and there is no need for propagation
- Sydney Coastal River-flat Forest:
  - A total of 66 species available,
  - 50 of these species are either to be propagated and/or already exist on site,
  - 16 of these species are present on site and there is no need for propagation

4.5 Plant Community Structure

Three (3) different plant community structures are proposed as follows:

- Treatment Type 1 - Fully Structured: Virtually all vegetation within the Core Riparian Zone (CRZ) is to be 'fully structured', i.e. it will contain all layers of the proposed plant community, being the native grass / forb ground cover, shrub, mid-stratum and canopy layers.
- Treatment Type 2 - Eucalypt Canopy with Native Grassland / Forb Ground Layer Only within the OPZ: In the following limited situations, the fully structured treatment within the CRZ will be replaced with Treatment Type 2 - Eucalypt Canopy with Native Grassland / Forb Ground Layer Only, as follows:
  - Along the CRZ / OPZ boundary, to facilitate where necessary a minimum three (3) metre setback between the path / cycleway system and the fully structured vegetation, thereby minimising interference to the path / cycleway system from over-hanging or sprawling vegetation (Note: Losses of fully structured vegetation to the CRZ due to this process are more than offset by the extension of fully structured CRZ communities into the OPZ);
  - Alongside the two (2) path / cycleway corridor crossing points, in order to facilitate public safety by providing clear sight lines through what would otherwise be highly confined and densely vegetated areas, obscured from public areas.

In addition to the reasons described above, this structural form:

- provides a robust and readily managed environmental buffer between the urban edge and the CRZ; and
- facilitates the provision of a native grassland / forb layer within the riparian corridor, which is considered to be an important component of Cumberland Plain Woodland.

- **Treatment Type 3 – Eucalypt Canopy with Turf Understorey within the OPZ:** This treatment will comprise a more formally tended parkland edge to the corridor, while still providing environmental benefits. The turf will be separated from the bushland planting by a perimeter walk / cycleway which acts as a management edge.

4.6 Bushfire Management

The site is not within a bushfire prone area and presents a relatively low bush fire hazard. The retention and enhancement of the riparian corridor and remnant northern bushland area presents little significant bushfire risk having regard to its size and slope (Rural Fire Service 2003).

A Bushfire Protection Assessment, undertaken by Conacher Travers (2004), has provided guidelines upon which the design of a 20m wide Asset Protection Zone (APZ) has been based between the Core Riparian Zone (CRZ) and future dwellings. The APZ comprises a 10m wide managed Outer Protection Area (OPA) and 10m wide Inner Protection Area (IPA).

4.6.1 Inner Protection Areas

The IPA (by definition) is to be a fuel free, or almost free of fuel area, and located immediately adjacent the assets potentially at risk. Vegetation in this zone must conform to the following guidelines:

- A shrub component occupying only 10% of the total area;
- Canopy trees are permissible providing the canopy does not form a link with shrubs, and:
  - No trees within 5m of the asset to be protected;
  - Between 5-10m, 1 tree/100m^2;
  - Between 10-20m, <10 trees/400m^2.

The recommended performance standard or safe fuel load for the IPA is 0.3 tonnes / hectare. The proposed IPA comprises a perimeter roadway around the riparian corridor with street trees and mown lawn areas conforming to these guidelines.

4.6.2 Private Property Works

A section of the APZ adjacent the Northern Bushland Reserve will be partially on private property and its maintenance is outside the scope of works for this VMP (refer Figure 4 – Item D).

4.6.3 Outer Protection Areas

By definition, an OPA is a reduced fuel area between the IPA, and non-fuel managed bushland, and assumes that all trees remain but with a modified shrub/grass and litter layer.

The proposed 10m wide OPA will include a cycleway/footpath as a management edge between the mown lawn/formal grassland treatment adjacent the road and the CRZ grassland / vegetation zones (refer Appendix E – Dwg No's DA02 & DA 03).

The recommended performance standard or safe fuel load for the OPA is 4-6 tonnes / hectare.

No fuel reduction measures will be required within the CRZ.

For the purpose of this VMP, the OPA will be termed the Outer Protection Zone, and is abbreviated to OPZ on all drawings and plans.

4.6.4 Bushfire Management Consultant

A Bushfire Management Consultant (BMC) will be engaged early on in the process to liaise with the Bushland Regeneration Contractor (BRC). The BMC will direct the BRC in what 4-6 tonnes/ha fuel load constitutes on the ground within the OPZ. The BRC will then manage this zone accordingly, removivng fuel as required. The BMC will be engaged periodically to inspect the OPZ to ensure that fuel loads are in compliance with the above requirements (s. 4.6.3).

4.7 Wetlands

Design and implementation of augmentation works to the Main and Inlet Ponds were undertaken by others in late 2003. The works included a marginal raising of the pond wall height by 400mm to increase stormwater detention capacity, and the incorporation of macrophyte planting beds along both sides of the wetland for polishing of contaminants. The macrophyte planting layout was designed by PSB (refer Appendix D).

The Main Pond acts as a regional water quality control and stormwater detention facility for all areas upstream of it, including the Nelson's Ridge Development (immediately upstream), and some adjoining areas of the existing suburb of Greystanes to the east of the site (refer Figure 1).

4.7.1 Wetland Management Plan

PSB will be commissioned separately by Stockland to prepare a Wetland Management Plan (WMP) for the Main and Inlet Ponds, and the watercourse proper (i.e. this VMP relates primarily to the terrestrial part of the riparian corridor commencing from the top of the watercourse bank, whilst the WMP will address those areas below the top of the bank).

4.0 PROJECT DESCRIPTION

The development of the management plan will include assessment and details of required management and maintenance tasks, describe the resources needed to undertake such tasks, and where possible find cost effective and practical regimes that utilise the landowner's existing infrastructure and management capabilities.

The WMP will be prepared in two (2) stages. An initial "Commissioning Plan" will be prepared to cover from the present to September, 2005 when the wetland is due to be handed over to Council. At this point it is proposed that this be finalised to an "Operational Plan". A more detailed description of the approach follows:

Commissioning Plan

- Desktop, anecdotal and field investigations to identify local and catchment issues that are likely to impact on the wetland (e.g. noxious aquatic weeds, problematic fauna).
- Biotic, abiotic and structural dissection of all wetland components detailed in a format that is easily understood by a broad range of personnel (regardless of experience or area of expertise).
- Requirements of the above dissected components in terms of establishment and regular maintenance tasks and procedures.
- Checklists, and information sections that include diagrammatic and photographic illustrations as necessary.
- Record keeping and database management, so that the long-term maintenance of the wetland is effectively implemented (regardless of personnel changes) and management able to respond adaptively as necessary.

The last point is an important component for management of all stages of the wetland's lifespan, i.e. wetlands are not steady-state systems, and continue to evolve — reliable records, performance assessment, etc. will be integral to an adaptive management approach in such an environment.

Operational Plan

- Review of Commissioning Phase maintenance tasks and procedures.
- Upgrade/amendment of Commissioning Phase maintenance tasks and procedures as necessary.
- Integration of relevant information and management guidance for any issues arising during the Commissioning Phase.
- Develop final plans of the extent of established vegetation.

4.8 Mosquito Risk Assessment

As part of the VMP process, a Mosquito Risk Assessment has been prepared (refer Appendix I). The assessment is retrospective to the extent that the wetland has already been designed and constructed by others. In normal circumstances a mosquito risk assessment would be undertaken at the wetland design stage to incorporate any relevant recommendations into the documentation and subsequent built work.

Mosquitoes associated with constructed wetlands, in particular *Coquillettidia linealis* and *Culex annulirostris* (both present on the site), are major nuisance biting pests and vectors of mosquito-borne pathogens (eg. Ross River virus and Barmah Forest virus). The importance of these species in metropolitan areas has been elevated as the construction of wetlands for wastewater storage and treatment, wildlife habitat and public amenity has increased and evidence for transmission of arboviruses in outer metropolitan areas increases.

The aim of this investigation was to:

- Document the extant mosquito fauna to identify actual and/or potential pest or vector (disease carrying) species.
- Assess the potential for the constructed wetland and surrounding habitats to provide habitat for, and produce significant populations of, pest mosquitoes with regard to the current wetland design proposals.
- Provide baseline data that may be used to assess changes in the abundance and diversity of mosquito fauna following changes in the wetland and continuing development of the site.

In summary, the report concluded that:

- Pest mosquitoes were identified at the site. The abundance of most mosquitoes at the site was relatively low, although this could be attributable in part to the survey work being carried out relatively late in the 'mosquito season'.
- There is no evidence that the proposed composition and design of wetland plantings will, at least in their initial stages, promote breeding by mosquitoes, but as the macrophyte zones of the Main Pond and Inlet Pond cover a relatively large area (approximately 1.2 ha) and as vegetation density increases, they may produce pestiferous populations of some species.
- It is unlikely that mosquito colonisation could be completely excluded from the peripheral macrophyte zone in the Main Pond or Inlet Pond but a number of mosquito management strategies, combined with a suitable surveillance program, can be incorporated into the overall Wetland Management Plan proposed for the site (refer s.4.7.1) to maintain mosquito populations at tolerable levels.

- An ongoing mosquito-monitoring program will greatly assist the management of the wetlands by providing information on the activity of pest mosquitoes in the local area and identifying changes in the suitability of the wetland for pest mosquito production.
- Some temporary rainwater pool breeding mosquito species may cause pest problems near to the wetland and in the adjoining residential area, when they are produced in large numbers. Such problems if correctly identified through routine monitoring or periodic surveys, can be readily dissociated from the constructed wetland and appropriate intervention arranged.

The report will enable comparisons to be made between conditions prior and post residential subdivision (refer s.6.2.6).

4.9 Native Fish Stocking

As part of the VMP process, the Main Pond will be stocked with appropriate native fish. Based on past experience we would expect that in the order of 12 native fish species are suitable for the site, and potentially include the following species:

- *Gobiomorphus coxii* Cox's gudgeon
- *Hypseleotris compressa* Empire gudgeon
- *Hyseleotris galii* Firetail gudgeon
- *Galaxias maculatus* Common jollytail
- *Pseudomugil signifer* Southern blue-eye
- *Retropinna semoni* Australian smelt
- *Macquaria novemaculeata* Australian Bass

Other fauna inclusions may be crustaceans such as freshwater yabbies and shrimps, and freshwater mussels, which can potentially help with water clarity.

Where species are capable of reproduction within Girraween Creek, these will be locally sourced.

A final species list will be determined as part of a Fish Stocking Report to be prepared by a specialist aquatic ecologist, and following fish sampling in the creek downstream from the site.

4.10 Stormwater Disposal

Council has proposed a conventional pit and pipe system for the collection and disposal of stormwater.

Gross pollutants will be trapped prior to entering the corridor. The detail of the trapping mechanisms will be determined during the design development phase of the project.

4.11 Monitoring / Reporting

Monitoring and reporting will commence following Practical Completion (PC) of the riparian corridor works (with the exception of preliminary photo monitoring and benchmark vegetation sampling).

Monitoring

In order to sufficiently measure the specified restoration objectives, the following monitoring components will be undertaken:

- regular three (3) monthly inspections of works within the riparian corridor and progress reporting;
- photographic monitoring;
- biodiversity monitoring;
- water quality and aquatic ecological monitoring;
- mosquito monitoring; and
- fish monitoring.

The above are detailed in s.7.1 of this Plan.

Reporting

Upon obtaining of PC for the project, the following reporting will be required:

- three (3) monthly reporting by the Bushland Restoration Contractor throughout the PEP, and
- six (6) monthly reporting to DIPNR.

The above are detailed in s.7.3 of this Plan.

4.12 Liaison

The preparation of this Plan has been undertaken in consultation with the following Authorities and specialist consultants:

Department of Infrastructure, Planning and Natural Resources

- Janne Grose – Strategic Planning, Parramatta
- Greg Brady – Environmental Review Coordinator, Parramatta
- Cliff Daylight – Aboriginal Boards & Committees Director, Sydney

Holroyd City Council

Brent Thompson - Strategic Planning

Edgar Freimanis
EcoHort Pty Limited
7 Gilham Street
CASTLE HILL NSW 2154

(Bushland Management Plan)

Dr Cameron Webb
Department of Medical Entomology,
Institute of Clinical & Medical Research,
Westmead Hospital,
WESTMEAD NSW 2145

(Mosquito Risk Assessment)

William Rooney
156 Barrenjoey Road
NEWPORT NSW 2106

(Native Fish Stocking)

5.0 RESTORATION STRATEGIES

5.1 Plant Selection

The restoration work is intended to re-establish natural riparian plant communities, characteristic of the original vegetation that would have occurred along Girraween Creek, using plant material propagated from local genetic stock where possible. Species selected are representative of the locally occurring CPW and SCRFF vegetation communities.

Restoration aims to create and/or rehabilitate a fully structured riparian community and ground level connectivity for the length of the works (with the exception of Cowra Street – refer Figure 3). The species diversity goal is to achieve the establishment of a total of 80 species of local provenance for the combined CPW and SCRFF communities within the riparian corridor.

For the location of different vegetation communities refer Figure 5.

5.2 Plant Procurement

The riparian restoration works will use plant material propagated from local genetic stock, where possible.

For a vegetation community to be listed as an Endangered Ecological Community, under the TSC Act, the community must be reduced to less than 10% of its original extent[2]. Accordingly, collection sites for SCRFF and CPW provenance material in the local area are highly fractured and widely distributed.

To ensure that the project's species diversity goal is achieveable, the following supply methods will be used to obtain local genetic plant material:

- Seed collection;
- Propagation cuttings and plant division;
- Translocation of plant material on-site; and
- Further seed collection and propagation during summer 2004/2005.

5.2.1 Seed Collection

Seeds have been sourced by two means.

1. A specialist Bushland Regeneration Contractor (BRC) has been commissioned to procure seed suitable for propagation, from both within site and the locality; and

[2] CPW has been reduced to around 3% of its original extent.

2. Purchase of seeds collected within the Prospect catchment area by Greening Australia (GA). Other seed and propagules, collected by GA, are available from the Eastern Creek (within 5km radius) and South Creek catchment areas (within 18km radius).

GA has collected a range of species from the Prospect Reservoir under a license agreement, issued by the NSW National Parks and Wildlife Services (NPWS). Permission has been obtained from the NPWS for the supply of seed materials in the CSIRO Greystanes restoration project.

Record of Provenance

A schedule showing what species have been collected from what locations is shown in Appendix B – Schedule 1, including the distance from the subject site (last page of schedule). This schedule will provide a valuable reference for future generations that may wish to collect seed from the site, as it defines the precise provenance of each species. Of the 85 species thus far procured for the project at the time of writing, the propagative material for 65 of these (76%) has been sourced from within 5 kilometres of the site. The remaining stock has been sourced from within 18 kilometres of the site.

5.2.2 Seed Germination Testing

Seed germination testing of collected seed prior to propagation will be undertaken. A sample of each seed batch will be taken and tested at an independent and appropriately qualified and resourced seed testing laboratory. The weight of each seed-test batch will vary depending on factors such as seed size, seed weight and the overall amount of seed collected for each batch.

It can be expected that each sample may weigh an average of 5 grams in weight. Seed listing procedures should be in accordance with the Flora Bank Guideline No.4 – Keeping Records on Native Seeds. Germination tests should be implemented a short period (3-6 weeks) prior to the commencement of each phase at the plant supply/propagation components of the project.

5.2.3 Vegetative Cuttings and Plant Division

Cutting and rhizome material will be collected from the field (within 5 kilometres of the project area) and picked-up by the propagating nursey using techniques outlined in Hartmann *et al* (1990).

When collecting rhizome material it is preferred if material can be sourced from areas within the site that are proposed for clearing as a part of the development works. In these areas there are no restrictions on how much material can be collected from donor areas. If collection is required from outside the site, collections should ensure that material is taken from thick patches of the target species, preferably on the fringe of bushland remnants. No more than 5% of the target rhizome material patch should be disturbed. Any divots or holes that may have been dug to harvest the rhizome material should be covered over to the original ground level, maintaining original soil stratigraphy.

Certain clumping species (sedges, rushes, grasses), may be propagated by digging-out mature clumps, separating the large clump into a series of small cuttings which include a section of rhizome, buds, roots and shoots, and either potting these-up into containers for growing-on, or directly planting them into suitable planting areas. This technique should generally be avoided from areas of remnant bushland as it generally involves the digging-out/destruction of a significant proportion or all of the entire remnant clumping plant. However, there should be no restrictions when collecting remnant clumps of these species from areas that are proposed for clearing.

5.2.4 Translocation

Sections of primarily scattered, small and low to medium quality remnant CPW and modified freshwater wetlands will be cleared during development works.

From these areas relatively intact mixed native grass and herbland will be removed in sod sections and translocated back onto rehabilitated landforms within the CRZ.

Details of suitable donor and recipient sites for translocation are provided in Appendix B (Schedule 3) and further detail of translocation treatments in s.5.9.3.

5.2.5 Propagation and Plant Schedules

A Plant Propagation Schedule has been prepared and shows:

- what species have been collected by seed;
- what species have been identified as suitable for propagation by means of vegetative cuttings and plant division; and
- the quantities available (and how these will transpose into likely plant numbers).

The Plant Propagation Schedule wil be used to finalise the Plant Schedule. On finalisation of the Plant Schedule, a specialist nursery will undertake the native plant propagation. Plants will be grown on to Hiko tube size with the exception of street trees to be planted in the turfed areas, which will be more advanced trees in larger pot sizes. Plant propagation will take place over a six-month period.

A Plant Propagation Schedule and an indicative Planting Schedule are provided within Appendix B.

5.2.6 Plant Propagation

Seed and vegetative material collection and/or forward orders for suitable amounts of material should be run over a period, which at a minimum incorporates two full cycles of the spring, summer & autumn collection periods (minimum 24-months). This period should ensure additional quantities of seed could be collected by the contractor/supplier, if required. At least 16-20 weeks is required to grow a batch of plants in hiko tubes (in the growing season) from seed and vegetative materials, before they can be installed in the field. This is important in terms of timing and integrating the collection and propagation components into the overall revegetation works program.

5.3 Restoration Approach

The proposed restoration program has been developed by a specialist bushland restoration consultant and is based on current best practice restoration principles and techniques, and conforms to relevant statutory requirements and guidelines (TSC Act, NPW Act, RFI Act, DIPNR 2003 and *Noxious Weeds Act 1993*).

A combination of assisted bushland regeneration and bushland reconstruction will be employed in designated zones of varying levels of resilience.

5.3.1 Assisted Bushland Regeneration

Assisted bushland regeneration focuses on reinforcing the existing plant community by removing obstacles and/or threats that prevent the growth of native propagules, and to a lesser degree, supplementary reconstruction of structural layers that are absent from the zone. These zones are typically disturbed bushland where partial community structure is present and the likelihood of regeneration from seed banks and/or nearby propagules is high (refer figure 5).

Zones containing remnant weed affected elements of native vegetation will be managed using appropriate bush regeneration techniques, which include, but are not limited to:

- Fencing off and signposting significant areas of native vegetation;
- Primary, follow-up and maintenance weed control;
- Supplementary reconstruction of specific structural layers; and

- Implementation of ecological burning regimes.

5.3.2 Bushland Reconstruction

Bushland reconstruction involves initial and ongoing control of weeds using bushland regeneration techniques (as described above) and "*the introduction of locally indigenous plant species, modelled on the diversity and structural characteristics of the original plant community*" (DIPNR 2003).

Reconstruction is implemented when native plant resilience is depleted in areas due to past disturbance mechanisms, but site conditions are still favourable for the re-planting and/or re-seeding of functioning native plant communities (refer figure 5). Reconstruction generally entails the following:

- Non-selective mechanical and herbicide weed control;
- Ecological burning of introduced / pastoral grass areas;
- Soil tilling/preparation and amelioration;
- Planting of plants from tree, shrub and ground layers in highly degraded areas; or
- Planting of native grassland areas;
- Direct seeding of grass species; and to a lesser degree,
- Translocation of grassland and wetland plant sods (from areas to be disturbed) to suitable recipient sites.

5.4 Ecological Burning

Fire is an essential part of the growth and reproduction of many Australian native plant species and communities, including CPW and SCRFF communities. Conversely fire can have serious impacts on the diversity and structure of plant communities (e.g. where fire frequency is too high or the intensity is too low).

The frequency of fires must take into account the duration of time required between each fire in any one community to ensure that:

- sufficient seed banks have developed within each treatment zone or otherwise risk the dominance of species that regenerate vegetatively over those dependent on seed germination; and
- plants have sufficiently "recovered" from past fire(s) and are capable of surviving another burn.

The intensity of fires must take into consideration:

- the amount of fuel that will burn and subsequent fire intensity anticipated;
- the depth into the soil and heat required to trigger germination of the seed bank;
- the age of canopy trees and whether they are capable of regeneration through coppicing and/or resprouting from lignotubers (an even aged stand of trees that rely on seed germination may become extinct from a site if destroyed in a fire without recruitment potential).

Controlled burning regimes are also useful for reducing biomass and making herbicide and hand weeding treatments easier to effect in areas where naturalised and native grass and herbaceous species co-exist.

The need for ecological burns at the study site, as a one off treatment, during the initial bush regeneration program should be considered an integral tool in the ongoing restoration of the endangered ecological communities at the study site, and should be implemented without compromise.

5.4.1 Ecological Burning Regime

The following fire treatments are proposed (Ecohort 2004):

- woody weed debris removed from bushland areas should be piled, dried for 3-6 months and burned on-site to assist in stimulating native plant regeneration;
- a "one-off" initial mosaic ecological burn at the commencement of the restoration period be undertaken to stimulate the soil seed bank in specified riparian corridor areas; and
- areas of naturalised grassland that have been dried out by winter frosts be burned.

5.4.2 Weed Piles

Cut woody weed debris removed from bushland areas as part of the initial bush regeneration and weed clearing works should be piled, let dry for 3-6 months and burnt on-site to assist in stimulating native plant regeneration, in areas where heat responsive soil stored native plant seeds are expected to germinate. This practice should not be used in areas where soils have been significantly disturbed by cut and fill activities.

Weed burn piles should not be stacked too high, as excessive heat generated by high (>2 metre) piles may adversely affect the viability of the native seed stored in the soil. Unburnt piles should not be left on-site for more than 6 months as they may provide habitat for feral animals.

The Baulkham Hills Rural Fire Service has published guidelines for constructing appropriate cut woody weed ecological burn piles, which provides a useful reference (Appendix H).

5.4.3 Mosaic & Grassland Burning Regimes

Specialised hand held low-pressure gun burners can be used to burn seed crops from perennial and annual grasses such as winter grass and summer grass.

Similarly, in areas where native shrub growth is thick and senescing and where fuel loads on the forest floor are sparse, dead and over-grown native shrubs may be cut-down at ground level and also stacked in piles for a subsequent one-off ecological pile burn.

5.4.4 Considerations

The following points need to be considered and implemented, in relation to fire management at bush regeneration sites, as applicable:

- the bush regeneration contractor should implement the pile burns using acceptable Occupational Health and Safety techniques and after obtaining appropriate permits from the relevant local fire authorities;
- a letter box drop should be undertaken and appropriate signage installed to inform and educate local residents and users of the site about the proposed ecological burning program;
- as with other forms of native vegetation disturbance, it is important to monitor the regrowth of native and naturalised plant species after the implementation of the pile burning treatments to gauge the success of ecological pile burns;
- follow-up and maintenance bush regeneration weed control programs should be implemented to control naturalised plant species that are likely to colonise areas after fire; and
- future ecological fire management needs of the site should be reassessed after the completion of the initial 5-year bush regeneration works period.

5.5 Weed control

5.5.1 Primary weeding

Primary weeding will be undertaken in 100% of all reconstruction zones and 70% of all regeneration zones in the first year. The remaining 30% of regeneration zones are to be left as temporary fauna habitat and will be subject to primary weeding in the second year, when establishment of the adjoining reconstruction planting zones will provide alternative fauna habitat.

Primary weeding involves techniques such as:

- selective hand removal of weeds;
- selective foliage spraying of weeds with herbicides;
- cutting/scraping and painting deep rooted woody weeds and climbers;
- target drilling and injecting certain large exotic trees; and
- Burning areas dominated by naturalised grasses.

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

Experienced bush regenerators should always implement primary weeding works.

5.5.2 Secondary weeding

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

The follow-up bush regeneration works should commence no longer than three (3) months after the first exposure to primary weeding and continue to the end of the PEP as a minimum. It is likely that the bush regeneration process will need to continue after Handover of the works by the responsible Authority, until the remnants attain high percentage cover levels sufficient to move towards a maintenance weeding regime.

5.5.3 Maintenance weeding

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

Detailed maintenance weeding information has not been specified in this plan, as it is anticipated that maintenance weeding levels will be more adequately quantified in greater detail and specified within the Maintenance Manual to be developed by the Landscape Contractor on completion of the PEP (refer s.5.11.1).

A reassessment of bush regeneration needs should be determined every 2 years after that, over the following 10 to 12 years.

5.6 Soil Preparation

Soil amelioration will be dependent on results from soil testing, however some ripping of subsoils and fine tilling of topsoils will be required prior to direct seeding or translocation treatments (refer s.5.9.2 and 5.9.3).

5.7 Soil Stabilisation

5.7.1 Mulching

It is recommended that all planting areas outside of frequently inundated zones and that are not going to be treated using any direct seeding or translocation techniques should be mulched, before or directly after planting.

Mulch is beneficial as it reduces soil temperatures around newly planted tubes, reduces evaporation of water from soil around the plant, suppresses weed growth and can reduce erosion potential around the seedling. Mulching materials should be free of weed seed and propagules, and should generally consist of a locally produced tub-ground woodchip/leaf mulch material (refer Landscape Works Specification (Appendix G)

A thin mulch layer can also be applied to assist in facilitating germination when direct seeding native grasses. Suitable materials for mulching when direct seeding native grasses include weed-free straw, or other fibrous or organic materials, treated with a binding polymer, to prevent seed mixes and the relatively thin layer of mulch from blowing-away in windy conditions. The direct seeding mulch layer should either be mixed in with the seed mix or top-dressed to a depth of 5-10 mm. An overly thick mulch layer will suppress native grass seed germination.

5.7.2 Erosion control matting

Areas that do not support any resilient native plants, are proposed for planting and are located within the 1 in 2 year flood boundary should be stabilised with an erosion control matting prior to the implementation of planting works, and as soon as possible after weed clearing works are complete. Erosion control matting is designed to hold soil, decrease the risk of erosion and perform the same functions as other mulch products. When properly installed, matting will be less readily washed away during flood events, in comparison to products such as leaf or woodchip mulch.

Trees and shrubs that are planted in amongst native or exotic grass areas (excluding mulched areas) should be installed with a 300-400 mm square mulch mat.

Detailed specifications for soil stabilisation can be find in the Landscape Works Specification (Appendix G).

5.8 Irrigation

Provision should be made to install a permanent Sydney Water meter, with either 19mm, 50mm or 75mm outlets (depending on revegetation-site size), with appropriate backflow prevention valves and vandal-proof taps at each revegetation-site.

Where sufficient water is available within the Main Pond, this source may be used to irrigate the riparian corridor works.

Temporary irrigation systems using high and low density pipe and fittings should then be installed for each site. The designs of these systems will vary depending on the adopted revegetation treatment. Irrigation requirements are provided within the Landscape Works Specification.

5.9 Planting Program

In any native revegetation project it is important to consider the restoration of all structural layers of vegetation. Tree, shrub and ground layers will be restored by:

- planting local native material in plant cell containers, supplemented by years of subsequent recruitment from these plantings and natural regeneration from proximate areas;
- translocation of native grasses, herbs and wetland species; and
- direct seeding of native grass species.

Planting will be staggered in order to provide protection for sensitive ground layer species (e.g. shade tolerant herbs and ferns). Initial plantings will comprise planting of tree and shrub species with supplementary seeding of native grass species. Some plantings of smaller/sensitive ground layer species can be undertaken where existing remnant tree and shrub species offer protection in regeneration zones.

Secondary plantings will comprise consolidation of the smaller shrub and ground layer structures and/or species that were not available at the time of primary planting.

Planting will be largely directed by the timing of availability of plant materials and seasonal variation and is likely to be subject to variation.

5.9.1 Tubestock installation specifications

Trees and shrubs are to be supplied in Hiko (0.08 to 0.125L) cell size containers, and ground layer herbs, grasses and climbers are to be supplied in Type A (0.02 to 0.035) cell size containers (e.g. Speedy-cell or Viro-cell) for planting in designated areas, using techniques described within the Landscape Works Specification. Appropriate care should be taken to ensure that all cells are planted at the correct depth into the soil, mulch or weed mat layer.

A three (3) to six (6) month period should elapse between the implementation of primary and follow up weed control in Assisted Bushland Regeneration areas, and the commencement planting, in order to allow sufficient time to assess the natural resilience of these areas.

5.9.2 Direct Seeding

Seed of local provenance grassland species will be used for direct seeding into specified areas. Native grass species suitable for direct seeding include *Microlaeana stipoides, Themeda triandra, Capillipedium parviflorum* and *Chloris ventricosa*.

Direct native grass seeding should be implemented in areas where subsequent natural regeneration has not occurred within (where possible) 12 months after initial primary and follow up weed control has been implemented, and as follows:

- **method:** topsoils are to have been pre-treated, by at least two weed eradication treatments, 2-3 months prior to seeding and finely tilled, to provide a weed free and friable soil environment. Native grass seed and/or grass seed florets are to be spread by hand and worked into the topsoil using a hand-rake.
- **mulching:** a thin mulch layer will assist in facilitating germination providing it is laid at less than 25mm deep. Suitable materials include native grass husks, stems and leaves, weed-free straw (or other fibrous organic materials) or treatment with a binding polymer to prevent seed mixes from blowing away in windy conditions.
- **timing:** direct seeding must coincide with high soil moisture content levels, preferably not long after significant rains. Sowing in spring and early autumn is optimal for the suggested grass species. Sowing in mid-summer can be successful provided soil conditions are adequately wet and supplementary irrigation is ensured.
- **irrigation:** irrigation will be required within the 4-8 week period following seeding to assist in successful germination and establishment.
- **weeding:** weeds should be intensely managed pre- and post-germination to ensure optimal success. Selective broadleaf and annual grass herbicides can be used 8-weeks after sowing. Patchy weed growth can be treated using wicker application, spot-spraying or spray topping treatments of appropriate glyphosate solutions. Areas treated for weeds should be re-sown with the appropriate native grass seed mix or species by hand after herbicides have taken effect.
- **maintenance:** native grass plantings should be slashed or burned every 2-4 years to encourage new growth and assist in controlling weeds.

5.9.3 Translocation

The growth habit of the native grass species recommended for translocation is that of clumping or in tussocks. In order to collect sufficient and undamaged root matter and maintain sod stability during cutting, removal and transplanting, it is anticipated that sods be excavated to a minimum depth of 75mm. The width of sods will be dependent on the equipment used, but as a general guide a width of approximately 250-300cm will be suitable for the use of most machinery.

The cut native grass sods should be carefully placed and packed together in a single layer on a flat surfaced timber pallet to minimise disturbance during transport. Irrigation of translocation donor sites, prior to cutting, may assist in facilitating easier cutting and cohesion of soil around roots.

It is preferable that the freshly cut sods be transported directly to the recipient site for planting. The recipient site should be similar in soil type, localised elevation and hydrology to the original donor sites, wherever possible. Refer Figure 5 for suitable translocation donor and recipient sites.

The following strategies should be implemented when laying the native grass sods at the designated recipient sites:

- **methods**: the sub-soil of the recipient sites should be prepared to maximise quick root establishment and provide sufficient nutrients to be able to support plant growth. This should include:
  - pre-treatment by at least two weed eradication treatments, 2-3 months prior to weed control,
  - soil ripping and cultivation to a depth of 300mm,
  - fine tilling of topsoils to a 100mm depth (or the addition of 30-50mm of imported or good quality screened local topsoil) to ensure a level surface prior to the laying of native grass and herb sods.
- **placement:** sods should be placed together as close as is possible at the permanent or temporary recipient site, to minimise gaps and weed growth between sods.
  - adjoining areas of sub-soil in the constructed landforms should also be ripped and tilled to the above specifications and backfilled with local or imported topsoil to the final level of the adjoining sods and revegetated using strategies outlined in this section,
  - a fork lift attachment will assist in the placement of native grass sods from the pallets onto the prepared recipient sites. A light machine with a bucket and hand tools should be used to assist in the finer details associated with the laying operation and to minimise gaps between the sods.
- **establishment & maintenance: t**he transplanting of the sods should be carried-out by an appropriately qualified bush regeneration contractor and maintained as follows:
  - maintenance irrigation and weeding should be incorporated of translocated plant materials as a part of ongoing maintenance of bushland and revegetation areas throughout the riparian corridor,
  - a temporary irrigation system should be installed to ensure that the native grass and herb sods establish successfully,
  - irrigation should be maintained for a period of 3 to 6 months after translocation to the final recipient site.

5.10 Plant Establishment

5.10.1. Maintenance

A two-year Plant Establishment Period will follow Practical Completion of the works.

Recurrent maintenance works will include watering, mowing, weeding, rubbish removal, fertilising, pest and disease control, reseeding, returfing, replacement/ adjustment of rabbit guards, replanting, replacement translocation, cultivating, pruning, turf edge clipping, aerating and topdressing. Refer to the Landscape Works Specification for full details of the requirements of the Landscape Contractor throughout the Plant Establishment Period.

5.10.2 Maintenance Program

The Landscape Contractor will be required to prepare a proposed planting maintenance program for the Landscape Architect, and amend it as required until approved. The Landscape Contractor must then comply with the approved program.

The Landscape Contractor will be required to keep a Maintenance Logbook throughout the Plant Establishment Period, recording when and what maintenance work has been done and what materials, including toxic materials, have been used.

Monitoring and reporting requirements during the Plant Establishment Period are also detailed in sections 7.0 and 8.2 of this Plan.

5.11 Handover

At the completion of the Plant Establishment Period, the riparian corridor will be formally handed over to Holroyd City Council. Council will then manage the site in perpetuity, including implementation of the on-going management strategies and monitoring requirements outlined in this document.

5.11.1 Operation and Maintenance Manual

Prior to Handover, the Bushland Restoration Contractor will prepare a Maintenance Manual for the works covered by this Plan. This will comprise an outline of the major expected management tasks that will be required to successfully maintain the corridor, including:

- frequency of various applications,
- a schedule of all consumables used to maintain the site, e.g. chemical / fertiliser types and application rates, mulch and sources, sources of all plant stock, and
- identification (using either pressings or photographs) of all of the major weeds of concern.

The Bushland Restoration Contractor will undertake a formal on-site handover to Holroyd City Council, highlighting the major management tasks and reviewing the Maintenance Manual.

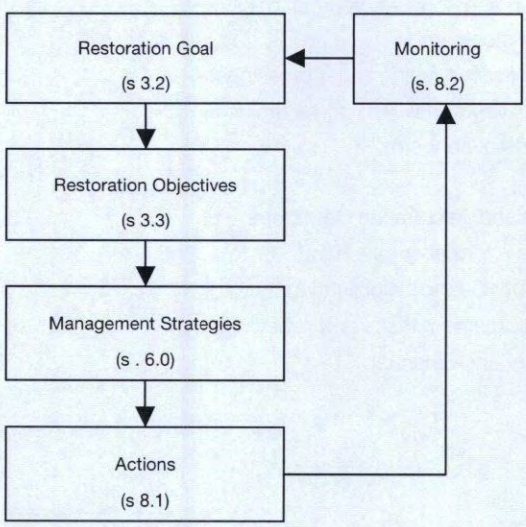
6.0 MANAGEMENT STRATEGIES

6.1 Management Approach

The approach to this Plan is to guide short-term and long-term management strategies and actions for Girraween Creek. Outcomes are then checked back against the restoration goals and objectives using performance indicators (s. 8.3).

This section provides an overview of major issues that are likely to be encountered in the establishment and long-term management of the riparian corridor. Management strategies are also provided. However, it will be essential that an adaptive management approach is implemented so that management outcomes can be monitored and evaluated, and management actions adjusted as required to meet the goals and objectives.

An adaptive management framework is illustrated in the following flow chart.



6.2 Issues and Strategies

6.2.1 Water Quality

The water quality of Girraween Creek will be directly influenced by the surrounding land use in the catchment. Urban development of the catchment during construction and in the long-term will result in increased stormwater runoff from hard surfaces and increased pollutants entering stormwater. Ecological impacts from stormwater pollution will not only occur locally, but are exported downstream to the Parramatta River system.

Stormwater pollutants arise from a number of sources, and include:

- sediment from land cleared for subdivision and building;
- nutrients from fertiliser, pet droppings, detergents and sewer overflows;
- toxic substances from paint, herbicides and pesticides; and
- oils and surfactants from cars and road surface.

Turbidity is potentially quite high in the catchment due to the fine colloidal sediment washed into the systems from disturbance of clay soils with high erosion potential. This may cause habitat degradation (e.g. lack of light penetration prevents submerged aquatic plants from establishing), and reduce aesthetic enjoyment and recreational use of the waterbody.

6.0 MANAGEMENT STRATEGIES

Nutrients originate from both point and diffuse sources, including rural and urban areas from which there is runoff. Nutrient removal can be enhanced by riparian buffer strips alongside water courses and filtration through wetlands and associated macrophyte growth.

The quality of water discharging to the creek has the potential to transport pollutants that are either unable to be captured or treated due to infrastructure failure caused by lack of maintenance, blockages, or overburden during storm events.

Urbanisation of the catchment will lead to an increase in stormwater runoff into the system. The 100-year ARI storm, will be accommodated within the lower pond, with an outflow structure to ensure that there is no increase in the 100 year ARI discharge from both this site and the upstream Nelson's Ridge development site over that currrently occurring.

At a finer resolution, increased base flows and velocity of flows to those occurring pre-development are likely to alter localised conditions within the creek. A change from intermittent to more constant and a higher volume of flows may lead to an increase in both the depth and duration of inundation within ponded areas of the creek. A potential impact will be the displacement of biota adapted to ephemeral conditions (periodic wetting and drying).

An increase in velocity of flows provides a higher erosion potential and displacement of species that require still water for all or part of their life cycle (e.g. amphibians) or species that cannot tolerate higher flows (e.g. aquatic plants unable to withstand flattening by flows and smothering by particulate matter within the flows).

Strategies for water quality protection include:

- regular monitoring and maintenance of all stormwater inlets and devices within the corridor including litter traps. These will be checked and cleaned as part of a regular maintenance regime (see Action Plan). Additional inspections may be required after storm events, and maintenance may need to be increased in regularity in autumn when deciduous leaf fall in the catchment will contribute a greater litter load to the stream system;
- establishment and maintenance of healthy riparian vegetation, which acts as a filter for overland runoff;
- training of maintenance staff to identify water quality problems and potential sources;
- regular water quality monitoring, e.g. using biological indicators (macroinvertebrates) as a measure of ecosystem health;
- monitoring of algal formation and removal of excessive growth;
- education in the catchment about the effects of human activities on water quality; and
- educating people walking dogs to collect the droppings.

6.2.2 Algae

Algae are a natural component of most aquatic ecosystems, but under nutrient enriched waters, can substantially increase in numbers, then being referred to as "blooms". Algal blooms reduce the value of a water body as an aesthetic and recreational amenity, present a public health hazard (when blue-green algae is the dominant species), and when decaying can reduce oxygen concentrations to such an extent that fish kills occur.

Control techniques for algae include the use of algicides, flocculants, nutrient control and artificial mixing of water bodies. Algicides and flocculants contain chemicals that are toxic to aquatic organisms and aeration of water bodies can be expensive.

Managing water quality to prevent the occurrence of blooms is therefore the most practical method as opposed to treating blooms once they have occurred. Management of water quality aims to reduce nutrients, with phosphorus being the main factor correlated to algal abundance.

Algal growth is limited to a degree by dense macrophyte growth and shading by riparian vegetation, which alters the microclimate of the water and limits photosynthesis. A dense growth of macrophytes will also maximise uptake of nutrients thus assisting in limiting algal growth.

Strategies to manage algal growth include:

- promote the establishment of aquatic macrophytes and overhanging riparian vegetation to limit algal growth.
- where excess algal growth occurs:
  - have samples quickly identified,
  - if blue green algae, erect warning signs and seek specialist advice within 24 hours of notification.
- if filamentous green algae is a persistent problem:
  - investigate the source,
  - investigate the use of Phosloc® to remove excess phosphorus from the water column, or
  - seek specialist advice.

6.2.3 Weed Control

Aquatic and terrestrial weeds have a number of negative impacts on the riparian environment and without early management intervention can become costly to control. Potential sources of weed invasion, include:

- physical disturbance of soil;
- imported soil;
- dumped garden refuse;
- physical disturbance of vegetation;
- impacts from stormwater;
- bird/ other animal / wind / water dispersion, and
- neighbouring property.

Most weeds will be eradicated from the site during the riparian restoration process. There is potential for weeds to re-colonise if maintenance and monitoring is not carried out on a regular basis.

6.0 MANAGEMENT STRATEGIES

Weeds are an inevitable element that needs to be addressed in the on-going management of natural systems in an urban environment.

Terrestrial Weeds

Terrestrial weeds present on the site comprise a range of tree, shrub, grass and broad leaf species, including but not limited to:

- Introduced and naturalised grasses: *Pennisetum clandinestinum, Cynodon dactylon, Setaria* spp., *Paspalum* spp., *Phalaris arundinaceae, Ehrharta* sp., *Echinochloa crus-galli*
- Broadleaf weeds: *Chenopodium alba, Sida rhombifolia, Bidens pilosa, Plantago lanceolatum, Verbena* spp., *Tradescantia fluminescens, Solanum* spp., *Rumex* spp., *Foeniculum vulgare, Phytolacca octandra*,
- Trees/shrubs: *Maclura pomifera, Salix* spp., *Rubus fruticosus., Lantana camara, Cestrum parqui, Ligustrum* spp., *Lycium ferocissimum*

The best strategy for weed control is prevention, which is achieved by a regular maintenance and monitoring regime. This will allow early detection of weeds before they spread and become more costly to control. It will also help to isolate causes and mitigate impacts in order to control migration of weeds onto the site.

It is expected that weed control effort will be greatest at the beginning of the restoration works, with cost and labour decreasing over time as native vegetation establishes and reduces opportunities for weed colonisation. Strategies for controlling weeds include:

- hand removal of weeds as far as possible (especially close to water courses);
- herbicide spraying if >20% of the ground surface area is infested, and limit treatment to spot spraying rather than broad scale application;
- removal of weed material from site with seed heads, or that is able to propagate vegetatively (e.g. Wandering Jew);
- remove all fruiting and wind dispersed weeds before seed sets;
- follow up weeding after planting to remove emerging seedlings;
- use of weed free mulch; and
- regular topping up of mulch to minimise opportunities for wind borne weed colonisation.

Maintenance staff are to be familiar with the identification of all species planted and the identification of common invasive weed species. Additionally, maintenance staff should be familiar with bush regeneration techniques, as the system is self-perpetuating, and therefore the staff will need to be able to recognise native seedlings.

Aquatic Weeds

A number of serious aquatic weeds occur within the catchment and surrounding areas. Noxious weed species of concern include Alligator Weed, Salvinia and Water Hyacinth. Left untreated, these weeds can cover an entire watercourse in a very short time, and be very costly to manage.

The above mentioned aquatic weeds display a number of similar traits, in that they all form dense mats on the surface of the water, have rapid growth rates and respond to high nutrient levels. All three species propagate vegetatively (as they do not have viable seed, or spores in the case of Salvinia). This creates difficulty in treatment as chemical applications have limited long term success, with biological controls more appropriate for large areas. Additionally, at present there is no herbicide registered for use in Australia that can be used on Alligator weed in an aquatic environment. As a result, it is important that maintenance staff become familiar with and are able to identify these plants in the field, so they can be removed promptly if they emerge.

Spiny Rush (*Juncus acutus*) is a serious environmental weed, which is currently present within the site. It can take over large areas, displacing native sedge and rush species, and once established it is difficult to eradicate, with its prolific seed remaining viable for many years. This species must be controlled and not be allowed to spread.

Native aquatic plants such as Cumbungi (*Typha sp.*) may also become pests in urban waterways, by blocking channels and out-competing other native species. This species is widespread at the site and requires ongoing control to prevent dominating growth.

Many of the noxious or more serious environmental aquatic weeds have limited control methods. Most herbicides are either ineffective or unable to be used in an aquatic situation. Mechanical harvesting is expensive, or impractical in shallow or narrow situations.

Management of aquatic weeds should entail the following:

- Water quality management, including nutrient reduction and sediment capture;
- Early management intervention, including regular inspection and early identification and treatment; and
- Education and community awareness.

6.2.4 Vegetation Management

Once restoration works are complete, on-going, long-term management will maintain ecosystem health in response to continuing human-induced impacts.

A bushland restoration approach will be used for the management of the native riparian vegetation on-site. The limited turfed areas surrounding the pathways are to be managed using a standard landscape management approach.

General management strategies are as follows:

- native vegetation is to be left to grow in a form consistent with the growth habit of the species;
- mowing is to be limited to the turf areas only;
- grass clippings are to be kept away from the creekline; and
- regular monitoring for rapid response to any problems.

Riparian Zone

Management strategies for this zone are:

- minimal disturbance of soil and vegetation in weed removal;
- maximum weed cover allowed is 5%;
- ensure a 'clean' edge with the turfed areas, including augmenting of buffer planting if required;
- manage for on-going seeding and perpetuation of the community;
- mulch levels to be maintained and topped up as necessary;
- manage for scour at the stream edge;
- litter collection; and
- eradicate feral pests impacting on native vegetation.

Landscape Area

General landscape maintenance includes:

- fertilising;
- mowing;
- lawn weeding; and
- litter collection.

Aquatic Zone

Maintenance activities for this zone include:

- check communities are performing as designed and manage for creep between communities, e.g. macrophytes should not colonise the open water zone;
- maximum weed cover allowed is 5%;
- litter collection (floating / submerged);
- removal of excessive algal growth and surface scum where present; and
- collection of algae where present for identification.

Herbicide Use

Herbicide is to be used judiciously so as not to have an impact on water quality, native flora, native fauna and habitat. The use of herbicides in the riparian zone should be avoided or minimised (especially adjacent to the creek). Roundup Biactive ® is a glyphosate, non-residual herbicide that is relatively safe to use around waterways.

Fertiliser Use

Where practicable, no fertiliser is to be used in native vegetation areas. Inappropriate fertiliser use may lead to excess nutrients in the watercourse, which may lead to algae problems and growth of aquatic weeds.

6.2.5 Habitat Management

The provision and maintenance of habitat for native fauna is a major goal of this stream restoration. In its present degraded state Girraween Creek provides limited habitat for native fauna. In the long-term the re-construction of a natural stream channel and re-establishment of aquatic and terrestrial vegetation in the riparian zone will provide improved resources for native fauna. The stream restoration has been designed to provide structural complexity and floristic diversity of native vegetation, which will in turn lead to increased habitat diversity, both in-stream and in the riparian zone of the creek corridor.

6.0 MANAGEMENT STRATEGIES

Design elements for increased habitat diversity include:

- logs and rocks placed in and around the wetland ponds; and
- use of a variety of substrates along the shoreline e.g. boulder and sandy/gravel substrates.

Maintenance activities required in the riparian corridor are to be carried out in order to enhance and maintain fauna habitat. Issues that require appropriate management include site access, maintenance techniques, use of herbicides and fertilisers, water quality and quantity, and protection from predators.

Native fish stocking

It is proposed to stock the Main Pond with native fish species after restoration works are complete, and once water quality is adequate and aquatic vegetation is sufficiently established to provide fish habitat.

Modification of designated areas of the pond base will be required to substrate surfaces conducive to fish breeding and habitat. This will include the introduction of pea gravel, sand and possibly tree trunks.

The fish stocking consultant will conduct a survey of fish inhabiting this creek downstream of the proposed development, as well as the suitability of fish habitat prior to the introduction of any native fish into the main lake.

Priority will be given in species selection to those that are predators of mosquito larvae such as Pacific Blue-eye (*Pseudomugil signifer*) and Fire-tailed Gudgeon; and to fish species whose natural range of distribution is within the area (*Hypseleotris galii*).

Native fish stocking will need to be monitored and managed to ensure the success of the initiative (see s. 8.2')

NSW Fisheries approval will be required for fish stocking.

Aquatic Habitat

Strategies to establish, maintain and enhance aquatic habitat in Girraween Creek include:

- avoid/minimise use of herbicides and fertilisers near the creek;
- monitor and maintain water quality;
- monitor and control pest fauna e.g. carp, mosquito fish and mosquitoes;
- promote habitat complexity in the channel and ponds by retaining woody debris;
- manage recreational use; and
- monitor fish populations and replenish populations if required.

Terrestrial Habitat

Strategies include:

- control access to formalised areas e.g. paths, boardwalks, turfed areas;
- minimise disturbance when carrying out regular maintenance in the riparian zone;

- leave leaf litter, branches and debris in the native vegetation areas as this is valuable habitat for ground dwelling fauna such as lizards, insects, and frogs in moist areas;
- enhance and maintain the diversity of vegetation structure and species to increase habitat;
- encourage establishment of a dense native shrub layer in the woodland areas, as this provides important habitat for small to medium native birds;
- control feral animals and pest fauna species; and
- education and signage for users.

6.2.6 Pest Fauna

Cats, foxes, rabbits, domestic dogs, black rats, house mice, Indian Mynah, domestic ducks, Mosquito Fish and Carp are examples of exotic animal species that compete with and threaten native fauna.

Common native fauna such as Currawongs and Noisy Miners readily exploit bushland in urban environments and prey upon or outcompete more sensitive or rarer native species.

Large populations of waterbirds can damage aquatic vegetation and reduce water quality. Feeding of waterbirds is a common and pleasant past time undertaken by a large proportion of visitors to aquatic environments such as the site's wetland. Feeding encourages waterbirds to congregate at public access areas which leads to concentrated bird droppings and damage to banks and vegetation.

Large populations of waterbirds already utilise the open water body of the wetland and therefore education of residents and visitors to the site must include appropriate information to prevent feeding or other inappropriate behaviour effecting the waterbird populations. Educational programs should also include the impacts caused from the introduction of domestic waterbirds.

Plague minnow or Mosquito fish (*Gambusia holbrooki*) currently inhabits the site. This species is listed as a Threatening Process under the TSC Act due to its ability to predate on frog larvae and attack native fish.

Terrestrial feral animals currently using the site include rabbits, foxes, dogs and cats with sheep and horses no longer on the site (Hayes Consulting, 2002).

Management of the riparian zone should seek to minimise access to and use of the site by such fauna, and encourage a wider diversity of other native species. This should include rabbit guards on plantings, adequate provision of shelter habitat for native fauna, and appropriate design of macrophyte plantings to ensure damage by waterfowl is minimised. Water level manipulation is also an important management tool for water borne, or otherwise associated, pest fauna. Strategies for the management of pest fauna are designed to discourage these animals whilst promoting habitats for native species.

Strategies include:

- installing rabbit guards during plant establishment;
- undertaking a coordinated rabbit baiting program;
- trapping, if pest populations impact on native species using the riparian zone;
- vigorously discouraging feeding of waterbirds; and
- educating recreational users not to feed animals, to keep dogs on leashes, keep cats in at night and not to leave rubbish/food within the corridor or in any other places that could encourage pest fauna.

6.2.7 Public Health and Safety

Strategies need to be put in place to show that provision of 'due care and diligence' in the design and management of the site has been considered.

Strategies to ensure public safety in the use of the reserve include:

- providing and maintaining a vegetative barrier that restricts movement to the pond edges, spillway and weir;
- adequate signage describing the risks associated with the wetland, in accordance with Australian Standards (AS 2899.0-1986, AS 2899.1-1986, AS 2899.2-1986) and any standards required by other authorities. Risks include deep water areas, potential for contaminants in the water, eating of fish and high flows in flood events; and
- monitoring of water quality, integrity of structures and warning signs is to be undertaken to reduce risks.

Mosquito Management

Design, operation and maintenance of the riparian corridor and associated infrastructure will be carried out so as to minimise mosquito breeding opportunities.

Mosquito habitat issues include quality, depth, and movement of water, nature and slope of edges, presence and density of marginal and emergent vegetation, presence and abundance of mosquito predators and proximity to human habitation (Russell, 2000).

Management strategies will aim to both minimise habitat available for mosquitoes, and maximise habitat for native mosquito predators within the riparian corridor.

The system is unlikely to be affected by pest level populations of mosquitoes if:

- substantial areas of open water are maintained in the ponds;
- water flow through the creekline is maintained; and
- establishment and maintenance of fish and invertebrate mosquito larvae predators, is achieved.

Maintenance activities may specifically include:

- ensuring vegetation or debris does not inhibit surface water movement;
- maintenance of high water quality;
- ensuring creek and pond margins do not become clogged with emergent and floating plants and grasses which will trap pools of water when the water level rises in flood above normal flows;

- introduction of native fish species to prey on mosquitoes; and
- management of the aquatic environment to encourage the establishment of a diversity of fauna, including insect predators of mosquito larvae (Russell, 2000).

Mosquito Risk Assessment

A Mosquito Risk Assessment has been prepared for this project (refer Appendix I). Management for the riparian corridor must be informed by a detailed review of the Mosquito Risk Assessment (MRA).

The MRA comprises:

- evaluation of the extant mosquito habitats and populations within the vicinity of the site;
- collection and identification of the species involved;
- detailing the risk each species poses with respect to pest nuisance or disease risk;
- expert consideration of the proposed development with respect to its potential for producing mosquitoes and adding to any local mosquito populations and associated problems or concerns; and
- expert opinion on these risks with recommendations for their minimisation.

Key management strategies from the assessment are summarised below:

- **Macrophyte Zones:** The MRA identifies that from a mosquito management perspective, the most important feature of the proposed wetlands is the extensive macrophyte zones being created along the margins of the Main Pond and Inlet Pond. The macrophyte zone, between the bank and 'deep/shallow zone diversion walls', is relatively deep (approximately 600mm) but may support mosquito breeding during periods when water levels drop to below 300mm or accumulated debris or filamentous algal growth restrict water movement or otherwise provide more favourable conditions. During periods of low rainfall, as water levels drop in the macrophyte zone, isolated pools may be created and predator populations (e.g. fish and macroinvertebrates) decline, increasing the suitability of the habitat for mosquito breeding.
- **Pond Bank Slopes:** The proposed bank slope at the margin of the macrophyte zones in the Main Pond, Inlet Pond and creekline is 4H:1V. The recommended slope to minimise mosquito breeding is from 2.5H:1V to 4H:1V. The steep slopes restrict the density of vegetation, and reduce the area of shallow water, minimising suitable mosquito breeding conditions by maximising the access of predatory fish to mosquito larvae and exposing larvae to surface water disturbance that may increase larval mortality.

- **Pond Terrestrial Edge:** Terrestrial edge vegetation should be minimised to reduce any potential refuge for mosquitoes created when water levels rise, and banks should be monitored to identify slumping and/or erosion that may result in the enhancement of habitats for mosquito breeding.
- **Inappropriate Macrophyte Species:** The species of macrophytes of greatest concern for mosquito breeding are *Typha* spp. and *Phragmites* spp (not part of the planting scheme, but Typha currently inhabits the pond, and both species are readily able to colonise from other waterbodies). These are are prone to wetland invasion and dense growth and may "clog" wetland systems, creating refuge for mosquito larvae and restricting access of predators. Also, dead plant material increases the organic content of the water, increasing the suitability of the habitat for mosquitos.
  As the macrophyte zones of the Main Pond and Inlet Pond cover a relatively large area (approximately 1.2 ha.) and as vegetation density increases, this zone may may produce suitable mosquito habitats.
- **Water Quantity:** Consideration must be given to the quantity of water entering the Main Pond and Inlet Pond during the summer months to ensure water depth in the macrophyte zones are maintained. The detention basin of the Main Pond is relatively deep, providing sustaining refuge for fish and other mosquito predators, and should not provide significant mosquito habitat. However, if the water level drops within the macrophyte zone, or the bed of the detention basin is exposed, this provides potential mosquito habitat for some species.
- **Stormwater Infrastructure:** Sedimentation pits, litter traps and GPTs, and other structures constructed as part of the wetland system that retain water accessible to mosquitoes can provide mosquito habitat suitable for nuisance night biting pests indoors in residential areas. These habitats will be enhanced for mosquito breeding if there is an accumulation of organic pollution. The production of mosquitoes can be avoided by ensuring the structures are self-draining or having the siltation depth shallow enough to encourage evaporative drying. Where this is not possible or practical, then monitoring and occasional treatment with an appropriate formulation of an approved control agent may be required.

- **Rainwater Pools:** Rainwater pools in bushland areas may produce pest mosquito populations following rainfall, and while some of these will cause only localised nuisance impacts, some species will travel further from breeding habitats and may present a more general concern. The area of greatest concern for providing potential breeding is the low-lying Northern Bushland Reserve that will receive both rainwater runoff and overflow from the Main Pond and there should be measures to prevent surface pooling of water in the bushland zones.
- **Mosquito Monitoring:** An ongoing mosquito-monitoring program will greatly assist the management of the CSIRO (Lakewood) wetlands by providing information on the activity of pest mosquitoes in the local area and identifying changes in the suitability of the wetland for pest mosquito production. Annual inspections of the wetland to sample larval populations and assess any changes in the suitability of the habitat for pest mosquito production should be carried out, at a minimum, every two weeks from January through until March. If mosquito breeding in the wetland increases and pest impacts are considered serious, some monitoring and occasional treatment with an appropriate formulation of an approved control agent may be required.
- Adult mosquito population sampling during these annual inspections would provide confirming information on the productivity of the wetlands for potential pest species.

6.2.8 Litter

Litter is aesthetically unpleasing and can negatively impact on the health of the stream corridor by degrading water quality and habitat. These impacts will generally arise as a result of public use of the reserve and via urban stormwater runoff.

Rubbish is not only a visual eyesore, but also presents a number of ecological problems including:

- dumped rubbish acts to smother native plants; and
- in the case of dumped garden waste and soil, causes the spread of excess nutrients and the spread of weed propagules into bushland; and
- agricultural dumping, or accidental spills, such as fertilisers, pesticides and herbicide waste leads to increased nutrients and other pollutants entering the creeklines and adversely impacting the flora and fauna in these zones.

These impacts should be discussed in an informative and non-patronising manner within educational programs for the area.

Strategies to manage litter within the site (and catchment) will maintain the aesthetic qualities of the riparian zone, maintain water quality functions of the ecosystem and prevent degradation of wildlife habitat. Strategies include:

- regular maintenance inspections, and additional inspections following storm events; and
- regular maintenance and clearing of litter trap structures.

6.2.9 Recreation

The Girraween Creek Corridor will provide a major aesthetic and recreational feature for the surrounding community, and will link up by a series of pathways with the Nelson's Ridge development upstream, and potentially downstream via the M4 underpass to downstream areas at a future time. Recreation is to be a secondary use for the corridor through managed access. The area is to be utilised as a passive recreation resource. Inappropriate recreational use (that may disturb wildlife and degrade habitat) will be discouraged.

Opportunities for passive recreation in the riparian corridor reserve have been designed in consultation with DIPNR and requirements under the *Rivers and Foreshore Improvement Act* 1949. However, these uses need to be managed so as not to have a negative impact on the environment, and compromise the ecological values of the area.

It will be important that the area be well used and accessible to the community. A strong sense of ownership by the local community is a good deterrent to vandalism. Community interest and use of the area will be heightened if the area is well maintained, and if the natural riparian zone is well integrated with the surrounding development.

Education and interpretation will also be essential in achieving a sense of ownership of the area. Strategies include:

- development of a "welcome kit" for new residents moving into the area which provides an informative presentation without being too technical or, on the other hand, being condescendingly simple;
- installation of interpretive signage;
- development of a catchment targeted education program to promote responsible land use activities and behaviour in the catchment;
- involvement of specialist community groups such as bird watchers;
- promote and encourage community involvement in bush regeneration programs, litter reduction, clean up activities and other activities suitable for community participation; and
- infrequent information delivery regarding maintenance works, e.g. ecological burning, de-watering of wetlands.

7.1 Monitoring

The objective of monitoring is to **measure the effectiveness of management strategies** in achieving the restoration objectives. On-going monitoring will help to identify and then implement actions to address problems as they arise.

Monitoring criteria includes:

- the success or failure of native vegetation species;
- the success of biodiversity goals;
- the presence and abundance of weed species (aquatic and terrestrial);
- disturbances and physical damage to vegetation (such as soil erosion, vandalism); and
- water quality assessment.

7.1.1 Regular Monitoring of Works

Regular monitoring is to be undertaken by the Landscape Contractor (or Bush Regeneration Contractor) every three (3) months during the PEP and is to commence upon Practical Completion (PC) of the works, following the schedule provided in s. 8.2.

7.1.2 Photographic Monitoring

Long-term photographic monitoring points are to be set up prior to commencement of works. Colour photographs will be taken at each monitoring point to provide a long-term record of change. Photographs are to be taken when monitoring points are set up prior to commencement of works and then on a six monthly basis. The direction of the photos and monitoring point locations are to be sited on a map for subsequent use in follow up monitoring.

Monitoring points will be established prior to commencement of works and monitoring will begin on completion of the restoration works.

Colour photographs taken at established monitoring points can provide a valuable record of establishment and long-term change in the riparian corridor. Photographic monitoring from the specified points using a camera aperture of 50mm will be undertaken at the following stages:

- prior to commencement of works;
- at Practical Completion of works;
- at 6-monthly monitoring intervals; and
- at the end of the Plant Establishment Period.

The colour photographic record of the works are to be mounted on A4 or A3 sheets with descriptions under each specifying the photo points and any pertinent commentary, and will be used as part of the reporting process.

On-going post-PEP photographic monitoring on an annual basis is recommended.

7.1.3 Restoration / Biodiversity

Quantitative monitoring will be undertaken by a Specialist Consultant (ecologist) and comprise the following "before and after" monitoring:

- Benchmark: Preliminary gathering of the abundance and distribution of plant species in areas of SCRFF and CPW in which each of the regeneration and reconstruction treatments will be applied. (e.g. percent cover of plant species in designated areas to determine pre-existing flora from which to measure restoration against);
- Ongoing: Replicated measurements over time and comparative analysis until a stable "end point" is achieved; and
- Reference: Benchmark and ongoing measurements shall be obtained from a nearby location (e.g. Prospect Reservoir), representative of the "end-point" (e.g. intact SCRFF and CPW vegetation). Reference sites provide important information regarding environmental factors that may affect plant establishment and that are not restricted to the study site. Without such information the efficacy of management strategies cannot be made.

Auditing of Species Diversity / Plant Establishment

A primary goal of riparian restoration is to achieve the establishment of 80 species of local provenance for each of the two CPW and SCRFF communities within the riparian corridor. To ensure that the species diversity goal is met, both qualitative and quantitative monitoring will be used (refer s.4.4.2 for the current expectation with regard to species numbers).

Qualitative monitoring will be undertaken on a regular basis by the Landscape Contractor/Bush Regeneration Contractor, during regular three (3) monthly inspections of the riparian corridor.

Quantitative monitoring by a Specialist Consultant (ecologist) will provide management information at a finer resolution (e.g. abundance, distribution, health, viability) (see s.7.1.3).

7.1.4 Water Quality and Aquatic Ecological Monitoring

Assessment of stream fauna can be used to assess levels of environmental stress through the diversity of the macroinvertebrate population and presence of pollutant-sensitive or pollutant-tolerant animals.

Macroinvertebrates can provide an indication of the water quality as well as a measure of the diversity and habitat quality of the system. Assessment may be determined by using two standard biota indexes developed for macroinvertebrate sampling in Australia (i.e. the AUSRIVAS & SIGNAL indexes).

The advantage of using biota monitoring over chemical water quality monitoring is that biological data will reflect the long-term average condition of the system rather than at a single point in time. The monitoring is undertaken on a twice yearly frequency whilst chemical sampling is often required at monthly or even weekly intervals.

It is recommended that biota monitoring start at the end of the Plant Establishment Period and to be carried out twice a year in Autumn and Spring. An experienced consultant should be engaged to carry out the sampling and analysis work and will be required to produce a report for Stockland.

7.1.5 Mosquito Monitoring

The Mosquito Risk Assessment recommends annual inspections of the wetland to sample larval populations and assess any changes in the suitability of the habitat for pest mosquito production, to be carried out, at a minimum, every two weeks from January through until March. If mosquito breeding in the wetland increases and pest impacts are considered serious, some monitoring and occasional treatment with an appropriate formulation of an approved control agent may be required.

Adult mosquito population sampling during these annual inspections would provide confirming information on the productivity of the wetlands for potential pest species.

7.1.6 Native Fish Monitoring

After the introduction of native fish to the system at a time specified by the consultant, monitoring will be required to assess the establishment and performance of the native fish populations and individual species numbers at a frequency determined by the consultant.

7.2 Inspection Process

For the first two years after completion of works DIPNR will be involved in the monitoring process.

Upon certification of Practical Completion of the site works, the Landscape Architect will institute a 3 monthly inspection regime of the works to monitor the performance of the riparian works. The inspection process will incorporate the following elements:

- notification of Landscape Contractor of upcoming inspection and request for Contractor's 3 monthly report;
- review of the Contractor Report prior to inspection;
- inspection of the site with the Contractor, noting of conformance with Contractor Report, minuting of progress, including noting any defects and stipulating timeframe for rectification;
- undertaking of a follow-up inspection if required to confirm defects have been rectified;
- providing, on a six monthly basis, a short covering letter to DIPNR and the Client reporting on all of the above, and including a copy of the current Contractor Report.

7.3 Reporting

After monitoring inspections have been carried out, quarterly reports are to be produced including all monitoring information.

Plant Establishment Period

The Contractor Report will summarise the progress of the previous 3 months of work during the PEP, including:

- what has been successful;
- what has not been successful;
- measures undertaken to rectify the situation and achieve the biodiversity goal of 80 species for the combined SCRFF and CPW communities;
- any plants replaced;
- discussion of any issues as required, and appending of the updated Maintenance Program and Maintenance Logbook.

Colour photographic records of the works are to be mounted on A3 sheets with descriptions under each specifying the photo points and any pertinent commentary.

DIPNR Monitoring / Reporting

Finalisation of PC will require a site meeting with DIPNR to inspect for compliance with Part 3A permit conditions. Following PC approval by DIPNR the Plant Establishment Period (PEP) will commence.

The Plan provides for the provision of four (4) x six (6) monthly reports to DIPNR during the PEP, addressing the performance criteria within the VMP for each stage of the works. The following six monthly process applies (in accordance with DIPNR's VMP Guideline document):

- A brief concise report will be required from the Landscape Contractor addressing the performance criteria specified in this Plan and summarising the previous six (6) months of work.

The Landscape Contractor will be required to provide certification with each report, confirming that all planting used has been grown on using propagative materials of local provenance;

- The inspection process will incorporate the following elements for each inspection:
  - Notification of the Landscape Contractor of upcoming inspection and request for Contractor's six (6) monthly report,
  - Review of the Contractor Report prior to inspection,
  - Inspection of the site with the Contractor, auditing conformance with requirements of the VMP and Contractor Report, minuting of progress, including noting any defects and stipulating timeframe for rectification,
  - Undertaking of follow-up inspection/s as required to confirm defects have been rectified,
  - Providing a short covering letter to DIPNR reporting on all of the above, including a copy of the Contractor Report with photographic monitoring sheets.

8.1 Action Plan

Key: LA - Landscape Architect
LC – Landscape Contractor
MC – Main Contractor
SC – Specialist Consultant
SL – Stockland Limited
BRC – Bush Regeneration Contractor

Task/Method	Specification Clauses	VMP	Duration	Responsibility
Pre-Construction Phase - Stage 01				
Plant Procurement				
• Sourcing of propagative native plant material.	n/a	4.2 & 5.2	2 months	LA
• Finalisation of plant species and numbers.	n/a	5.2.5	1 month	LA
• Letting of propagation contract	tba	n/a	1 month	SL
• Plant propagation	tba	5.2.6	5-6 months	SL/Nursery
• Plant material inspections prior deliver	tba	n/a	1 month	LC
Baseline Monitoring				
• Set up monitoring points & take first photographic record from each point	n/a	7.1	1 day	LC
• Undertake benchmark monitoring of representative areas in both SCRFF and CPW and for both regeneration and reconstruction treatments	n/a		1-2 days	BRC/SC
Approval Process				
• Obtain license from NSW NPWS required under Section 91 of the TSC Act	n/a	2.6.1	2 months	LA
Construction Phase - Stage 01				
Sediment & Erosion Controls				
• Install sediment and erosion controls to protect riparian corridor from adjacent subdivision building works.	n/a	n/a	1 week	MC
• Install sediment and erosion controls to protect watercourse from adjacent riparian corridor works.	tba	n/a	1 week	LC
Irrigation				
Installation of meters, pipes and fittings	tba	5.8	1 week	LC/BRC
Riparian Corridor Restoration				
• Site preparation including				
- soil testing	tba	4.3	1 month	SC
- ecological burn treatments	tba	5.4	2 weeks	BRC
- soil preparation	tba	5.6	2 weeks	LC/BRC
- soil stabilisation (mulching or matting)	tba	5.7	2 weeks	LC/BRC
• Weed Control and Planting Program				
- primary weed eradication			1 month	BRC
- primary planting, seeding and translocation			2 weeks 2 weeks	BRC BRC
- secondary weed eradication			2 weeks	BRC
- secondary planting				

Task/Method	Specification Clauses	VMP Section	Duration	Responsibility
Construction Phase - Stage 01 *continued*				
Construction Works • Perimeter works, including: - Road kerb and guttering, - Stormwater infrastructure, including main stormwater outlets direct to Main and Inlet Ponds. • Constructed landscape features within the riparian corridor, including: - Perimeter walkway / cycleway system and cross-corridor pathway systems to the Main Bushland Reserve (2no. – the southern crossing will have a bridge.) and the Northern Bushland Reserve (1no. to M4 underpass) – (all stages), - Girraween Woodland Park, including shale access / pathway suitable for Sydney Water maintenance access, basalt maintenance edge, bollards, grassed viewing mound, picnic shelters / viewing mound shelter, and turfing – (Stage 1), - Main Pond Wall Lookout, including shale access / pathway suitable for Sydney Water maintenance access, boardwalk and lookout shelter (Stage 1), - Main Pond Boardwalk to western perimeter linking from near the Main Pond Wall to the Main Pond Formal Park, and including an extension to the water's edge - (Stage 2), - Northern Bushland Park, including activity nodes for a playground, and fitness equipment/sculpture/seating, shade structures and bollards – (Stage 3), - Interpretative Elements, including signage – (all stages).	n/a tba tba tba tba tba tba	n/a n/a n/a n/a n/a n/a n/a	3 months (Stage 1) 3 months (Stage 2) 3 months (Stage 1) 3 months (Stage 2) 2 months (Stage 3)	MC LC
DIPNR Liaison Notify DIPNR in writing, one month prior to Practical Completion		4.11	-	LA
Practical Completion (PC) Inspection of works DIPNR certification re. meeting all 3A Permit requirements Photographic monitoring		4.11	-	LA

Task/Method	Specification Clauses	VMP Section	Duration	Responsibility
2 Year Plant Establishment Period (PEP)				
Plant Establishment Period				
• Establish the parkland works undertaking maintenance task as outlined in Landscape Works Specifications	tba	n/a	12 months	LC
• Establish / develop the corridor restoration works undertaking maintenance tasks as outlined within the VMP	n/a	5.10	2 years	LC/BRC
Native Fish Stocking				
• Work includes the undertaking of a downstream fish survey, assessment of suitability of water quality conditions re. fish release and follow-up monitoring.	tba	6.2.4	6 months	SL/SC
Bushfire Fuel Reduction Management				
• Landscape Contractor to consult specialist Bushfire Consultant (to include site inspections as necessary) in regards to managing accumulation of fuel within the OPZ.	tba	4.6	2 years	LC/ SC
Progress Reporting				
• Landscape contractor to prepare a maintenance program and keep a logbook for works undertaken during this phase		5.10	2 years	LC
• Six monthly progress reporting to be provided				
Inspection/Monitoring				
• Inspection and monitoring of riparian corridor every three months		7.2	2 years	LA
• Restoration works / plant species diversity			2 years	SC
• Water quality & aquatic habitat assessment monitoring			2 years	SC
• Mosquito monitoring (January to March by specialist if required)			2 years	SC
• Native fish establishment monitoring			2 years	SC
DIPNR Liaison				
• Reporting to DIPNR (6 monthly)		4.11	2 years	LA
• Notify DIPNR in writing, one month in advance of completion of the Post Construction Phase.				
Finalisation of PEP				
• Notify DIPNR in writing, one month in advance of completion of the Post Construction Phase.		4.11	1 month	LA
• Preparation of Riparian Corridor Operation & Maintenance Manual		5.11.1		LC

Task/Method	Specification Clauses	VMP Section	Duration	Responsibility
Handover				
• Inspection of works.		5.11	-	LA
• Maintenance Manual			-	SL
• Formal handover of the works to Holroyd City Council who will be responsible for on-going maintenance of all landscape and riparian corridor restoration works.			-	LA + SL
Maintenance Staff Training				
• Handover training workshop for key Holroyd City Council maintenance staff.		5.11	One month prior to Handover	LA + SL
On-going – Long-term Management (post contract)				
Maintenance Period				
• Maintain the bushland parks (Girraween Creek Bushland Park and Northern Bushland Park)	tba	6.0	On-going	Council
• Maintain / develop the riparian corridor restoration works	tba			
Restoration Monitoring				
• Restoration works		7.1.3	On-going	SC/Council
• Water quality & aquatic habitat assessment monitoring		7.1.4		SC/Council
• Mosquito monitoring (January to March by specialist if required)		7.1.5		SC/Council
• Native fish establishment monitoring		7.1.6		SC/Council
Maintenance Monitoring				
• Monitoring / maintenance inspections of the creek corridor to be carried out on a 3-monthly basis or following storm events; and	n/a	6.0	On-going	Council
• Monitoring via visual inspections to assess general health/diversity of vegetation, weed infestations, sediment accumulation, litter, algal blooms, erosion, and other issues				

8.2 Monitoring Schedule

Item	Action	Function	Monitoring/ Inspection
Structural			
Inlet Structures Litter traps and bio-remediation ponds	Check for litter, debris and sediment build-up. Clean litter traps when 50 % full. Remove blockages to any structures.	The efficiency of a device to remove and retain pollutants reduces as the device fills with solid materials. Regular maintenance is therefore essential	quarterly or after storm events
Outlet Structures Weirs, Spillway	Check for litter and debris. Remove blockages to any structures.		quarterly or after storm events
Litter and Debris	Check riparian and aquatic zones for litter or debris and remove (by hand or other methods as deemed necessary).	Litter and debris affects water quality, habitat and visual amenity	quarterly or after storm events
Erosion	Check all areas in the riparian zone and in particular inlets, outlets, batters and drainage lines. Record location and extent of any erosion or subsidence. Repair as soon as possible.	Erosion leads to de-stabilisation of creek banks and can affect nutrient and turbidity levels in adjacent waterways and downstream of the site.	quarterly or after storm events
Sedimentation	Check for sediment build-up in all areas of the aquatic system Schedule maintenance works particularly where water volume is undermined or short circuiting of the system is resulting	Sediment build up can affect flows, wetland pond volume and macrophyte growth.	quarterly or after storm events
Signage	Check signs have not been vandalised. Replace and / or repair as required.	Signage is essential for public health and safety and interpretation of the environmental values and functions of the system	quarterly
Access	Check pathways are not blocked or damaged. Replace and / or repair as required.	Access is to be controlled so as not to cause erosion and impact on plant growth and fauna habitat.	quarterly
Public Health and Safety	Inspect fences, pontoons, and lookout for safety. Replace and / or repair as required.	It is the responsibility of the manager, Norwest Association Limited to consider public health and safety issues	quarterly
Abiotic			
Water quality	Check for odours, scums, slicks, algae and water clarity. Aquatic biota monitoring twice a year in Autumn and Spring.	Good water quality is important for stream fauna and habitat, to prevent weed invasions and adverse impacts on downstream areas	quarterly half yearly
Water levels	Record water levels at time of inspections	Water level control is a powerful tool for management of aquatic plants, weeds, pest fauna & to allow access to ponds for maintenance work	quarterly

Item	Action	Function	Monitoring/ Inspection
Biotic			
Weeds	Document any weed invasions. Remove weeds promptly by hand before excessive growth requires the use of herbicides Aquatic weeds such as Alligator Weed, Water Hyacinth, Salvinia and Ludwidgia are of particular concern and early detection and action to control these species is essential.	On-going weed control and monitoring is essential to avoid large unsightly infestations. Weeds will displace native species, affect water quality, and reduce habitat value and aesthetic values of the system.	quarterly or after storm events
Algae	Identify species where excessive growth occurs Investigate causes where excessive growth of filamentous green algae becomes a persistent problem	Algae can form dense mats limiting light penetration into the water, deplete oxygen levels in water, cause unpleasant odours and may also be toxic (blue green algae).	quarterly
Aquatic and terrestrial vegetation health	Document vegetation composition and structure and compare with initial species composition and planting densities. Record general condition – disease, yellowing, and damage by water fowl. For terrestrial vegetation measure canopy cover, extent of ground cover, survival, species present and the presence of any seedlings	Health native vegetation is vital for the effective functioning of the system in water quality control, habitat provisions, and erosion control and for the aesthetic and recreational amenity of the site.	quarterly
Replanting	Replace plant losses. Refer to Landscape plans and Landscape Works Spec.		As required
Herbicide	Prescribed herbicides to be used only if all other control methods are inadequate	Herbicides have the potential to impact on water quality, fauna and habitat in the system	As required
Fertiliser	Fertiliser use should be limited and controlled. Low phosphorus fertiliser is to be used.	Nutrients from fertilisers and associated run-off have adverse effects on water quality and may lead to the growth of algae and aquatic weeds.	As required
Native fauna	Record the presence or indicators (droppings, tracks, nests, calls etc) of native fauna using the site.	The presence of native fauna is a good indication of the health and sustainability of the system and the level of biodiversity present.	quarterly
Pest fauna	Record sightings or the presence of droppings/tracks of other fauna	Pest fauna competes with and preys on native fauna.	quarterly
Mosquitoes	Check for larvae in pooled water and at aquatic margins If observations or anecdotal evidence suggests that mosquitoes are becoming a problem, a professional entomologist should be contracted to undertake an assessment of the site.	Mosquitoes have the ability to act as a vector for disease and are a nuisance pest.	quarterly

Item	Action	Function	Monitoring/ Inspection
Native fish stocking	Look for signs of native fish in shallow water zones. If problems are evident or other issues are impacting on native fish populations contract a specialist consultant to carry out an assessment.	Native fish introduced to the system will increase the diversity of native fauna present and may act to control mosquito populations by preying on the larvae.	quarterly
Other			
Macro-invertebrate monitoring	Aquatic ecological consultant to carry out assessment, to monitor water quality & aquatic ecosystem health	Diversity of macroinvertebrates is a good indicator of whole ecosystem health.	half yearly
Photo monitoring	Photographs to be taken of restoration works from set monitoring points	These photos are to be retained and are a valuable record of the progress and success of the project.	quarterly
Staff training	Train maintenance and management staff in general wetland ecology, native and weed plant identification, bush regeneration & pollutant removal processes.		As required
Yearly review	Review maintenance and monitoring procedures. Review performance assessment goals		Annually

8.3 Objectives and Performance Indicators

The following performance indicators have been developed in order to assess the success of the restoration project. They will assist decision- making in relation to maintenance and monitoring requirements for the system as part of an adaptive management process (see s. 6.1).

Objective (desired outcome)	Performance Indicator
To enhance the ecological functions of the creek corridor	• Low / manageable weed densities • Optimal functioning of stormwater treatment structures • Good water clarity and visibility to a depth of 2m • Water and habitat quality 'good' as determined by regular bio-monitoring • Low/manageable evidence of aquatic weed and algal infestation • Healthy native vegetation with cover and diversity to meet design intent
To restore native aquatic and riparian vegetation	• Natural communities characteristic of CPW and SCRFF • Vegetative cover established in canopy, shrub layer and groundcover • Aquatic plants establish in diversity and density • Low/manageable weed densities
To provide habitat for a diversity of aquatic, semi-aquatic and terrestrial native fauna	• Re-colonisation of the site by native fauna - Native fish, frogs, crustaceans (e.g. yabbies) and insects present • Evidence of pest fauna is at a minimum • Water and habitat quality 'good' as determined by regular bio-monitoring • Low / manageable weed densities
To provide a movement corridor for native fauna as part of a regional corridor network	• Re-colonisation of the site by native fauna • Ground and canopy level vegetation connectivity established
To provide high quality passive recreational and educational opportunities for the surrounding community without compromising ecological values	• Public regularly observed using the creek corridor • Low/manageable evidence of impacts (e.g. erosion, litter, vegetation damage, dog faeces) from recreational use • Interpretive facilities provided in the creek corridor • The community is well informed about values and functions of the creek corridor and on-going performance and management issues

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10.0 AUTHORS

The key authors of this report were:

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- Mark Blanche – Project Direction / Management / Part Author - Vegetation Management Plan
- Kathryn Duchatel – Primary Author - Vegetation Management Plan

EcoHort

- Ed Freimanis – Author - Bushland Management Plan

APPENDICES

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Appendix B: Schedules

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Appendix C: Bushland Management Plan (Ecohort)

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Appendix E: Development Application Drawing Set

Landscape Drawings
Landscape Works Specification

Appendix F: Opinion of Probable Costs

Appendix G: Landscape Construction Certificate Document Set

Appendix H: Bush Management Guidelines

Arranging Pile Burns on Bush Regeneration Sites 17.04.2000

Appendix I: Mosquito Risk Assessment

Mosquito Risk Assessment: CSIRO (Lakewood), Greystanes.

5.4 D. Alligator Weed Management Plan 2017 Ecological Consultants Australia

Lakewood Alligator Weed Management Recommendations

By Ecological Consultants Australia Pty Ltd

September 2017

About this document

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Statement of Authorship

This study and report was undertaken by Ecological Consultants Australia at Studio. The author of the report is Geraldene Dalby-Ball with qualifications BSc. majoring in Ecology and Botany with over 20 years' experience in this field, Andre Olson of Dragonfly Environmental assisted in technical aspects of aquatic weed management and site inspections.

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Executive Summary

Findings and Background

- Alligator Weed is present in the Lakewood riparian area and has the potential to cover extensive areas of open water and grow amongst aquatic plants on the water's edge.
- Alligator Weed is present in open water and the wet/dry areas.
- Wet/dry interface areas are poorly defined and results in management issues in general. Alligator Weed flourishes in the wet/dry interface and spreads by pieces. Vegetation management such as mowing/slashing can spread this weed.
- Alligator Weed is a listed Noxious Weed. NB there is new noxious weed legislation and this should be checked for the specific requirements of the site (as the management agreements are developed)
- Alligator Weed is present in the catchment and spreads easily so continued re-infestation is likely in general and especially post medium level flood events.

Management Recommendations

- On-going management and surveillance is recommended. Frequent (seasonal) treatment of Alligator Weed will result in reduced annual cost of control and reduce the likelihood of it excessively expanding over open water areas. Seasonal work recommendations have been detailed in this plan.

Conclusions and Recommendations

- Alligator Weed management is recommended to occur on a seasonal basis. For best outcomes the timing and frequency of works would be in accordance with timing proposed in this plan.
- Training in aquatic weed, identification and management is provided for those managing the Lakewood Riparian area is recommended.
- It is recommended that the interface between wet and dry areas be well defined such that Alligator Weed habitat is reduced. This will also reduce the likelihood of it being spread through mowing / slashing etc. It is acknowledged that the site is flood prone and it's not possible to have clear boundaries in all areas however it is still recommended wherever practical.

Table of Contents

1.1 Scope

Ecological Consultants Australia (ECA) has been contracted to provide advice on managing Alligator Weed as part of the Plan of Management (PoM) for Lakewood Riparian Area. For detail on the site refer to the PoM (Draft 2017).

1.2 Legislative and Policy Context

The environmental management is affected by a wide range of regulatory and policy requirements, which are addressed through the visions and actions outlined in this PoM.

Key legislation to consider when managing Alligator Weed in Lakewood Riparian Corridor include:

- *Environmental Protection and Biodiversity Conservation* Act 1999 (Commonwealth)
  Mandates actions relating to nationally listed threatened species and communities.
- *National Parks and Wildlife* Act 1974 (NSW)
  Provides for the protection of all native fauna, with licences being required to harm them or their habitat. Requires permits for activities that damage or destroy items of Aboriginal heritage.
- *Noxious Weeds* Act 1993 (NSW)
  Requires landowners to control classified weeds on their land, with required control measures depending on level of classification – see also new Noxious Weed legislation.
- Pesticides Act, 1999 (NSW) Regulates the use of pesticides and off-label permits are required for some herbicides used on Alligator Weed.
- *Threatened Species Conservation* Act 1995 (NSW)

Provides for the creation, by the Office of Environment and Heritage, of recovery plans for species or communities listed as threatened. Two ecological communities grow within the study area and council is obliged to implement the recovery plans where the plans are available.

- *Protection of the Environment Operations* Act 1997 (NSW)
  Provides for licences to regulate activities with potential environment impact, such as water extraction (drawing water levels down where possible to treat Alligator Weed).

Alligator Weed growing densely in wet-edge habitat and into open water. Source GSDB

1.3 Site Location and context for Alligator Weed management

Figure 1 shows the site and surrounding area. Of note here is the proximity to other waterways include Prospect Reservoir and tributaries. Effective Alligator Weed management requires whole catchment management and so while this plan highlights works to be done in this location there is likely to always be a background situation with recurring Alligator weed until whole of catchment management is undertaken and even then, on-going work is required as it can be transported land management practices (mowing etc) and birds and reintroduced to the site.

Figure 1. Site (iwthin the yellow outline) and sourrounding area. Source: Six Maps accessed August 2017

Figure 2 outline of area covered by this plan. Source former Cumberland Council

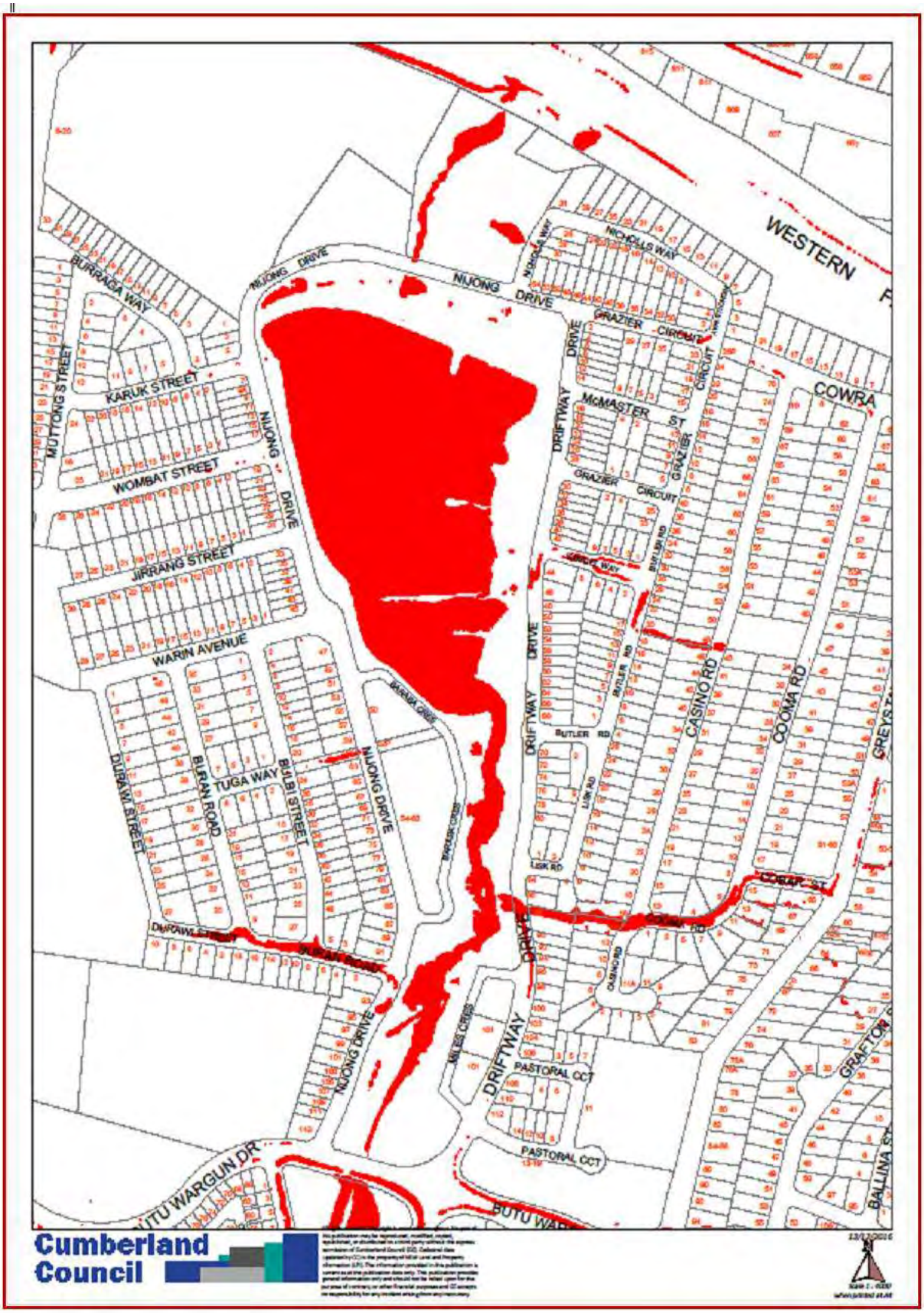

Figure 3 Floodway mapping Source: Former Cumberland Council

Figure 4 shows the vegetation communities in the immediate surroundings. The northern most section of the site is mapped as having Endangered Ecological Communities EECs. Cumberland Shale Plains Woodland is listed as a Critically Endangered Ecological Community (CEEC) and SheOak Riparian Forest. EECs are as defined by the NSW Threatened Species Conservation Act or Commonwealth Environmental Protection and Biodiversity Conservation Act communities occur in close proximity that are EECs. Additional EECs are known to occur in the nearby tributaries and in and around Pemulwuy. Thus management on-site needs to consider the possible impacts of works directly or indirectly on EECs. In this case no 7-part tests are needed however it would be sensible to have training in regards to the location of Cumberland Shale Plains Woodland and SheOak Riparian Forest such that activities do not have an impact on these areas.

Figure 4. Site and immediate sourroundings with Vegetation Communities mapped as per Sydney Metro Mapping 2015.

2 Methods

2.1 Site Inspections

Andre Olson (Aquatic Weed Specialist) of Dragonfly Environmental and Geraldene Dalby-Ball (wetland management specialist) ECA assessed the site in early and late August 2017. Weather was fine and sunny during time of visit. Inspections were made on-foot and the entire area as shown in Figure 2. Wetland edges, riparian zones and emergent aquatic plants were searched as part of the inspection.

2.2 Existing Data

Aerial imagery

Aerial imagery was used to look at the lake through time and see the times of extensive plant growth over the open water area.

On-site knowledge

The authors also discussed the site with personnel from Council who are familiar with the site over the longer time periods including peak summer conditions when weed growth is at a maximum. This information was taken into account in terms of management suggestions. It is noted that even without this information it is clear from the site inspections that Alligator Weed has the potential to spread extensively across the open water and through the drainage lines.

Threatened Species

Bionet, previous studies and the author's knowledge of the local area, were used to determine the possible occurrence of endangered ecological communities and threatened plant species on-site. The Bionet records accessed covered a 10km^2 area with the centre of the site as the centre point of the Bionet database search. Records selected were from the time period of 1st January 1980 to 20th August 2017.

Records from the following databases were collated and reviewed:

- Atlas of NSW Wildlife (Bionet). New South Wales, Office of Environment and Heritage (OEH).
- NSW Threatened Species Information (OEH).
- PlantNET (The Royal Botanic Gardens and Domain Trust 2014).
- Protected Matters Search Tool of the Australian Government Department of the Environment (DoE) for matters protected by the Cwlth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Other sources of biodiversity information:

- Relevant vegetation mapping, including:
    - Vegetation Information System, VIS Mapping (OEH).
    - Native Vegetation of the Sydney Metropolitan CMA Area, Sydney Metropolitan (CMA, 2009).

3 Findings and Recommendations

Alligator Weed was predominantly in northern pond and in drainage swale that runs along northern section of Nijong Drive as per Figure 5.

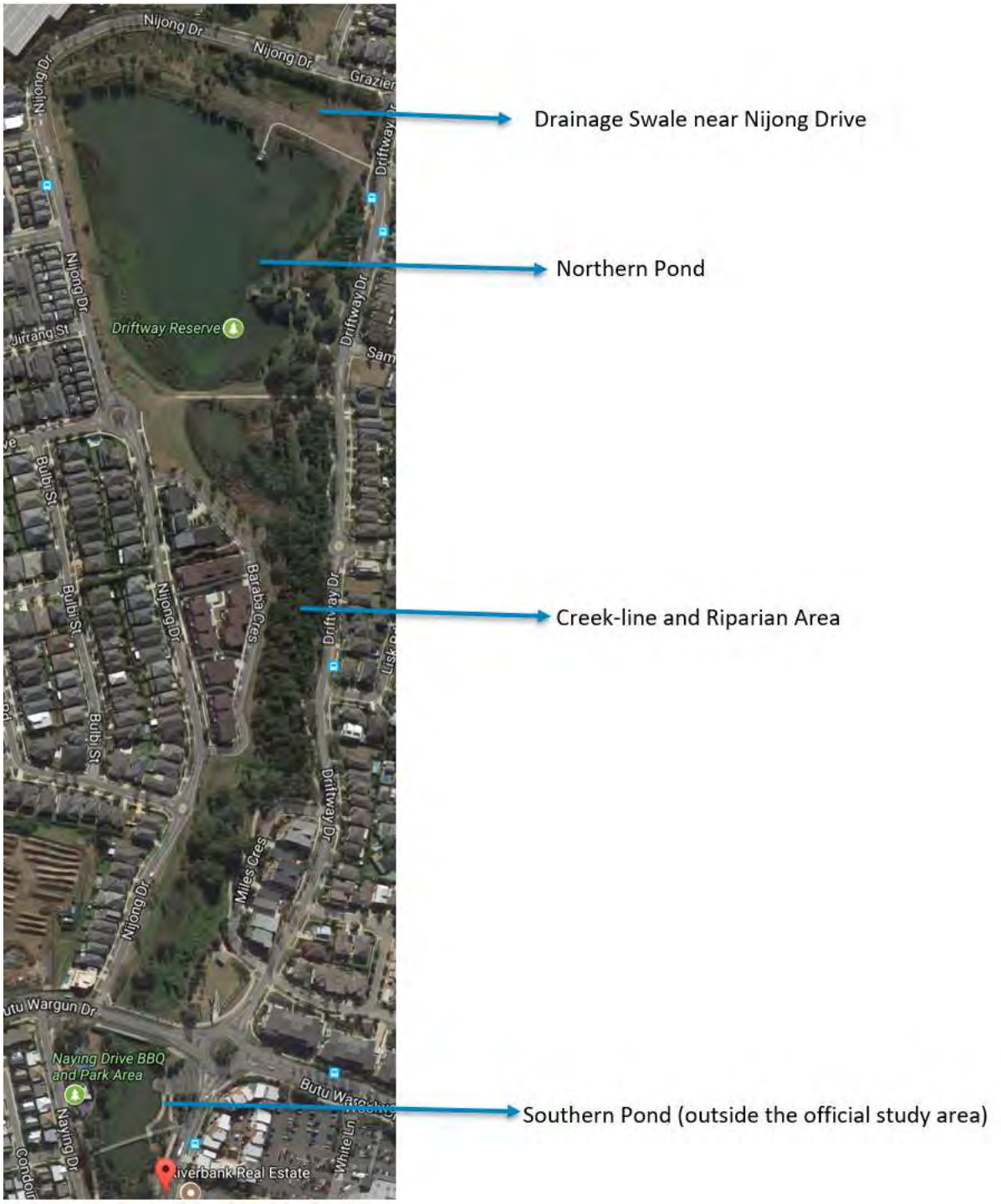

Figure 5. Areas referred to in Management Recommendations including Table 1.

Alligator Weed is around ~30% as an understorey to the aquatic plants in areas shown in Figure 5b. Alligator Weed is less than 5% on grass adjoining channel water – the important point is not to spread it.

Alligator Weed is present along the Creek-line Riparian area mostly as small fragments within other vegetation. It has the potential to increase cover in these areas particularly post flood when other debris has been washed away exposing the substrate.

Figure 5b shows the northern pond. The southern ponds (outside the official study area) had no Alligator Weed visible during time of site inspections it does have the weed *Juncus acutus* though.

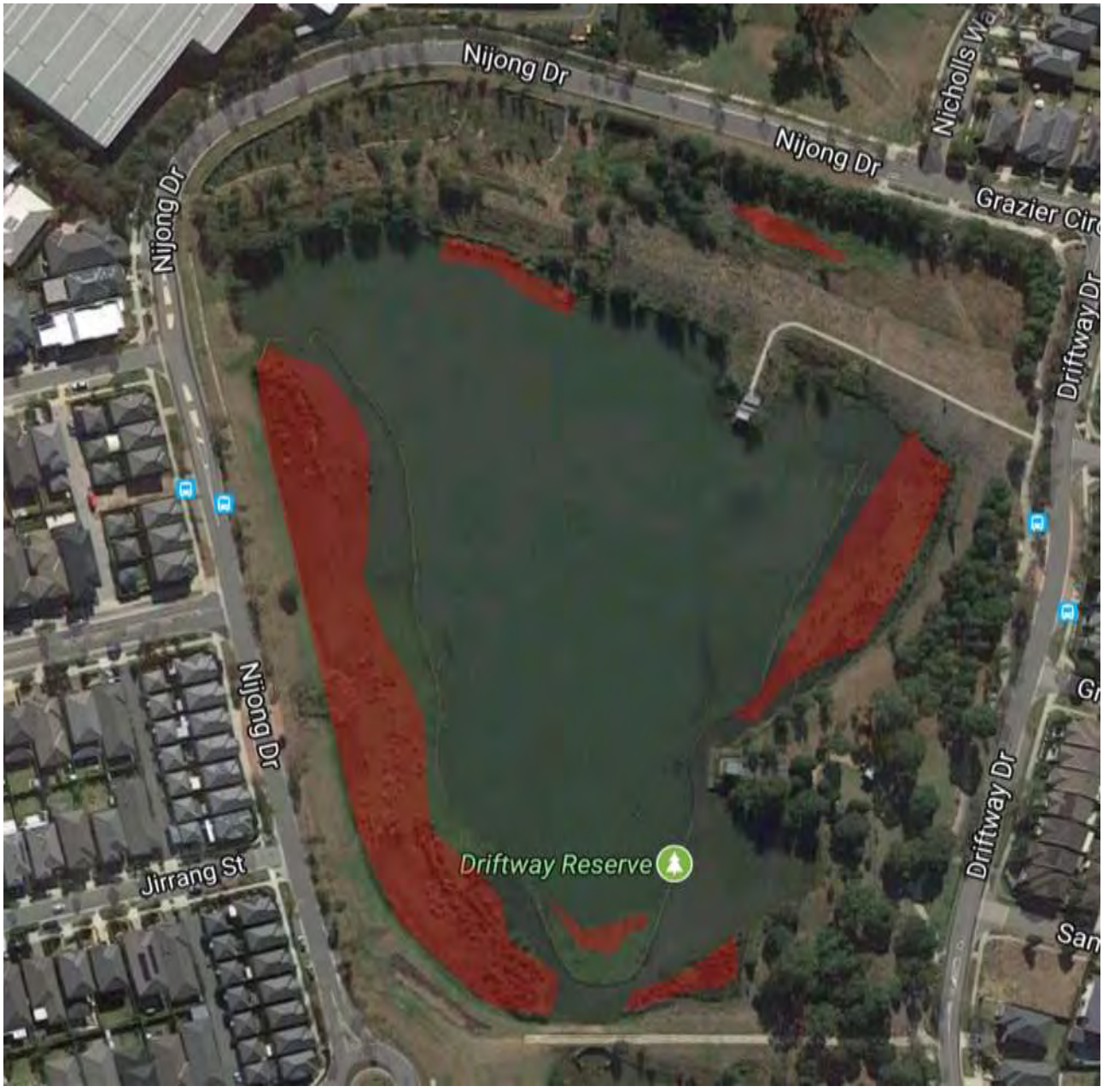

Figure 5b: Alligator Weed locations during onsite during inspection (Northern Pond)

3.1 Site images and management considerations

Plates 1 to 10 show typical site conditions as they relate to Alligator Weed and other problem aquatic and semi-aquatic weed species. Notes below images also include location specific management recommendations.

Plate 1: Pampass Grass and *Juncus acutus* are other noxious and environmental weeds that need removing from wetland system

Plate 2: *Juncus acutus* seed in foreground and floating Alligator Weed clump in background

Plate 3: Alligator Weed growing in deeper water and amongst native aquatic vegetation.

Plate 4: Alligator Weed growing amongst native aquatic vegetation and forming mats and islands within open water sections of wetland system.

Plate 5: Alligator weeds stems and stolons found on exposed muddy substrate.

Plate 6: Waterfowl eg Moor Hens and Ibis are foraging on Alligator Weed and aiding its spread across the site and catchment.

Plate 7: Alligator Weed stems floating in wetland. These will reshoot in warmer weather

Plate 8: Alligator Weed found in drainage swale that runs along Nijong Drive

Plate 9: Alligator Weed growing in shallow water and amongst native aquatic vegetation.

Plate 10: Brushcutting of areas where Alligator Weed is growing in water and on bank is to be avoided

3.2 Recommended Actions

A works program to control Alligator Weed (*Alternanthera philoxeroides*) in the wetland/creek of Lakewood Wetland System is summarized in Table 1.

The aim of the works is to attempt to significantly reduce the current infestation. Works include the use of a high volume sprayer using Metsulfuron – Methyl to target any Alligator Weed seen in the area. Follow up works will be conducted 4-6 weeks later to target any re-emergence or regrowth. Follow up works will be conducted by thermal weeding, which has been used successfully in the past to for control Alligator Weed. If conditions are not suitable for thermal weeding (e.g. too dry or too hot), backpack sprayers with Metsulfuron – Methyl will be used. All works will begin from the top of the catchment, heading down.

Alligator Weed is often found in mown areas that are frequently inundated, such as the wetland batter where it is sometimes mown and may spread vegetatively. It is recommended that for works to be effective in control and eventual eradication of this Noxious Weed from the water basins. Other potential sources such as ovals and creeks further up the catchment will require monitoring and treatment by relevant land holders if Alligator Weed is present.

Metsulfuron-methyl Annual Treatment Program.

- Spray using volume sprayer and boat. Manual spraying in areas of aquatic native vegetation and may follow up works throughout the year.
- Apply the first foliar treatment in October - November 2017. Apply the second foliar treatment in February 2018.
- Apply the third foliar treatment at the end of the growing season in May 2018.
- Carry out this annual treatment program for a number of years (6 on average) and then consider the possibility of eradication by physical removal of any remaining underground plant parts.

Work under license: **PERMIT 14734** Expires 30/06/2019 Metsulfuron-methyl 600 g/kg (Brush-off®)

Works will require a High Volume Sprayer. If Alligator Weed is not treated early and expands then an aquatic harvester will be required for manual removal:

Proposed timeline:

Table 1 (below) outlines the proposed timeline and recommended duration of each action.

NB: This is a *proposed* works table, works can be adjusted according to site responses, inclement weather, or other factors, and only after consultation with Council.

Table 1 Gannt chart of recommended works and resourcing required. After 2019-2020 repeat above and if new infestation from catchment or flooding are reduced then the cost per year can be reduced for on-ground works but recommended not for surveillance.

NB: if on-going work is not undertaken the extent of the Alligator Weed will increase rapidly in the warmer months and the resourcing and cost for management will also increase.

3.3 Table 1 Recommended Management Actions and Resourcing

Key:

- The numbers in each box represent the minimum number of hours resourcing suggested for the action.
- Blue and grey shading indicate works associated with management but not direct treatment of Alligator Weed.
- Light and dark brown shading shows times and resourcing recommended for treatment.
- Management Zones refers to areas shown in Figure 5 and Figure 5a shows a detail of the Northern Pond.

Management 2018-2019

Lakewood Alligator Weed Control	Management Zone/s	Oct-17				Nov-17				Dec-17				Jan-18				Feb-18				Mar-18				Apr-18				May-18			
Project Administration																																	
Weed Condition Mapping	All Zones	6																															
Site Induction and Initial Meeting with Council	All Zones	2																															
Photo Monitoring Points and Monitoring Transects	All Zones	1										2												2									
Quarterly Monitoring and Surveillance of AW	All Zones									1												1											
Targeted Weed Control as per Weed Management Plan Yr 1:																																	
Alligator Weed Control Manual back pack spraying	Northern Pond						32	32		32	32			16				16				16				16				16			
Alligator Weed Control Volume Sprayer/Boat	All Zones					8	8	8	8									8	8		8									8	8		
Other Costs Optional:																																	
Waste Fees for Vegeation	All Zones												1											1									

Management 2018-2019

Lakewood Alligator Weed Control	Management Zone/s	Oct-18				Nov-18				Dec-18				Jan-19				Feb-19				Mar-19				Apr-19				May-19			
Project Administration																																	
Weed Condition Mapping	All Zones	6																															
Site Induction and Initial Meeting with Council	All Zones	2																															
Photo Monitoring Points and Monitoring Transects	All Zones	1										2											2										
Quarterly Monitoring and Surveillance of AW	All Zones									1												1											
Targeted Weed Control as per Weed Management Plan Yr 1:																																	
Alligator Weed Control Manual back pack spraying	Northern Pond						16	16		16	16			16				16				16				16				16			
Alligator Weed Control Volume Sprayer/Boat	All Zones					8	8	8											8		8										8		
Other Costs Optional:																																	
Waste Fees for Vegeation	All Zones												1												1								

Management 2098-2020

Lakewood Alligator Weed Control	Management Zone/s	Oct-19				Nov-19				Dec-19				Jan-20				Feb-20				Mar-20				Apr-20				May-20			
Project Administration																																	
Weed Condition Mapping	All Zones	6																															
Site Induction and Initial Meeting with Council	All Zones	2																															
Photo Monitoring Points and Monitoring Transects	All Zones	1										2											2										
Quarterly Monitoring and Surveillance of AW	All Zones									1												1											
Targeted Weed Control as per Weed Management Plan Yr 1:																																	
Alligator Weed Control Manual back pack spraying	Northern Pond						16	16		16	16			16				16				8				8				8			
Alligator Weed Control Volume Sprayer/Boat	All Zones								8									8	8												8		
Other Costs Optional:																																	
Waste Fees for Vegeation	All Zones												1												1								

NB the above is relevant for on-going work. If Alligator is untreated then increased resourcing and an aquatic harvester are likely to be needed.

4 Appendices

4.1 Appendix I Table 2 Noxious Aquatic Weeds summary

With the exception of Alligator Weed none of the other aquatic weeds were observed at the time of inspection however they are in the wider catchment. People managing the area should be aware of these weeds and what they look like so they can be treated rapidly should they occur in future.

Table 2 Noxious Aquatic Weeds that do or could grow in Lakewood open water areas.

	Alligator Weed	***Ludwigia peruviana* and *L. longifolia***	**Mexican Water Lily**	***Salvinia molesta***
Weed Photo				
Weed Type	Floating Attached	Emergent	Floating Attached	Free Floating
Dispersal Method	Pieces	Seeds	Multiplication	Multiplication
Key Habitat	Edge and damp to shallow wet areas and growing out into open areas	Edge and damp to shallow wet areas	Open water	Open water
Distribution /Abundance August 2017	Present as described in this plan	Not observed	Not observed	Not observed

	Alligator Weed	*Ludwigia peruviana* and *L. longifolia*	Mexican Water Lily	*Salvinia molesta*
Class*	3	3		2
Legal requirements	The plant must be fully and continuously suppressed and destroyed	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold propagated or knowingly distributed		The plant must be eradicated from the land and the land must be kept free of the plant

- Class changes depending on LGA. NB this system of classifying is currently being updated as part of new Noxious Weed Legislative amendments.

4.2 Appendix II – summary aims for 1, 4 and 10 years

Table 3 summaries outcomes for areas based on 2017 mapping. Its recommended that detailed mapping be done post works in 2017 and then mapping continued as part of surveillance each year. Mapping need not be detailed but should at least shows area with AW over 10m2 and approximate cover based on <5% cover, >5-20% cover, >20%-50% cover and >50%-80% and >80+

Table 3 Summary aims of Alligator Weed management in Lakewood Riparian Corridor over next 10 years

Timing	Summary Outcomes
Aim of On-ground Works one year from adoption of this PoM	AW to be <10% of open water to be covered in AW. New infestations identified and treated prior to them reaching 40% cover of any one 1000m^2 area. AW to be <5% in areas where it was not found in 2017 and AW to be less than 20% cover in areas it was identified in 2017 and No new infestations to exceed 10% ground cover. Management techniques not spreading AW (eg no slashing AW edges where that machine then goes to other areas. No new infestations.

Timing	Summary Outcomes
Aim of On-ground Works in 4yrs	AW to be <5% of open water to be covered in AW. New infestations identified and treated prior to them reaching 20% cover of any one 1000m^2 area. AW to be <5% in areas where it was not found in 2017 and AW to be less than 20% cover in areas it was identified in 2017 and No new infestations to exceed 5% ground cover. Management techniques reducing the area of AW Post flood surveillance in place for Noxious Aquatic weed ID and management
Aim of On-ground Works in 10yrs	AW to be <5% of open water to be covered in AW. New infestations identified and treated prior to them reaching 20% cover of any one 100m^2 area. AW to be <5% in areas where it was not found in 2017 and AW to be less than 20% cover in areas it was identified in 2017 and Management techniques reducing the area of AW Post flood surveillance in place for Noxious Aquatic weed ID and management

Links for further information on

4.3 Appendix III Expertise of author

With over 20 years wetland and urban ecology experience with extensive technical and on-ground knowledge in these areas.

Geraldene has over 8 years local government experience as manager of environment and education for Pittwater Council. Geraldene presented papers on the topic at the NSW Coastal Conference, Sydney CMA and Hawkesbury Nepean forums. Geraldene is a Technical Advisor Sydney Olympic Park Wetland Education and Training (WET) panel.

Key interest area is working in multi-disciplinary teams to bring ecological and wetland and riparian ecology expertise to large-scale projects.

Geraldene has up to date knowledge of environmental policies and frequently provides input to such works. Geraldene was a key contributor to the set of Guidelines commissioned by South East Queensland Healthy Waterways Water Sensitive Urban Design Guidelines. Geraldene's role included significant contributions and review of the Guideline for Maintaining WSUD Assets and the Guideline for Rectifying WSUD Assets.

Geraldene is a frequent contributor to community and professional workshops on ecological and wetland and waterway matters particularly relating to environmental management.

Geraldene is a joint author on the popular book Burnum Burnum's Wildthings published by Sainty and Associates. Author of the Saltmarsh Restoration Chapter Estuary Plants of East Coast Australia published by Sainty and Associates (2013). Geraldene's early work included 5 years with Wetland Expert Geoff Sainty of Sainty and Associates. Geraldene is an expert in creating and enhancing urban biodiversity habitat and linking People with Place.

Example projects can be provided.

Geraldene Dalby-Ball

Director ECA

SPECIALISATIONS

- Urban Ecology – and habitat rehabilitation and re-creation.
- Wetland design and management
- Urban waterway management – assessing, designing and supervising rehabilitation works
- Saltmarsh and Wetland re-creation and restoration – assessment, design and monitoring
- Engaging others in the area of environmental care and connection
- Technical Advisor – environmental design, guidelines and policies
- Sound knowledge and practical application of experimental design and statistics
- Project management and supervision
- Grant writing and grant assessment
- Budget estimates and tender selection
- Expert witness in the Land and Environment Court

CAREER SUMMARY

- **Director and Ecologist**, Ecological Consultants Australia trading as Kingfisher Urban Ecology and Wetlands. 2014-*present*
- **Director and Ecologist**, Dragonfly Environmental. 1998-*present*
- **Manager** Natural Resources and Education, Pittwater Council 2002-2010
- **Wetland Ecologist** Sainty and Associates 1995-2002

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Science with 1st Class Honors**, Sydney University
- WorkCover WHS General Induction of Construction Industry NSW White Card.
- Senior First Aid Certificate.
- **Practicing member** Ecological Consultants Association of NSW

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