Wetland Management Plan

Mills Park, Beckenham

V13002

Prepared for
City of Gosnells

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Cardno
Shaping the Future

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1 Introduction

Cardno has been engaged by the City of Gosnells (CoG) to prepare a Wetland Management Plan (WMP) for a portion of Mills Park, located at Lot 203 Brixton Street, Beckenham Western Australia (the site). Mills Park is a major community recreation and sporting facility and therefore a community asset. The CoG intends upgrade to Mills Park and has engaged Cardno to prepare a Master Plan. This plan intends to deliver redeveloped active and passive public open spaces, a new ecologically sustainable multi-use community facility and rehabilitation of natural environment.

This WMP supports the Mills Park Master Plan and forms the basis of the CoG's ongoing management of wetland and associated buffer areas in the park. It has been prepared in consultation with relevant stakeholders including officers from the CoG and the Department of Environment and Conservation (DEC) Wetland Branch. The report outlines restoration and management actions to be undertaken in wetland areas and associated buffers to protect the wetland, provide an overall improvement in the ecological value of the wetland areas, and a functional buffer between wetlands and adjacent land uses.

2 Site Description

Mills Park is approximately 27.2 hectares and bounded by Brixton Street, Bickley Road and the Roe Highway in Beckenham as shown in **Figure 1**. The site is mostly developed and predominantly used for active and passive recreation. There is approximately 16 ha of active space which includes four sports reserves, nine tennis courts, two bowls greens, three basketball courts and ancillary facilities for each. There is approximately 9.5 ha of open space.

This WMP applies to an area of approximately 19.5 ha in Mills Park that falls under two Unique Feature Identifier (UFI) wetlands, UFI 7727 and UFI 7739. The UFI wetlands comprise a section of Yule Brook in the eastern part of the park and remnant vegetation overstorey north and south of the brook. The Wetlands and the 50 m buffer around the wetland as required by the DEC, are shown in **Figure 2** and are further discussed in **Section 4.2**.

Site details are summarised in **Table 2-1**. An Aerial photograph of the site and cadastral boundaries depicting individual land parcels at Mills Park is shown in **Figure 3**.

Table 2-1 Site Details

Identification	Description
Site Name	Mills Park
Site Address	Lot 203 Brixton Street, Beckenham, Western Australia
Certificate of Title Details	CT 2549/651
Area	Park: 27.2083 ha
Site Boundary Co-ordinates	NW – 402160.39 6456690.26 NE – 402839.29 6456722.13 S – 402773.51 6456147.43
Current Zoning:	Local Open Space (LOS) Watercourses (Drains)
Local Government Area	City of Gosnells
Current Site Use	Recreational Park

Note: Boundary co-ordinates are reported in Grid Datum of Australia (GDA 94), Zone 50.

2.2 Past and Existing Land Uses

Prior to its establishment as a recreation and sporting facility, the site was used for agricultural and horticultural uses including some viticulture. In 1965 a bowling club was established adjacent to Brixton Street. This was followed by car parking facilities and tennis courts (1974), BMX track (1985), cricket nets and associated buildings and infrastructure (1995). The area of remnant wetland vegetation has not been previously cleared for other uses but given the current extent of degradation and weed invasion it is likely that it was previously used for livestock grazing and stock had an access to the wetland area.

A Water Corporation (WC) operated irrigation basin and pump station and Telstra tower are located northeastern corner of the site in the middle of the UFI wetland. A maintenance track and several “unofficial” off-road tracks traverse the area south of the wetland.

There are signs of previous earthworks with anthropogenic fill including some limestone and yellow sand and building rubble found in the upland areas on the south side of Yule Brook.

2.3 Adjacent Land Uses

The land to the north, west and south west generally remained undeveloped until approximately 1974 when it was progressively developed for residential use until about 1985. The Roe Highway, passing the site on the east, was constructed in 1981-1983. The land to the east and south east from the Highway has remained generally undeveloped with rural residential properties increasing in density over time.

2.4 Site Tenure

Site tenure is shown in **Figure 4**. The CoG owns all private lots except a number of lots overlaying the watercourses which are owned by Department of Water (DoW). There is some inconsistency between the current location of the watercourses and the actual lot boundaries of the DoW land but this has no material impact on the WMP.

2.5 Existing Environment

2.5.1 Climate

The Swan Coastal Plain has a Mediterranean climate with hot dry summers and mild wet winters. Winter precipitation varies between 600-1,000mm per year with five to six dry months per year (Beard 1990). Data obtained from the Bureau of Meteorology (BoM) nearest reporting station shows that Gosnells has an average rainfall of 909.3mm per year, with about 80 rain days in the year. Mean maximum temperatures range from 18.6°C in July to 33.1°C in February. Mean minimum temperatures range from 8.7°C in July to 18.7°C in February (BoM, 2013).

2.5.2 Regional Context

The site lies on the Swan Coastal Plain Subregion of the Drummond Botanical Subdistrict in the South West Botanical Province as described by Beard (1990). Flora composition of the Swan Coastal Plain Subregion has been described by Beard (1990) as predominantly consisting of *Banksia* Low Woodlands on leached sands with *Melaleuca* swamps on poorly drained areas and Woodlands of *Eucalyptus* spp. on less leached soils.

The regional vegetation description at Mills Park is Guildford complex which consists of open forests to tall open forests of marri-jarrah-wandoo with some woodland of wandoo. *Eucalyptus rudis* and *Melaleuca* are present as minor components (Heddle *et al.* 1980).

2.5.3 Geomorphology, Geology and Soils

The site forms part of the Perth Basin, the geological unit that extends from the southern end of the Carnarvon Basin in the north to the south coast at Cape Leeuwin. The Swan Coastal Plain (SCP) is the surface expression of a small part of the Perth Basin and characterises the Perth region and surrounds (Seddon 2004).

The Swan Coastal Plain is approximately 20 – 30km wide consisting of two sedimentary belts of different origin:

1. On the eastern side of the Swan Coastal Plain, the Pinjarra Plain has been formed from deposition of alluvial material. The Pinjarra Plain has been formed by the coalescence of alluvial fans and it is relatively fertile compared to the dune systems to the west (Seddon 2004). It is reasonably well-drained but also contains seasonal swamps (Seddon 2004).

2. On the western side, three dune systems (Quindalup, Spearwood and Bassendean) are of aeolian origin (Seddon 2004). The dune systems represent differing ages of deposition with soils at different stages of leaching and formation.

Mills Park is located on older alluvial deposits of the Pinjarra Plain and is part of the Guildford association. The soil profile comprises 15-45cm of grey sand overlaying a yellow-grey and yellow-brown mottled kalonitic sandy clay B horizon. The site is relatively flat with a general slope towards the brook and towards the south east of the site. Site elevations range from 7.5 metres Australian Height Datum (mAHD) in the north east down to 3.5 mAHD at the lowest point of the brook bed, to 5.5 mAHD near the site boundary along the south eastern portion of the site.

A soil and groundwater investigation was undertaken between 17 January and 2 February 2012 with subsequent groundwater monitoring on 17 February and 20 February 2012. This investigation was part of the *Wetland Boundary Assessment* (Cardno, 2012). A summary of the findings is as follows.

> Soil profiles are consistent with the description of the Guildford Formation.

> Upland areas on the south side of Yule Brook contained fill material including limestone, yellow sand and building rubble.

> Soils beneath 1 m typically comprised natural interbedded sandy clay, clayey sand and clay.

2.5.3.1 Acid Sulphate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils that contain iron sulfide (iron pyrite) minerals. In an undisturbed state ASS are stable and present no risk to the environment. If disturbed by construction works such as dewatering, drainage and/or soil excavation the sulfides become exposed to air and oxidise, producing sulphuric acid. This can cause potentially adverse environmental impacts and damage to infrastructure.

Cardno undertook a Preliminary Site Investigation (PSI) and Limited Sampling Assessment as part of the Mills Park redevelopment. This PSI and Limited Sampling Assessment was undertaken in conjunction with a Wetland Boundary Assessment undertaken by Cardno entitled Cardno, 2012, E11040 '*Wetland Boundary Assessment'* prepared for the CoG (Cardno, 2012).

The PSI was based on a desktop review of past and present uses of the site and the environmental, social and cultural attributes of the site and site characteristics. A site inspection was undertaken as part of the PSI in order to identify any visual indicators of contamination and to confirm findings of the desktop appraisal of the site.

The desktop investigation identified the majority of Mills Park is mapped as having a *'moderate to low risk of Acid Sulphate Soils (ASS) occurring within three metres of natural soil surface'.* An area associated with Yule Brook in the WMP study area is mapped as '*moderate to high risk*' as shown in **Figure 5**.

2.5.4 Hydrology

2.5.4.1 Groundwater

As part of the *Wetland Boundary Assessment* (Cardno, 2012), groundwater investigations were undertaken over Mills Park. A summary of the findings are as follows.

> Groundwater is shallow (<1.8 metres below ground level (mbgl), neutral-to-slightly acidic and brackish.

> Groundwater movement is in a westerly-to-south westerly direction.

> A number of analytes reported concentrations above relevant groundwater beneficial use criteria including fresh water ecosystems, long-term irrigation and/or domestic non-potable uses due to the presence of heavy metals (Cu, Zn, Mn and Fe) and nutrients (nitrates, total nitrogen and total phosphorus). These elements are known to be regionally elevated in groundwater. There is presently insufficient information available to determine the influence of land uses at Mills Park on local groundwater quality.

2.5.4.2 Surface Water

Three Water Corporation managed drains meet at Mills Park and flow through the site, which convey runoff from upstream urban catchments to the Canning River. These drains are shown in **Figure 6** and are the Woodlupine Brook Branch Drain (Woodlupine BBD), the Yule Brook Main Drain (Yule BMD) and the Brixton Street Branch Drain (Brixton SBD).

The Woodlupine BBD conveys runoff from catchments north of Bickley Road through Mills Park via a constructed drain with no riparian vegetation. This drain flows under Bickley Road via two pipe culverts. The Yule BMD enters the site via three box culverts under Roe Highway with flow conveyed through a weed infested channel to its confluence with the Woodlupine BBD. Historical aerial photography suggests this section of the drain has been realigned in the past. The Brixton SBD conveys runoff from a small catchment to the north west of Mills Park. The runoff is piped from Bickley Road, under a section of Mills Park, to an open channel drain. This small drain flows into the Yule BMD approximately 80m downstream of its confluence with Woodlupine BBD. The combined runoff from the three drains exits Mills Park under the Brixton Street Bridge.

Little has been done to the drains in terms of maintenance, with an assortment of local native and introduced aquatic and marginal plant species colonising the channel and inhibiting continued erosion. No erosion or siltation of the channel have been observed and these are not currently considered to be significant issues at the site.

Wetlands UFI No's. 7727 and 7739 (see section 4.2) are classified as Palusplain wetlands, which are described as seasonally waterlogged flats. Although wetland UFI No. 7727 is classified as a Palusplain wetland in the dataset, Yule Brook is more characteristic of a creek with seasonal flows. The remainder of the area in UFI No.7739, apart from Yule Brook and associated riparian vegetation is comprised of non-phreatophytic vegetation and is not seasonally inundated.

Active areas within the park are currently experiencing seasonal waterlogging as water drains towards the middle of the sporting grounds in some areas.

2.5.5 Vegetation

A Level 2 flora survey of remnant vegetation in Mills Park was conducted by Cardno in August and November 2009 (Cardno, 2009) in accordance with EPA Guidance Statement No. 51 – *Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia* (2004).

2.5.5.1 Vegetation Condition

The vegetation condition over the site ranges from Completely Degraded to Degraded as defined by Keighery 1994. The vegetation in the riparian zone of the WMP area is Degraded. This is defined by

Keighery, 1994 in *Bush Forever Volume 2* as “basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good without intensive management”. Although native tree species still form most of the overstorey the understorey has been removed or substantially altered.

The vegetation within the area surrounding the defined wetlands is heavily disturbed grassland with remnant overstorey and supplementary overstorey plantings. It includes active recreational areas and areas adjacent to the wetland areas which are composed of non-phreatophytic native and introduced plant species and highly modified upland areas that have no biodiversity values.

There are a number of weed species throughout the site. Some are Declared Plants under the *Agriculture and Related Resources Protection Act 1976.*

2.5.5.2 Vegetation Communities

The survey recorded three plant communities in the site as listed below and shown in **Figure 7**.

1. **MrEr** – Woodland of *Melaleuca rhaphiophylla* and *Eucalyptus rudis* over *Gahnia trifida* and *Acacia saligna* with *Watsonia meriana* var. *bulbillifera* and introduced grasses on clay loams of the riparian zone of drainage lines (**Plate 2-1**).
2. **CcAs** – Woodland of *Corymbia calophylla* over *Acacia saligna* and *Watsonia meriana* var. *bulbillifera* with *Ehrharta calycina* on brown loamy sands.
3. **MrVj** – Low woodland of *Melaleuca rhaphiophylla* and *Viminaria juncea* over introduced grasses on seasonally wet black clay loams.

The understorey vegetation in the WMP portion of Yule Brook is Completely Degraded (**Plate 2-2** and **Plate 2-3**). The remaining mature eucalypt and *Melaleuca* overstorey provide some fauna habitat and visual amenity value.

A Naturemap search undertaken for the locality indicated that five Threatened Ecological Communities (TECs) have been recorded close to the site. One vegetation community, CcAs, showed some similarity to Gibson‟s FCT 3c – *Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands. This community was mapped as degraded in the site survey and is not considered to reflect FCT 3c ecological values.

In most Australian vegetation communities the majority of floristic diversity occurs in the understorey. As the understorey degrades the remnant vegetation loses its statistical correlation with the intact community. In the case of Mills Park where all (or mostly all) understorey species have been lost, the remaining few overstorey species have a low statistical correlation with (what would have once been) the original community.

A search was conducted of the DEC Declared Rare Flora (DRF) or Priority Flora (PF) databases to identify species potentially occurring in the vicinity of the site. No DRF or PF were recorded in the site survey.

No Bush Forever areas are situated in the site. The nearest Bush Forever site to Mills Park is the Brixton Street Wetlands, situated to the east of the Roe Highway. The redevelopment of Mills Park will have no adverse impact on the Brixton Street Wetlands, being upstream and well separated by the Highway road reserve.

Plate 2-1 Woodland of *Melaleuca and Eucalyptus over weed* dominated understorey (November, 2011)

Plate 2-2 Yule Brooke drainage channel, showing *Melaleuca* overstorey with grass and weed dominated understorey (November, 2011)

Plate 2-3 Weed dominated understorey in the *Melaleuca* woodland (October, 2012)

2.5.5.3 Weeds

A total of 51 introduced (weed) species were recorded within the site representing 65% of the total number of recorded species. Common weed species observed were *Eragrostis curvula* (African Love Grass), *Ehrharta calycina* (Perennial Veld Grass), *Watsonia meriana* var. *bulbillifera* and *Fumaria capreolata* (White flowered Fumitory). Four of the recorded weed species are 'Declared' plants under the *Agriculture and Related Resources Protection Act 1976* (ARRP Act 1976) including *Asparagus asparagoides* (Bridal Creeper) Category P1, *Gomphocarpus fruticosus* (Cotton Bush) P1, *Moraea flaccida* (Cape Tulip) P1 and *Zantedeschia aethiopica* (Arum lily) P1 and P4. The definitions of the declaration categories P1 and P4 for plants under the ARRP Act are as follows:

P1 Introduction of the plant into, or movement of the plant within, an area is prohibited.

P4 Spread of plant beyond where it currently occur's to be prevented.

The presence of the P4 plant, *Zantedeschia aethiopica* therefore has implications for management of the site. Proponents are under a legal obligation to:

> prevent spread of seed or plant parts within and from the property;

> treat to destroy and prevent seed set of all populations within the site; and

> develop and implement a weed management plan.

2.5.6 Fauna

A Level 1 fauna survey was conducted at the site in September 2009 by Greg Harewood on behalf of Cardno (Greg Harewood, 2009). Methods were in accordance with EPA Guidance Statement 56 (2004) consisting of a desktop assessment and a preliminary field survey.

Evidence of one listed threatened species was observed (Forest Red tailed Black Cockatoo – old foraging evidence). Evidence of a DEC priority species was seen (Southern Brown Bandicoot – diggings within vegetation bordering Yule Brook). Yule Brook and associated surrounding vegetation was recognised as an area that provided habitat for native fauna species in a largely cleared landscape.

Carter's freshwater mussel (*Westralunio carteri),* which is endemic to the South West of Western Australia, has been recorded from sites downstream of Mills Park as well as from the section of Yule Brook which traverses the site.

During the survey, a number of introduced fauna species were recorded at the site. These include Domestic Pigeon, Spotted Turtle-Dove, Laughing Kookaburra, Turtle-Dove, Rainbow Lorikeet and Mosquito fish. In addition to these confirmed sightings, it is likely the site also provides habitat for other introduced species such as Mallard, House Mouse, Black Rat, Dog, Red Fox, Cat and Rabbit.

Yule Brook and Woodlupine Brook contain populations of Mosquito fish (*Gambusia holbrooki*). Originally introduced to control midge and mosquito larvae in freshwater and brackish wetlands this fish has become a pest. It displaces local native fish species such as the Western Pygmy Perch (*Edelia vittata)* and predate on aquatic frog spawn and tadpoles. It is declared 'Noxious' across Australia.

2.5.7 Ecological Linkages

Regional biodiversity linkages have been identified by the State Government in Bush Forever (Government of Western Australia 2000), Perth's Greenways and the System 6 study and supported by the WA Local Government (WALGA and PBP 2004). The designed linkages are aimed to conserve and enhance regional biological linkages and reflect the on-ground linkages throughout the Perth Metropolitan area. The riparian vegetation along Yule Brook was identified as a Greenway in Bush Forever Volume 1 (Government of Western Australia 2000) but is not part of a recognised Regional Biodiversity Linkage (Del Marco et al. 2004).

2.5.8 Plant Disease

No dieback (*Phytophthora cinnamomi*) or *Armillaria* surveys have been undertaken in the site, and so it is unclear if these plant pathogens are present in the wetland areas. However, observations on site have not revealed signs of plant diseases or large areas of dead trees.

2.5.9 Fire

No sign of recent fire has been observed in Mills Park. Charred trunks of large Eucalypts in the wetland indicate that fires have previously occurred in the park (**Plate 2-4**). The site supports a high fuel load, largely as a result of dense annual grass weed infestation.

Plate 2-4 Signs of past fire activity in the wetland

2.5.10 Non-Indigenous Heritage

A search of the Heritage Council of Western Australia's (HCWA's) database (2006) found no areas at the site that have recorded European significance (HCWA, 2013).

2.5.11 Aboriginal Heritage

An online search of the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System (DIA, 2013) that incorporates both the Heritage Site Register and the Heritage Survey Database was undertaken.

The search indicated that there are no Aboriginal Heritage Sites in or directly around the site. The search did identify one 'other heritage place' within 100 m to the north east of the site. This feature is reported as being "Yule Brook Farm" and is recognised as having archaeological significance. DIA is currently assessing the status of the feature.

2.5.12 Community Use and Access

Mills Park is a heavily utilised public sporting and recreational facility however the remnant wetland in the site is generally not used by Gosnells residents. At present access to the wetland is largely uncontrolled and there is evidence of frequent rubbish dumping in bushland areas adjacent to the RE wetland (**Plate 2-5**).

Plate 2-5 Rubbish Dumping (December, 2012)

3 Proposed Development

3.1 General

The overall Mills Park Master Plan aims to redevelop the active and passive public open spaces of Mills Park. Key elements proposed in the Master Plan include one cricket oval, two soccer fields, six tennis courts, two lawn bowls greens, one senior Australian Rules football field plus two junior football fields. It will also include a new pavilion and cafe building, picnic grounds, play spaces and car parking areas as presented in **Figure 8**.

3.2 Proposed Development within the Wetland

The main community infrastructure will be constructed outside the wetland boundaries and buffer areas. However, small scale structures and community assets have been proposed in or close to the wetland. The majority of these structures are located within the 50 m wetland buffer area as previously shown in **Figure 8.**

The proposed works contained within the mapped wetland are detailed in the **Figure 9** and include the following.

> Upgrade the existing bridge crossing across the Yule Brook and path to improve connectivity through the Mills 1 Oval (*Australian Rules Football (AFL) and Cricket Ovals)* and Mills 2 Oval *(AFL and Cricket Oval)* on southern part of the wetland.

> Construct a new pathway and bridge crossing across the northern section of Yule Brook to link the area with the rest of Mills Park.

> Construct a hard surface road and car park to the southern part of the wetland that partly intersect with the wetland boundary.

> Upgrade the existing maintenance track to the Telstra tower.

> Upgrade the existing walking path from the existing tennis courts to the Telstra tower.

It is proposed to realign Woodlupine BBD and the southern section of the Yule BMD and pipe a section of Yule BMD. These drains will be modified and landscaped with local native riparian species to enhance biodiversity and amenity values

The Master Plan also proposes a ‘Nature Play’ construction, where an area is located within the WMP boundary near an existing path between the AFL and cricket ovals. This feature will include balancing logs, stepping stones, and elements which encourage children to be educated about the wetland. Interpretive signage will be installed at various points in the WMA to highlight points of interest and assist in educating visitors on the importance of wetlands. The location, design and content of interpretive signage will be determined at a later stage in collaboration with the CoG. Signage will also be erected at identified revegetation sites advising of the work being undertaken.

3.3 Stakeholder Consultation

The CoG has undertaken its own internal and external stakeholder consultation process as part of the Mills Park Master Plan project. **Table 3-1** provides a summary of consultation undertaken.

Table 3-1 Stakeholder Consultation

Date	Meeting	Purpose
18-Jun-09	Councillor Workshop	Master planning process explained
15-Jul-09	Councillor Workshop	Updates and progress reporting
20-Apr-10	Councillor Workshop	Updates and progress reporting
22-Apr-10	Club Questionnaire	Sent to 11 clubs
07-May-10	Community Questionnaire	Sent to residents within a 200m radius (approx. 400 homes)
22-Jun-10	Councillor Workshop	Updates and progress reporting
29-Jun-10	Youth consultations	Beckenham Primary School workshop, Holiday Program sessions, youth workshop
11-Aug-10	Community Workshop	To gather information pertaining to the community's and Councillors priorities for the future development at Mills Park.
19-Oct-10	Councillor Workshop	Councillor and community workshop updating progress
30-Jun-11	Community Workshop	Present concept plan for comment to user and community representatives
13-Feb-12	Community and Councillors	Master Plan updates
20-Jun-12	Councillor Workshop	Cardno and staff presentations
24-Jul-12	Community and Councillors	Master Plan updates
18-Sep-12	Councillor Workshop	Cardno and staff presentations
22-Nov-12	Beckenham Community Centre	Presentation of draft concept plan for comment
29-Nov-12	Club Consultation	Presentation of draft concept plan for comment

During public meetings a common view expressed by the community is that redevelopment options should include retention of remnant trees and vegetation and rehabilitation and expansion of natural areas where possible.

4 Site Wetlands

4.1 Wetlands Management

Much of the Swan Coastal Plain's surface was once defined by wetland environment (V & C Semeniuk 1987). Since European settlement over 70% of these wetlands have been filled, drained, mined and cleared of vegetation for growth and development (Halse 1988). The remaining wetlands fringing and within urban and rural areas are under continued threat from vegetation clearing, grazing, flooding, organic and metal contamination, nutrients enrichment and groundwater extraction (Townley *et al*. 1993).

Wetlands in Western Australia have been defined locally as "areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or otherwise, fresh and saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries (Wetlands Advisory Committee 1977). This definition has been adopted by Semeniuk (1987) and by V & C Semeniuk Group for the purposes of wetland mapping and classification on the Swan Coastal Plain (Hill et al. 1996).

The DEC maintains the Geomorphic Wetland Swan Coastal Plain dataset which categorises individual wetlands into specific management categories as described in **Table 4-1**. This dataset is periodically updated when site-specific wetland surveys provide new and relevant information.

Table 4-1 Wetland Management Categories

Management Category	Description of Wetland	Management Objectives
Conservation (CC)	Wetlands which support high levels of attributes and functions.	To preserve wetland attributes and functions through reservation in National Parks, Crown Reserves, State owned land and protection under environmental protection policies.
Resource Enhancement (RE)	Wetlands which have been partly modified but still support substantial functions and attributes.	To restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in Crown Reserves, State or Local Government owned land and by environmental protection policies, or in private property by sustainable management.
Multiple Use (MU)	Wetlands with few attributes, which still provide important wetland functions.	Use, development and management should be considered in the context of water, town and environmental planning through land care.

Source: (Western Australian Planning Commission 2005).

Each wetland listed in the Geomorphic Wetland Swan Coastal Plain dataset is given a Unique Feature Identifier (UFI). However in the case of large wetlands that have undergone a degree of disturbance, a separate management category may be assigned to parts of the wetland in order to reflect the current values.

4.2 Site Wetlands Definition

Figure 10 shows four wetlands currently mapped in the DEC Geomorphic Wetland Swan Coastal Plain Dataset occurring in Mills Park. These are:

UFI 15254	Multiple Use (MU)
UFI 7727	Resource Enhancement (RE)
UFI 7739	Resource Enhancement (RE)
UFI 7741	Resource Enhancement (RE).

In the course of preparing the Master Plan for Mills Park an application to amend the DEC dataset was submitted to DEC in 13 April 2012. The application was prepared in accordance with the Protocol for Proposing Modifications to the Geomorphic Wetland Swan Coastal Plain dataset (DEC 2007). The objective of the supporting report to the application was to gather all relevant information concerning UFI 7727 and UFI 7739 and propose amendment of the boundaries of these wetlands to accurately reflect on-ground conditions as pictured in **Figure 11**.

The DEC response to this application was to not accept the boundary amendment proposal as shown in **Figure 11** but to increase the extent and boundary of RE wetland UFI 7727 to include parkland cleared areas containing remnant wetland trees and areas of established revegetation works along the Roe Highway interface as illustrated in **Figure 12**. The balance of the area of Mills Park remains as MU wetland. This change to the wetland boundaries has not yet been updated in the DEC dataset.

The implication is that this WMP has been prepared to manage a portion of Mills Park that conforms to the amended DEC RE wetland boundary and the associated 50 m buffer required by DEC as previously shown in **Figure 2**. Rehabilitation of the full extent of the 50 m buffer zone is not practically achievable in the context of existing and proposed active sports areas and associated infrastructure described in **Figure 8**.

5 Wetland Management Plan

This WMP has been prepared for the sole purpose of protection and enhancement of the identified wetland areas on site. It relates to two Resource Enhancement (RE) wetlands, UFI 7727 and UFI 7739 and associated wetland buffer area that is categorised as Multiple Use (MU). The following section summarises the legislative context and assesses the risks of the proposed works at Mills Park that may have an impact on the wetland and associated buffer areas.

5.1 Legislative, Policy and Guideline Context

5.1.1 State Government

Development of this WMP has been based on State Government documents which outline the importance of wetlands and guide the strategic management of wetlands including:

> Government of Western Australia 1997, Wetlands, Conservation Policy for Western Australia;

> Environmental Protection Authority (EPA) 2004, Environmental Protection Authority Position Statement No. 4 *Environmental Protection of Wetlands*;

> WAPC 2005, Guidelines for the Determination of Wetland Buffer Requirements;

> Department of Environment and Conservation 2007, Protocol for proposing modifications to the 'Geomorphic Wetlands Swan Coastal Plain;

> Department of Environment and Conservation 2008, Guidelines checklist for preparing a wetland management Plan; and

> Environmental Protection Authority 1993, A Guide to Wetland Management in the Perth and Near Perth Swan Coastal Plain Area, Bulletin 686.

The EPA Position Statement No. 4 outlines a number of principles for the environmental protection of wetlands including:

> Ecologically Sustainable Development;

> The "wise use" of wetlands;

> An ecosystem management approach;

> Inter-generational equity; and

> The precautionary principle.

Reference was also made to documents which provide information on the management of wetlands and buffers including the EPA's Guidance Statement No. 33 for Planning and Development (EPA 2009) and the DEC's Guidelines Checklist for Preparing a Wetland Management Plan (DEC 2008). Both these documents describe the intent of a WMP as being to maintain, if not improve the values of the wetland in accordance with EPA's policy in its position statement No.4. The DEC guidelines also specify the required information and content of a WMP, and this guidance has been used in the development of this WMP.

In addition to these guidelines, there are additional documents that have been considered during the preparation of this WMP including:

> Planning for Bush Fire Protection Edition 2 (Western Australian Planning Commission and Fire and Emergency Services Authority 2010) and

> River Restoration Manual (Water and Rivers Commission 2001).

5.1.2 Local Government

The CoG does not have any existing management plans specifically related to Mills Park. However, there are a number of documents produced by the CoG which contain information and recommendations relevant to the site. These include:

> CoG's Biodiversity Conservation Management Plan (2010). This plan prioritises Local Natural Areas (LNAs), or bushland and wetland areas to be managed for their biodiversity values. Mills Park is not listed as one of the City's current priority biodiversity assets.

> The Bickley Brook Urban Waterways Renewal Project, a partnership between the state and federal governments, the City of Gosnells and the South East Regional Centre for Urban Landcare (SERCUL), has established rehabilitation sites that provide working models of restoration and management of a degraded watercourse to enhance environmental values and wetland processes.

5.2 Relevant Documents

A number of other documents and studies have been undertaken over Mills Park that provide relevant background information for the WMP. The documents have not been specifically included in the WMP, but are available from the CoG upon request. The documents include:

> Cardno's full proposal for the Master Plan conceptual design as approved by the CoG in February 2012. The Master Plan provides a functional design to optimise the sporting and recreational uses of the site and aims to enhance site's environmentally sensitive areas. Details of the design and features are to berefined during the subsequent stages of the project.

> Hydrological, flora, vegetation and fauna surveys that were undertaken between 2009 and 2011 to provide environmental background information for the site and determine wetland and biodiversity values as part of the Master Plan process.

> A detailed site investigation (DSI) for contaminated soils and acid sulphate soils (ASS). Investigations were undertaken across Mills Park in 2009 to identify potential issues associated with the proposed realignment of the Yule Brook that may disturb natural soils with potential ASS.

5.3 Potential Impacts

The redevelopment of the Mills Park involves demolition, construction and rehabilitation works conducted on site. These activities may have an impact on the wetland management area during and after the works. Based on the DEC's Guidelines Checklist for Preparing a Wetland Management Plan (DEC 2008), the baseline information presented in this report and the Master Plan developed for Mills Park, the following potential risks to the wetland management area have been identified that may arise during implementation of the Master Plan:

> Disturbance of acid sulphate soils;

> Hydrological impacts and erosion;

> Chemical and fertiliser use;

> Clearing of native vegetation;

> Weed infestation;

> Impact on native fauna populations;

> Disturbance of ecological linkages;

> Introduction of plant disease and pathogens;

> Increased risk of fire;

> Disturbance of heritage places; and

> Restriction of community use and access.

5.3.1 Disturbance of Acid Sulphate Soils

An area associated with Yule Brook in the wetland study area is mapped as 'moderate to high risk' of containing potential ASS. No significant excavations are planned as part of the proposed wetland works that would require excavation to a depth of more than 3 m to disturb or result in exposure of large quantities of potential ASS. No specific management measures are therefore proposed.

5.3.2 Hydrological Impacts and Erosion

To implement the CoG Master Plan for Mills Park it is proposed to realign Woodlupine BBD and the southern section of the Yule BMD and pipe a section of Yule BMD. The reconstruction of existing drains as part of water management has the potential to generate changes to existing drainage regiems, erosion and sedimentation issues.

The construction of additional bitumen road surfaces, car parks, structured and artificial playing fields within Mills Park has the potential to result in the generation of additional stormwater runoff that will potentially contain elevated concentrations of nutrients, heavy metals and organic compounds.

5.3.3 Chemical and Fertiliser Use

An application of herbicide product will be necessary to control weed invasion within the wetland.

CoG is currently conducting regular maintenance on the active areas of Mills Park including moving, sweeping, weed control and fertilising using a granular fertiliser, folar fertiliser, wetting agent and ammonium sulphate ($(NH_4)_2SO_4$). The application of herbicide and fertiliser products has the potential to impact water quality downstream application area.

5.3.4 Clearing of Native Vegetation

The Mills Park Master Plan has been prepared to minimise additional disturbance of remnant native vegetation at the site. However, removal of some isolated trees will be required to facilitate construction of access routes, car parks and relocation of playing fields. These trees consist of mature paperbark (*Melaleuca raphiophylla*) and mature and immature marri (*Corymbia calophylla*). **Figure 14** shows the location where individual trees or vegetation is to be removed.

5.3.5 Weed Infestation

The areas of mapped wetland are at present heavily weed invaded with an assortment of weeds. This heavy weed growth is supressing the regeneration of local native wetland species and poses a significant bushfire hazard.

5.3.6 Impact on Native Fauna Populations

Yule Brook provides a source of fresh water for native birds as well as habitat for amphibians and waterbirds. The existing weed dominated understory in the wetland, while retarding native vegetation still provides refuge for fauna species. During implementation of the plan and in-stream works there is likely to be a short term impact on fauna habitat. This is especially relevant for Carter's freshwater mussel (*Westralunio carteri*) which is known to occur downstream of the site in the section of Yule Brooke between Albany Highway and the Kenwick Link.

Yule Brook and Woodlupine Brook contain populations of mosquito fish (*Gambusia holbrooki*). The species has the potential to displace local native fish species and predate on aquatic frog spawn and tadpoles.

5.3.7 Disturbance to Ecological Linkages

The wetland area is not a part of the recognised Regional Biodiversity Linkage. Proposed works do not increase the habitat fragmentation and no specific management measures are therefore proposed.

5.3.8 Introduction of Plant Disease and Pathogens

Soil borne pathogens, dieback (*Phytophthora cinnamomi*) and honey fungus (*Armillaria luteobubalina*) have the potential to significantly alter the structure of vegetation communities, causing the death of habitat trees and, in the case of *Phytophthora*, eradicating susceptible species. It is unclear whether these pathogens are present on site, but no signs of plant diseases or large areas of dead trees have been observed. No specific management measures are therefore proposed other than monitoring of overall vegetation health.

5.3.9 Increased Risk of Fire

The wetland areas and the surrounding woodland are currently heavily invaded by dense, perennial weed infestations and support a high bush fire fuel load.

5.3.10 Disturbance of Heritage Places

No Aboriginal or European heritage sites exist at the site. No specific management measures are therefore proposed.

5.3.11 Restriction of Community Use and Access

At present, the WMP area in Mills Park has little practical value to the local and broader Gosnells community. The area is situated well back from the main active facilities and remains in a largely unmanaged state. Presently it is possible for unauthorised vehicles to easily enter the wetland area via unfenced roadways and car parks.

Some of the features proposed in the Master Plan are located within the wetland and have the potential to result in loss of vegetation and biodiversity.

5.4 Risk Assessment

Cardno has conducted a risk assessment based on an understanding of the existing environment and the works that will be undertaken. The outcome of the risk assessment is captured in **Table 5-1.**

The risk assessment process involved an assessment of the proposed redevelopment to identify the potential sources of risk to the wetland environment. Each risk was then quantitatively assessed against likelihood and consequence to determine a rank, and hence management criteria. The environmental risk assessment process followed the steps summarised below.

Step 1: Assessment of the potential occurrence of the event

The likelihood of each event occurring was assigned a level based upon the nature of the activities being undertaken.

Level	Likelihood	Description
1	Rare	Very unlikely / May occur only in exceptional circumstances
2	Unlikely	Known to have occurred in a similar environment
3	Probable	The event will probably occur, or has occurred under some conditions (e.g. yearly)
4	Likely	The event is expected to occur under some conditions or has occurred more than once at the site in recent years (e.g. weekly/monthly)
5	Almost certain	The event is a common or frequent occurrence or an ongoing impact (e.g. daily)

Step 2: Assessment of the consequence of the event

The environmental consequence if each event occurred was assessed based upon the nature of the proposed works and potential risk event identified for the site.

Level	Consequence	Description
1	Insignificant	Confined to immediate area, no environmental damage
2	Minimal	Confined to isolated area, minimal environmental impact.
3	Moderate	Impact confined to the site, moderate environmental impact.
4	Major	Impact extends beyond site boundary, major environmental impact.
5	Catastrophic	Impact extends beyond site boundary, severe environmental impact, requires ongoing resources.

Step 3: Assessment of the overall risk posed by the event

Each risk event is assigned an overall level risk which is determined as a factor of the probability of the event occurring and the environmental consequence if the event occurred. The overall level of risk indicates the extent of management requirements.

		CONSEQUENCE				
		1	2	3	4	5
LIKELIHOOD		Insignificant	Minor	Moderate	Major	Catastrophic
5	Almost certain	5	10	15	20	25
4	Likely	4	8	12	16	20
3	Moderate	3	6	9	12	15
2	Unlikely	2	4	6	8	10
1	Rare	1	2	3	4	5

- Extreme risk; immediate action required
- High risk; senior management attention needed
- Moderate risk; management responsibility must be specified
- Low risk; manage by routine procedures

Based upon the risk assessment matrix provided above, a risk assessment rating of 6 or more (moderate risk) is considered to require a more detailed review of the proposed management procedures and is discussed further in **Section 5.5**. The extent of the review and control mechanisms will increase as the level of risk increases. Environmental risks classified as “Low Risk” during the risk assessment are considered manageable by the routine procedures and no further discussion of requirements to mitigate these potential issues is provided.

Table 5-1 provides an assessment of wetland risks in accordance with the above criteria.

Table 5-1 Risk Identification and Inherent Risk Rating

Risk Identification and Analysis			Inherent Risk Rating			Management Strategy
Risk Issues (Source/Event)	**Potential Causes**	**Potential Impacts**	**Likelihood**	**Consequence**	**Risk Rating**	**Management Measures**
Disturbance of ASS	Excavation of soils	Exposure of potential ASS	1	2	3	Proposed works are unlikely to disturb potential ASS. No specific management measures required as per **Section 5.3.1**.
Hydrological impacts and erosion	Changes to wetland hydrology	Altered flow regimes	3	3	9	Management measures required
	Realignment of drains within the wetland buffer	Erosion and sedimentation	3	3	9	Management measures required
	Construction of artificial surfaces	Increased stormwater runoff	4	3	12	Management measures required
Chemical and fertiliser use	Application of herbicides	Deterioration of wetland environment	2	3	6	Management measures required
	Application of fertilisers	Increased nutrient load downstream	3	3	9	Management measures required
Clearing of native vegetation	Removal of isolated trees and other vegetation	Reduced biodiversity and habitat for fauna	5	2	10	Management measures required
Weed infestation	Lack of weed management on site	Weed infestation and loss of native species	5	3	15	Management measures required
Impact on native fauna populations	Realignment of water courses within the wetland buffer	Erosion and sedimentation	3	2	6	Management measures required
	Removal of isolated trees and other vegetation	Reduced biodiversity and habitat for fauna	5	2	10	Management measures required

Disturbance of ecological linkages	Construction works	Increase in habitat fragmentation	1	4	4	Proposed works do not increase habitat fragmentation. No specific management measures required as per **Section 5.3.7**.
Introduction of plant disease and pathogens	Spread of soil borne pathogens	Death of habitat trees and other plants	2	2	4	No signs of plant disease or large areas of dead trees. No specific management measures required as per **Section 5.3.8.**
Increased risk of fire	High bush fire load as a result of weed infestation	Bush fire	3	4	12	Management measures required
Restriction of community use and access	Proposed features in wetland	Loss of vegetation and biodiversity	3	3	9	Management measures required
	Lack of management on site	Antisocial behaviour Unauthorised access	4	3	12	Management measures required

5.5 Management Objectives

The key objectives of the Mills Park WMP are to:

> Delineate and rehabilitate the RE wetland area;

> Delineate, rehabilitate and manage the associated buffer areas (MU wetland) according to the proposed land use;

> Control environmental weeds;

> Re-establish wetland understorey vegetation along Yule Brook;

> Replant local native trees;

> Implement fire hazard reduction measures;

> Provide controlled passive recreation opportunities via pedestrian/public access to the wetland areas; and

> Mitigate potential impacts from adjacent land uses.

The RE wetlands have remained unmanaged for some time. Preparation and implementation of the Mills Park Master Plan provides an opportunity to undertake management activities and enhance the environmental values of this wetland area and associated buffers.

The WMP will focus on the approximate 19.5 ha area shown in **Figure 2.** This area incorporates the area of mapped RE wetland identified by the DEC Wetland Branch (5.1 ha) as well as the area which falls within the 50 m buffer which does not conflict with existing or approved land uses (14.4 ha).

5.6 Management Zones

The Wetland Management area has been divided into a number of zones to compartmentalise management actions. These zones are broadly based on the current and proposed land use and vegetation types identified in the flora survey and are shown in **Figure 14 and Table 5-2**.

The plan proposes management broadly split into three zones:

1. First zone includes the RE wetland area comprising the remnant *Melaleuca raphiophylla-Eucalyptus rudis* vegetation, remnant *Corymbia calophylla, Acacia saligna* woodland and previously disturbed area along the Roe Highway and is divided into three zones, Wetland Zones A-C**.** Management actions generally aim to control invasive weeds, re-establish wetland understorey and overstorey vegetation and implement fire control measures.
2. Second zone comprises disturbed, unfertilised parkland area within the 50 m buffer around the RE wetland categorised as MU wetland with specimen endemic trees (Buffer Zone 1). Management actions generally aim to provide a biological buffer between RE wetland and adjacent land uses and improve wetland values as a part of the greater Mills Park redevelopment.
3. Third zone comprises active areas within the 50 m buffer around the RE wetland with playing and sporting fields, and existing and proposed infrastructure and small scale structures (Buffer Zone 2). Management actions generally aim to maintain the area so that it is suitable for the purpose without adversely impacting the RE wetland areas.

The intent of these zones is to divide the wetland into practical management areas in which restoration activities can be undertaken by the CoG in a staged manner.

Table 5-2 Management Zone Objectives

Management Zone	Area (ha)	Wetland Management Category	Primary Management Objective
A	2.8	RE	Rehabilitate and enhance *Melaleuca raphiophylla-Eucalyptus rudis woodland* through weed control and establishment of native understorey species.
B	1.1	RE	Rehabilitate and enhance *Corymbia calophylla, Acacia saligna, Melaleuca raphiophylla* and *Viminea juncea* woodland through weed control and establishment of native understorey species.
C	1.2	RE	Rehabilitate and enhance areas through weed control and revegetation of native species. Selective increase in native understorey.
1	2.9	MU	From a defined boundary edge, establish a native parkland buffer to the core wetland area through weed control and establishment of native understorey species. Area will be rehabilitated with a landscape aesthetic and with an aim to reduce the edge effect impacts of active areas to the wetland. Installation of small-scale structures and community assets to improve the recreational value of the area as per the Master Plan.
2	11.5	MU	Rehabilitate and enhance a well-maintained active area for recreation. Installation of structures, community infrastructure and community assets to improve the recreational value of the area as per the Master Plan.

It is anticipated works will be staged over a series of years to reflect budgetary and resource constraints. The likely staging of the project is shown in **Table 1-1**.

5.7 Performance Targets

Table 5-3 summarises management commitments and performance targets for the WMP. Further detail on these management and monitoring commitments is provided in the following sections.

Table 5-3 Management Commitments and Performance Targets

Issue	Management Commitment	Performance Target
Erosion	Erosion is managed in accordance with a sediment and erosion control plan.	Turbidity and erosion in the buffer zone caused by the realignment works is controlled.
Surface water flows	Re-contour and improve the existing drains and maintain the existing wetland flow regimes. Bio-retention swales are installed along the wetland boundary.	Maintenance of the hydrology of wetland areas. Direct drainage off sports fields and car parks is infiltrated on site within bio-retention swales prior to entry into the wetland.
Chemicals and fertilisers	Application of fertilisers is managed in accordance with a fertiliser plan. Chemical usage is managed in accordance with a chemical control plan. Bio-retention swales are installed along the wetland boundary.	Direct drainage off sports fields and car parks is infiltrated on site within bio-retention swales prior to entry into the wetland.
Weed control	Weed control is managed in accordance with a weed management plan.	Controlled use of chemicals and fertilisers. Weeds species comprising less than 20% groundcover in 10 years.
Revegetation	The identified areas are actively rehabilitated in accordance with a staged rehabilitation plan. Plants are only used from the revegetation species list in this WMP.	80% survival (species diversity and stems) of planted trees and shrubs after 1 year. 75% survival after 3 years.
Fauna	The identified areas are actively rehabilitated in accordance with a staged rehabilitation plan. Woody debris will be installed to provide fauna habitat.	Improvement of fauna habitat.
Bushfire control	Bushfire risk is actively managed in accordance with a fire management plan. Fire burden is reduced through weed control. Access for fire control is provided and other bushfire control measures are installed to the wetland interface.	Reduction in fuel load (weeds species comprising less than 20% groundcover in 10 years) and improved access for fire management and suppression. Fire rating classed as acceptable by local fire control officers.
Community use and access	Wetland area is developed as per the Master Plan. Any proposed works are managed in accordance with a construction management plan. Access to wetland areas as per a wetland access management plan.	Positive community feedback on WMP area and community use.

5.8 Management Measures

5.8.1 Surface Water Flows and Erosion

The portion of Yule Brook that is in the WMP area enters Mills Park from the northeast. It is therefore upstream of the majority of the works proposed in the Master Plan. This reduces the risk of direct or indirect impact to the WMP area from works associated with the Master Plan. The reconstruction of the drains downstream of the wetland is to be done in a manner that does not alter the hydrology of the wetlands and to maintain the existing flow rates as far as practicable. The existing weed-invaded drains are to be re-contoured to create a more gently sloping embankment on which local native riparian and wetland species can be planted to act as natural filtration and provide fauna habitat.

Prior to commencing the in-stream works in the wetland buffer area a sediment and erosion control plan is to be prepared and approved by the CoG.

The current overland flow patterns on site are to be maintained to ensure the flows to the wetland are maintained as per the existing system. Water sensitive urban design (WSUD) principles shall be implemented along the wetland boundary, and direct drainage from the sports fields and car parks is to be diverted through bio-retention swales or over vegetation strips to strip out nutrients, hydrocarbons and metals prior to entry into the wetland. No treatment of water is to be undertaken from the passive recreation spaces.

Potential monitoring requirements for the treatment system are to be detailed in the site drainage strategy, if required.

5.8.2 Chemical and Fertiliser Use

Application rates of fertilisers are likely to be reduced during and after the redevelopment of Mills Park as some of the grassed areas will be replaced with artificial turf, minimising the impacts downstream from the application areas.

It is unlikely that fertiliser applied during the drier months (October to April) will become sufficiently mobile to migrate to drainage lines. In the absence of regular rainfall during this time, applied fertiliser will likely be watered in using irrigation. This controlled water application would be insufficient to allow significant runoff of dissolved nutrients. For fertiliser application during the wetter months, the risk of dissolved nutrients entering the wetland in stormwater runoff increases. To control the nutrient load into the wetland, bio-retention swales are to be installed along the wetland boundary to filter direct drainage from the sport fields and car parks.

A fertiliser plan is to be developed to minimise impact to the wetland. The plan is to specify application rate, time and types of fertiliser to be used in active areas.

Application of herbicide products is necessary to control weed infestations within the wetland. The herbicide product chosen for weed control activities shall be those developed specifically for use in and around sensitive wetland sites, in order to minimise potential off-target impacts. Details of requirements for weed control are further discussed in **Section 5.8.4.1**.

Extra care is to be taken when chemical products are applied in close proximity to the wetland area. A chemical control plan is to be prepared and approved by the CoG to specify application times, areas and types of chemicals used in the wetland and adjacent land.

5.8.3 Clearing of native vegetation

Areas of proposed clearing within wetland and buffer areas are shown in **Figure 13** and approximate 0.04 ha. Site investigation and aerial photography (**Figure 3**) show that the areas to be cleared are already highly

disturbed with existing tracks traversing the area. Considering the size of the proposed clearing and the degraded nature of the area, it is unlikely a separate clearing permit is required. Confirmation is to be sought from DEC once the exact extent of clearing is surveyed on site.

During construction works in and around the WMP area care is to be taken to avoid damage to native vegetation. Temporary fencing shall be erected around areas of vegetation to be retained. Conservation areas are to be clearly delineated with flagging tape prior to entry of any machinery and movement of subcontractor vehicles in the site is to be overseen by construction supervisors, whether Local Government or private sector. Any trees proposed for removal are to be used as woody debris and installed to provide temporary refuge and long-term additional habitat for terrestrial fauna.

To manage any clearing of native vegetation, a vegetation clearing plan is to be prepared and approved by the CoG, and DEC, if required.

5.8.4 Weed Control and Revegetation

The re-establishment of natural wetland vegetation communities, enhancement of natural wetland processes and enhancement of habitat are among the key objectives of the WMP.

The vegetation condition of the site ranges from Completely Degraded to Degraded. Although native tree species still form most of the overstorey, the understorey has been removed or substantially altered through historic land use and weed invasion. Significant weed control effort is required to eradicate or control weeds to enable revegetation works to be successful in the long term. This process may take years.

5.8.4.1 Weed control

All care should be taken to avoid any remnant understorey species and tree samplings in weed control works which could be potentially protected and retained. While the blanket application of glyphosate based herbicide will effectively control the majority of weeds present in the WMP area, there are some weed species present which require more specific control actions as follows.

The recommended method of control for **giant reed (*Arundo donax*)** is to mechanically or manually slash the tall, woody canes, then treat the resulting regrowth with concentrated herbicide. Once the emerging shoots attain a height of between 50 and 100cm, they should be re-cut and a concentrated Glyphosate based herbicide applied. It is recommended that cutting be undertaken at the end of winter while the plant is not actively growing, to encourage vigorous regeneration during spring.

A number of **woody weeds** have also been identified from the REW and its buffer, including the highly invasive Japanese or Brazilian pepper (*Schinus terebinthifolius*), river red gum (*Eucalyptus camaldulensis*), Sydney wattle (*Acacia decurrens*) and showy honey-myrtle (*Melaleuca nesophila*). These plants are to be controlled through the cutting and painting of stems with a concentrated herbicide solution during the spring growing season. Further, basal barking where Garlon or similar herbicide will be added by brush to the external bark layer of the woody weed will be applied. Biomass from large trees can be left standing to provide habitat.

The bulrush (*Typha orientalis*) in Yule Brook and Woodlupine Brook drainage lines is to be treated by 'wiping' the foliage with a solution of Roundup Biactive® (360 g/L) at 13 ml/L.

Narrow leaved cottonbush (*Gomphocarpus fruticosus*) present on site can be successfully controlled through the hand-pulling of mature plants coupled with appropriate disposal and the spraying of Glyphosate-based herbicide of juvenile plants.

The use of metsulfuron methyl is recommended for the control of aquatic and marginal weeds, such as **fools water cress (*Apium nodiflorum*)** growing within the drainage channel, to minimise the adverse impacts of herbicides on off-target species.

In upland areas, the use of grass selective herbicides such as Fusillade, Sertin or Targa is recommended for the control of **grass weeds**. Care should be exercised in the broad scale application of grass selective herbicides, as some natives, including upland sedges, are sensitive to these chemicals and it is also known to stunt the development of native seedlings.

Following initial weed control efforts and subsequent replanting works, regular targeted Glyphosate spraying is required for the control of broadleaf and grass weeds which reinvade the wetland. Regular slashing or mowing will be sufficient for the control of weeds in parkland cleared areas, and reduce the risk of seed spread into wetland areas from adjacent areas and as a result of the movement of earthmoving equipment. In order to prevent encroachment of mowing/slashing equipment into the *Melaleuca raphiophylla, Eucalyptus rudis* wetland area, suitable barriers are to be established along the perimeter of this community to clearly delineate management areas to works crews.

To manage weed control activities, a specific weed management plan based on the above principles is to be prepared and approved by the CoG.

5.8.4.2 Revegetation

Following eradication of competing weeds, planting of native tube stock is to be undertaken in the mapped RE wetland. This will augment existing fauna habitat, improve canopy cover and provide additional foraging, roosting and breeding habitat for local fauna, as well as provide enhanced amenity for visitors to the area. Revegetation activities to be undertaken are to include:

> Only local native species will be used for revegetation works (**Table 5-4**). Where possible all tube stock shall be grown from locally collected seed;

> All tube stock and advanced tree and shrub specimens shall be sourced from NIASA accredited nurseries;

> Tube stock is to be planted according to its plant community type;

> Planting works for sedges are to be undertaken in September;

> All other planting works will be undertaken in the May-July winter planting season to maximise establishment prior to summer;

> Planting works shall only be undertaken following successful weed control to minimise potential competition and reduce maintenance requirements; and

> All plants are to be planted and protected with stakes sleeves or bags to reduce predation.

The revegetation species list for different management zones is presented in **Table 5-4**.

Table 5-4 Revegetation Species List

	Management Zone			
Species	**Yule Brook In-stream**	**Melaleuca Overstorey**	**Corymbia Overstorey**	**Wetland Interface**
Acacia pulchella var. glaberrima		x		
Acacia saligna			x	
Adenanthos cygnorum		x	x	
Astartea scoparia		x		
Babingtonia (Baeckea) camphorosmae		x	x	
Banksia attenuata				x

	Management Zone			
Species	**Yule Brook In-stream**	**Melaleuca Overstorey**	**Corymbia Overstorey**	**Wetland Interface**
Banksia littoralis		x		
Banksia menziesii				x
Banksia telmatiaea		x		
Baumea articulata	x	x		
Callistemon phoenicius		x	x	
Callitris pyramidalis		x		
Calothamnus quadrifidus		*x*	*x*	
Casuarina obesa		x		x
Conostylis aculeata sbsp. priessii		x	x	
Corymbia calophylla		x	x	x
Daviesia divaricata subsp. divaricata		x		
Dianella revoluta subsp. divaricata		x	x	
Eucalyptus rudis		x		x
Ficinia nodosa		x		
Gastrolobium capitatum		x		
Gompholobium marginatum		x		
Hakea varia		x	x	
Hardenbergia comptoniana		x	x	
Hemiandra pungens		x	x	
Hovea trisperma		x	x	
Hypocalymma angustifolium		x	x	
Hypocalymma robustum		x	x	
Jacksonia furcellata		x		
Jacksonia sternbergiana		x		
Juncus kraussii subsp. Australiensis	x	x		
Juncus pallidus	x	x		
Kennedia prostrata		x	x	
Kunzea glabrescens		x		
Macrozamia riedlei			x	
Melaleuca huegelii		x		
Melaleuca laterita		*x*		
Melaleuca rhaphiophylla		x		x
Melaleuca teretifolia		x		
Melaleuca viminea subsp. viminea		x		
Patersonia occidentalis		x	x	
Pimelea rosea subsp. rosea		x		
Pultenaea reticulata		*x*		
Regelia ciliata		x		
Regelia inops		x		

	Management Zone			
Species	Yule Brook In-stream	Melaleuca Overstorey	Corymbia Overstorey	Wetland Interface
Taxandria linearifolia		x		
Viminaria juncea		x		
Xanthorrhoea priessii			x	

A specific revegetation plan for each nominated rehabilitation zone is to be prepared by a suitably qualified person skilled in ecological restoration in accordance with the above principals and approved by the CoG.

5.8.5 Fauna

While the ultimate reinstatement of natural understorey vegetation will benefit local fauna the control of weeds through application of herbicides may have a short-term adverse impact on local populations. In order to minimise potential impact on these species, any trees proposed for removal shall be used as woody debris and installed to provide temporary refuge and long-term additional habitat for terrestrial fauna. This habitat shall be selected for its appropriateness with larger trunks and branches chosen over fine twigs and prunings which may pose a fire hazard. To reduce weed reinvasion, only native tree species are to be used for this purpose.

In-stream works may have a short term impact on fauna habitat. This is especially relevant for Carter's freshwater mussel (*Westralunio carteri*). In view of this, management measures for erosion and sediment control are to be specified as discussed in **Section 5.8.1**.

5.8.6 Fire

A key component of the WMP is the control of perennial grass weed infestations in the RE wetland. Perennial grasses such as veldt grass generate high fire fuel loads. Control of these weeds is to reduce the level of bushfire hazard in the wetland. The mowed parkland / wetland interface provides a natural hazard separation between the core RE wetland and surrounding land uses.

The pathway network proposed in the Master Plan provides an opportunity to establish permanent, well-maintained firebreaks and access for equipment in the event a fire was to occur in the wetland. These paths are to be of concrete construction and 2m in width, with clear 1m compacted and slashed or crushed limestone shoulders to enable access by maintenance and emergency vehicles. The areas of *Melaleuca* and *Corymbia* woodland are to be clearly separated from surrounding areas of wetland interface by 1m wide crushed limestone paths. These paths are to clearly differentiate areas to be mowed and those to be managed as natural areas. This will eliminate encroachment by mowing teams. These tracks are also to provide additional controlled access for visitors to the wetland.

As a component of the final design of Mills Park, a fire management plan is to be prepared and approved by the CoG.

5.8.7 Community Use and Access

Formalisation of the wetland area as part of the Mills Park Master Plan provides an opportunity to established controlled access to the wetland, enhance wetland amenity values and foster greater community use of this natural asset.

Construction and upgrade of any paths or tracks within the wetland is to be designed to avoid any trees or remnant native vegetation. Limestone surfaces are to be used to blend and delineate the pathways to the surrounding environment. Any proposed works that have the potential to disturb the hydrology of the wetland are to be controlled as outlined in **Section 5.8.1**.

Hard surface road and the carpark south of the wetland area will intersect the wetland boundary and construction works will require minor clearing as shown in **Figure 13.** Any clearing required in these areas shall be managed according to the management measures outlined in **Section 5.3.4**.

Any proposed earthworks, construction and rehabilitation works within the wetland are to be managed according to the construction and management plan that is to be prepared for Mills Park and approved by the CoG.

The initial removal of dumped household and commercial waste is a key priority. Installation of gates or bollards at potential access points to control unauthorised vehicle access is another early action that is required as part of an access management plan.

A specific access management plan is to be prepared and approved by the CoG.

5.9 Residual Risk

Implementation of the management measures outlined in **Section 5.8** aim to ensure that the risks associated with the proposed works are minimised and the residual risk can be managed by routine procedures.

Cardno has conducted a residual risk assessment based on the proposed risk management measures. The environmental risk assessment process followed the steps outlined in **Section 5.4**. Summary of the proposed management measures and the outcome of the risk assessment are captured in the **Table 5-5.**

Table 5-5 Risk Management Strategy and Residual Risk Rating

Risk Identification and Analysis			Management Strategy	Timeline	Residual Risk Rating		
Risk Issues (Source/Event)	Potential Causes	Potential Impacts	Management Measures	Project Stage[1]	Likelihood	Consequence	Residual Risk Rating
Hydrological impacts and erosion	Changes to wetland hydrology	Altered flow regimes	Works adjacent to and downstream from wetland areas are designed not to alter the hydrology of the wetlands and to maintain the existing flow rates.	PC, DC	3	1	4
	Realignment of drains within the wetland buffer	Erosion and sedimentation	Drains will be re-contoured to create a more gently sloping embankment. Implementation of the approved erosion and sediment control plan.	DC	3	1	4
	Construction of artificial surfaces	Increased direct drainage	Direct drainage will be infiltrated on site prior entering the wetland.	DC,FC	4	1	4
Chemical and fertiliser use	Application of herbicides	Deterioration of wetland environment	Selective use and application of herbicide products. Direct drainage is to be infiltrated on site prior entering the wetland. Implementation of the approved chemical control plan.	DC, FC	2	2	4
	Application of fertilisers	Increased nutrient load downstream	Selective use and application of fertiliser products. Direct drainage is to be infiltrated on site prior entering the wetland. Implementation of the approved fertiliser plan.	DC, FC	2	1	2

1

Pre-construction (PC)
During Construction (DC)
Following Construction (FC)

Clearing of native vegetation	Removal of isolated trees and other vegetation	Reduced biodiversity and habitat for fauna	Only minimal clearing is required. Any trees proposed for removal are to be used as woody debris and installed to provide habitat for fauna. Revegetation of native species. Implementation of the approved vegetation clearing and revegetation plans.	DC	4	1	4
Weed infestation	Lack of weed management on site	Weed infestation and loss of native vegetation	Specific weed control activities are to be implemented. Implementation of the approved weed management plan.	DC, FC	3	1	3
Impact on native fauna populations	Realignment of drains within the wetland buffer	Erosion and sedimentation	Works adjacent to and downstream from wetland areas are designed not to alter the hydrology of the wetlands and to maintain the existing flow rates Drains will be re-contoured to create a more gently sloping embankment. Implementation of the approved erosion and sediment control plan.	PC, DC	3	1	3
	Removal of isolated trees and other vegetation	Reduced biodiversity and habitat for fauna.	Only minimal clearing is required. Any trees proposed for removal are to be used as woody debris and installed to provide habitat for fauna. Revegetation of native species Implementation of the approved vegetation clearing and revegetation plans.	DC	4	1	4
Increased risk of fire	High bush fire load as a result of weed infestation	Bush fire	Control of weed infestations. Installation of firebreaks. Provide access to fire control. Implementation of the approved fire management plan.	DC, FC	1	3	3
Restriction of community use and access	Proposed features and structures in wetland	Loss of vegetation and biodiversity	Only minimal clearing is required. Any trees proposed for removal are to be used as woody debris and installed to provide habitat for fauna. Revegetation of native species Implementation of the approved vegetation clearing and revegetation plans.	DC	2	1	2
	Lack of management on site	Antisocial behaviour Unauthorised access	Installation of gates or bollards at potential access points. Implementation of the approved access management plan.	DC, FC	1	1	1

5.10 Works Schedule

An indicative works schedule and costs based on the current status of the Master Plan is outlined in **Table 1-1**. These indicative timings are to be incorporated into the specific management plans required under this WMP and are to recur for not less than five years.

Table 5-6 Works Schedule

Year	Month	Work Type	Management Area	Works programme	Indicative Cost and Assumptions
2013	**August-September**	Project management	All	Preparation of specific management plans listed in **Section 5.13**.	$80.000 As per the list in **Section 5.13.**
	August-September	Rubbish removal	All	Removal of refuse and green waste from illegal dumping, and disposal to an appropriate landfill facility.	$20,000.00 Cost of labour, fleet and disposal of to a landfill.
	August-September	Revegetation thinning	1 and 2	Removal of trees and shrubs within restoration plantings through cutting and painting to establish an open parkland environment. Green waste to be mulched and used onsite or disposed of appropriately (dependant on species).	$13,440.00 Labour and fleet cost: ▪ 8 hours/ha. ▪ $120 per/hour.
	August-September	Furniture placement	A, B, and C	Placement of appropriate furniture, including habitat logs and pegged PVC pipe lengths, to provide permanent and temporary fauna refuges.	$50,000.00 Costs of material and labour.
	September	Glyphosate spraying	A, B, and C	Blanket spraying of weeds in understorey.	$5,000.00 $980/ha, including material and labour cost.
	September	Slashing	A, B, and C	Slashing of grass and broadleaf weeds to enhance establishment of natural wetland environment.	$4,800.00 Labour and fleet cost: ▪ 8 hours/ha. ▪ $120 per/hour.
	September	Metsulfuron methyl spraying	A	Spraying of marginal and emergent weeds within drain.	$2,750.00 $980/ha, including material and labour cost.
2014	**June-July**	Tree Planting	1 and 2	Planting of established tree specimens within native parkland (as per detailed landscape plans)	$40,500.00 ▪ 2.5 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only a section of the management zones will require revegetation.

Year	Month	Work Type	Management Area	Works programme	Indicative Cost and Assumptions
2014	**June-July**	Tubestock Planting	A and B	Planting of tubestock and installation of stakes and bags within *Melaleuca* wetland and *Corymbia* woodland area.	$62,400.00 ▪ 4 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only a section of the management zones will require revegetation.
2014	**June-July**	Tree and Tubestock Planting	C	Planting of established tree specimens and tubestock within the previously disturbed areas.	$19,200.00 ▪ 4 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only section of the management zones will require revegetation.
	September	Glyphosate spraying	A	Blanket spraying of weeds in understorey.	$2,750.00 $980/ha, including material and labour cost.
	September	Fusillade Spraying	A, B, and C	Fusillade spot spraying for control of grass weeds.	$5,000.00 $980/ha, including material and labour cost.
	September	Slashing	A, B, and C	Slashing of grass and broadleaf weeds to enhance establishment of natural wetland environment.	$6,000.00 Labour and fleet cost: ▪ 8 hours/ha. ▪ $120 per/hour.
	September	Metsulfuron methyl spraying	A	Spraying of marginal and emergent weeds within drain.	$2,750.00 $980/ha, including material and labour cost.
2015	**June-July**	Tubestock Planting	A and B	Planting of tubestock and installation of stakes and bags within *Melaleuca* wetland and *Corymbia* woodland area.	$62,400.00 ▪ 4 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only a section of the management zones will require revegetation.

Year	Month	Work Type	Management Area	Works programme	Indicative Cost and Assumptions
2015	**June-July**	Tree and Tubestock Planting	C	Planting of established tree specimens and tubestock within the previously disturbed areas.	$12,000.00 ▪ 2.5 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only a section of the management zones will require revegetation.
	September	Glyphosate spraying	B	Blanket spraying of weeds in understorey.	$1,100.00 $980/ha, including material and labour cost.
	September	Fusillade Spraying	A, B and C	Fusillade spot spraying for control of grass weeds.	$5,000.00 $980/ha, including material and labour cost.
	September	Slashing	A, B, and C	Slashing of grass and broadleaf weeds to enhance establishment of natural wetland environment.	$4,800.00 Labour and fleet cost: ▪ 8 hours/ha. ▪ $120 per/hour.
	September	Metsulfuron methyl spraying	A	Spraying of marginal and emergent weeds within drain.	$2,750.00 $980/ha, including material and labour cost.
2016	**June-July**	Tubestock Planting	A and B	Planting of tubestock and installation of stakes and bags within *Melaleuca* wetland and *Corymbia* woodland area.	$62,400.00 ▪ 4 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only a section of the management zones will require revegetation.
	June-July	Tree and Tubestock Planting	C	Planting of established tree specimens and tubestock within the previously disturbed areas.	$19,200.00 ▪ 2.5 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only a section of the management zones will require revegetation.
	September	Glyphosate spraying	C	Blanket spraying of weeds in understorey.	$1,200.00 $980/ha, including material and labour cost.

Year	Month	Work Type	Management Area	Works programme	Indicative Cost and Assumptions
2016	**September**	Fusillade Spraying	A, B and C	Fusillade spot spraying for control of grass weeds.	$5,000.00 $980/ha, including material and labour cost.
	September	Slashing	A, B, and C	Slashing of grass and broadleaf weeds to enhance establishment of natural wetland environment.	$4,800.00 Labour and fleet cost: ▪ 8 hours/ha. ▪ $120 per/hour.
2017	**June-July**	Tubestock Planting	A, B and C	Planting of tubestock and installation of stakes and bags within *Melaleuca* wetland and *Corymbia* woodland area.	$81,600.00 ▪ 4 plants per m^2. ▪ $4 per seedling including seedling propagation, planting, growth bag and fertiliser. ▪ Only a section of the management zones will require revegetation.
	September	Fusillade Spraying	A, B and C	Fusillade spot spraying for control of grass weeds.	$5,000.00 $980/ha, including material and labour cost.
	September	Slashing	A, B and C	Slashing of grass and broadleaf weeds to enhance establishment of natural wetland environment.	$4,800.00 Labour and fleet cost: ▪ 8 hours/ha. ▪ $120 per/hour.
2013-2018	**Quarterly**	Monitoring	All	Ongoing quarterly monitoring as identified through the existing monitoring programs until no further maintenance is required and objectives of the WMP achieved.	$0 Already included as part of site management costs.
2013-2018	**Specific reporting month**	Reporting	A, B and C	Annual reporting detailing the management of the wetland ecosystem.	$0 Already included as part of site management costs.
				TOTAL	**$506,640.00 (excluding the management plans)**

5.11 Management Strategy and Timing

Implementation of the WMP is to occur in parallel with development of the park in accordance with the Master Plan. The development of Mills Park will occur in stages as funds and resources are made available by the CoG. At this stage, it is anticipated that the Master Plan along with supporting documentation will be finalised by the end of 2013. Construction works are scheduled to start in early 2014 and last for 36 months. Finalisation of the rehabilitation components of the WMP is anticipated to take at least five years. A current schedule of works for Mills Park is presented in **Appendix A**. This, or any updated, schedule of works is to be incorporated into the specific management plans required under this WMP.

5.12 Roles and Responsibilities

The WMP has been prepared in collaboration with CoG staff which includes the Environmental Coordinator of the Urban Regeneration Branch, Manager of Parks and Environmental Operations and the Coordinator of Environmental Operations.

Restoration works are to be managed by the CoG's Parks and Environmental Operations team. It will undertake the majority of on-ground works with assistance from independent contractors and volunteer groups. There is potential for the CoG to work with South East Regional Centre for Urban Landcare (SERCUL) to organise volunteers to undertake restoration works such as planting and weeding.

Cardno will undertake the role of Contract Superintendent for construction of landscape works detailed in the Master Plan.

5.13 Implementation and Review

To implement the WMP and effectively manage the risks associated with the proposed works, the following documentation is required:

> Construction management plan;

> Erosion and sediment control plan;

> Drainage strategy;

> Fertiliser and chemical control plan;

> Vegetation clearing plan (and any associated permits);

> Weed management plan;

> Revegetation plan;

> Fire management plan; and

> Access management plan.

These plans must include specific management measures, resources and costs associated with the proposed works.

The application of performance targets will support the evaluation of rehabilitation works across the management zones. Given that all works shall be undertaken either by or on behalf of the CoG who be responsible for the ongoing management of the Mills Park wetland, the targets provide a guide to the success of the WMP.

These targets have been devised for restoration activities to be undertaken and guide the ongoing future management of the wetland (refer to **Section 5.5**). It may be that a review of some targets is required over time, in light of monitoring performance from previous stages.

The implementation and review of the WMP is an ongoing process for at least five years. Wetland condition is to be assessed quarterly by a qualified professional. Annual report summarising these investigations is to be prepared and submitted to the CoG Chief Executive Officer on an annual basis for review and approval.

6 References

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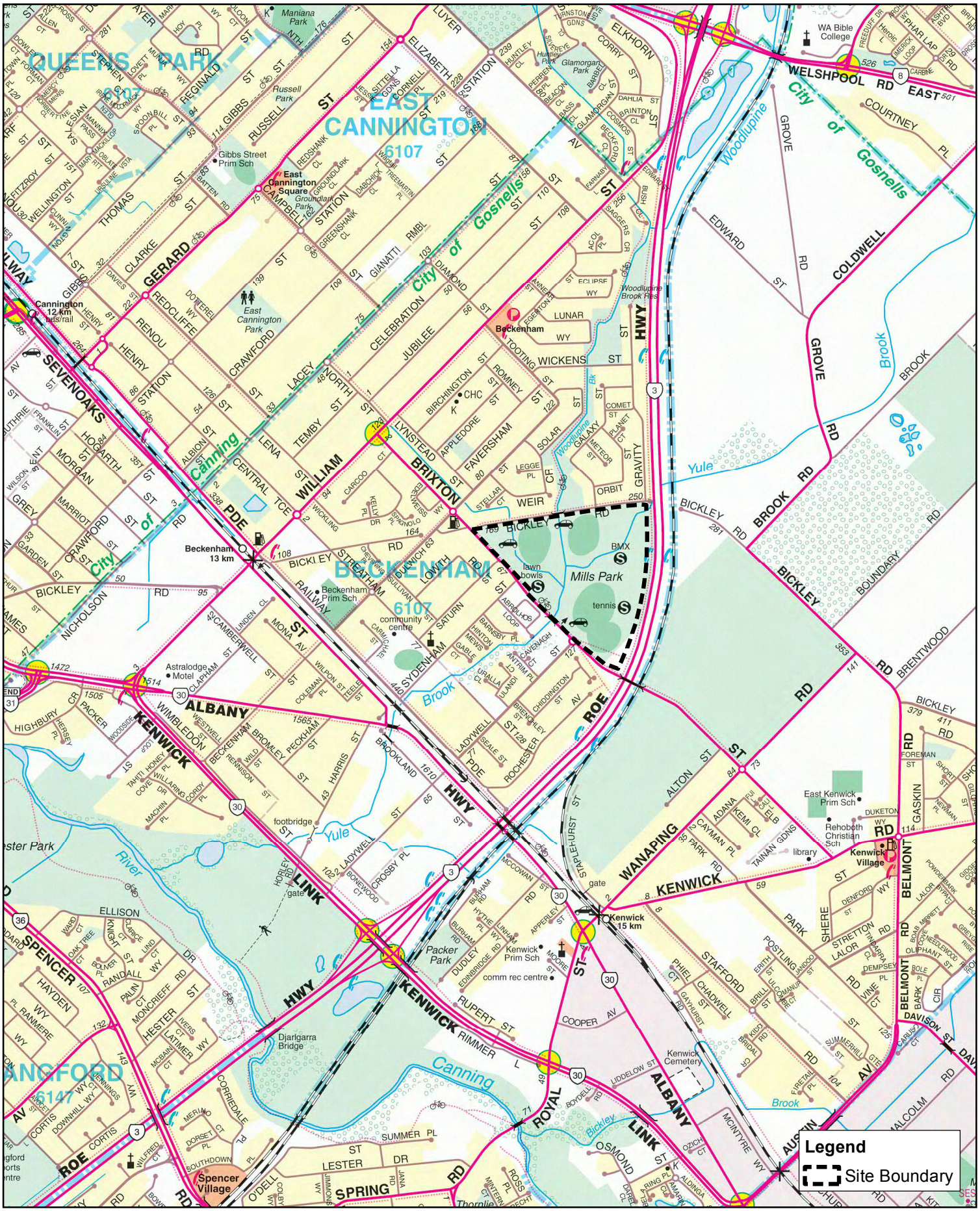
Figures



CITY OF GOSNELLS

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Metres

0 200 400 600

Mills Park Wetland Management Plan

LOCALITY PLAN

FIGURE 1

Cardno

Map Produced by Cardno WA Pty Ltd (PER)
Date: 2013-07-23
Coordinate System: GDA 1994 MGA Zone 50
Project: V13001_02
Map: EN1016_Locality Plan.mxd 01

LEGEND

- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 2-Wetland Boundary and Buffer

Client:
CITY OF GOSNELLS

0 20 40 60 100 200
Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG02	A

LEGEND

- Cadastral Boundaries
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 3-Aerial Photograph of the Site and Cadastral Boundaries

Client:
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Scale 1:2500 @ A3

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EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG03	A

LEGEND

- City of Gosnells Property
- Water Corp Property
- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 4-Site Tenure (Cadastral)

Client:
CITY OF GOSNELLS

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Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG04	A

LEGEND

- High to Moderate ASS disturbance risk (<3m from surface)
- Moderate to low ASS disturbance risk (<3m from surface)
- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 5-Acid Sulfate Soil Risk Mapping (DEC, 2012)

Client:
CITY of GOSNELLS

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Scale 1:2500 @ A3

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EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG05	A

LEGEND

- Watercourse
- Watercourse (Subsurface Drain)
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 6-Surface Water Drains

Client:
CITY OF GOSNELLS

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EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
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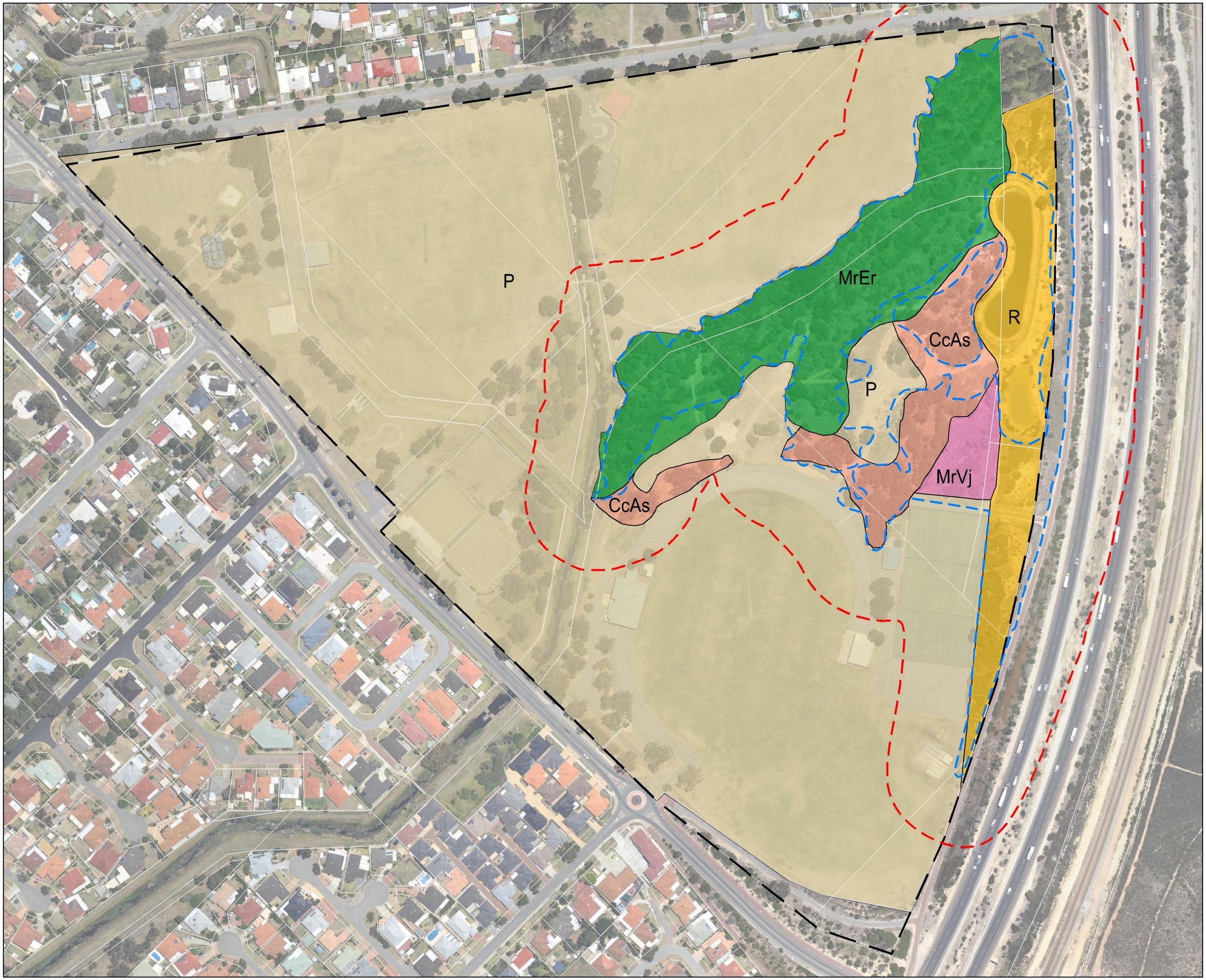

LEGEND

Vegetation Communities

- CcAs — Woodland of Corymbia calophylla overAcacia saligna and Xanthorrhoea preissii with Ehrharta calycina brown loamy sands
- MrEr — Woodland of Melaleuca rhaphiophylla and Eucalyptus rudis over Gahnia trifidia and Acacia saligna with Wattsonia meriana var. bulbillifera, and introduced grasses on clay loams of the riparian zone of drainage lines
- MrVj — Low woodland of Melaleuca rhaphiophylla and Viminaria juncea over introduced grasses on seasonaly wet black clay loams
- P — Playing fields and recreational facilities
- R — Areas previously disturbed and under rehabilitation

- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 7-Mapped Vegetation Communities (Cardno, 2012)

Client:
CITY of GOSNELLS

0 20 40 60 100 200
Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG07	A

LEGEND

- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 8-Mills Park Concept Master Plan

Client:
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Scale 1:3000 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG08	A

LEGEND

- Existing Features
- Proposed Features
- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 9-Proposed Works Within Wetland Areas

Client:
CITY OF GOSNELLS

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Scale 1:2500 @ A3

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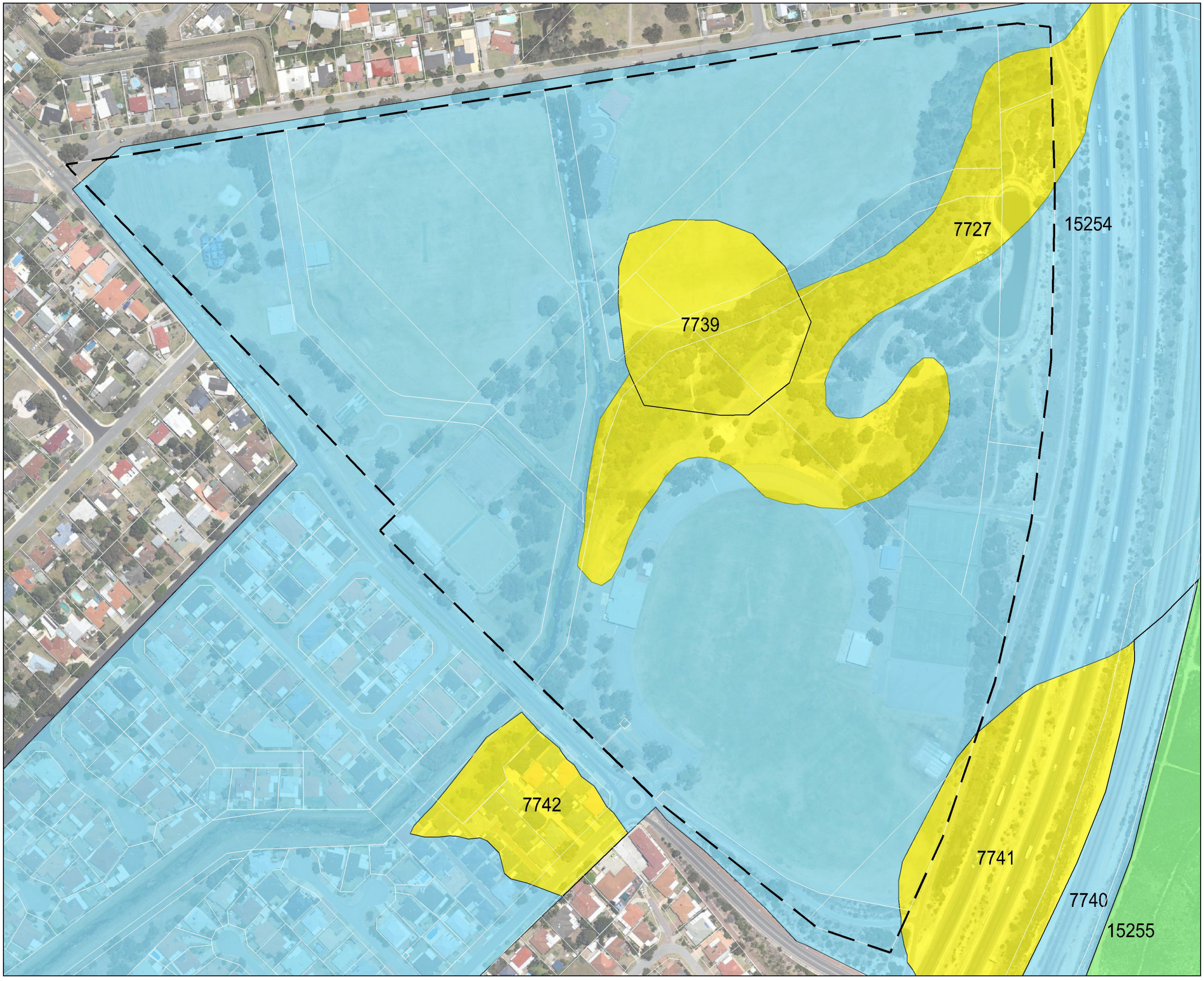
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG09	A



LEGEND

- Conservation (CC)
- Multiple Use (MU)
- Resource Enhancement (RE)
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 10-DEC Geomorphic Wetlands Swan Coastal Plain Dataset (prior to modification)

Client:
CITY OF GOSNELLS

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Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG10	A

LEGEND

- Wetland Boundary
- Site Boundary

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Project:
Mills Park Wetland Management Plan

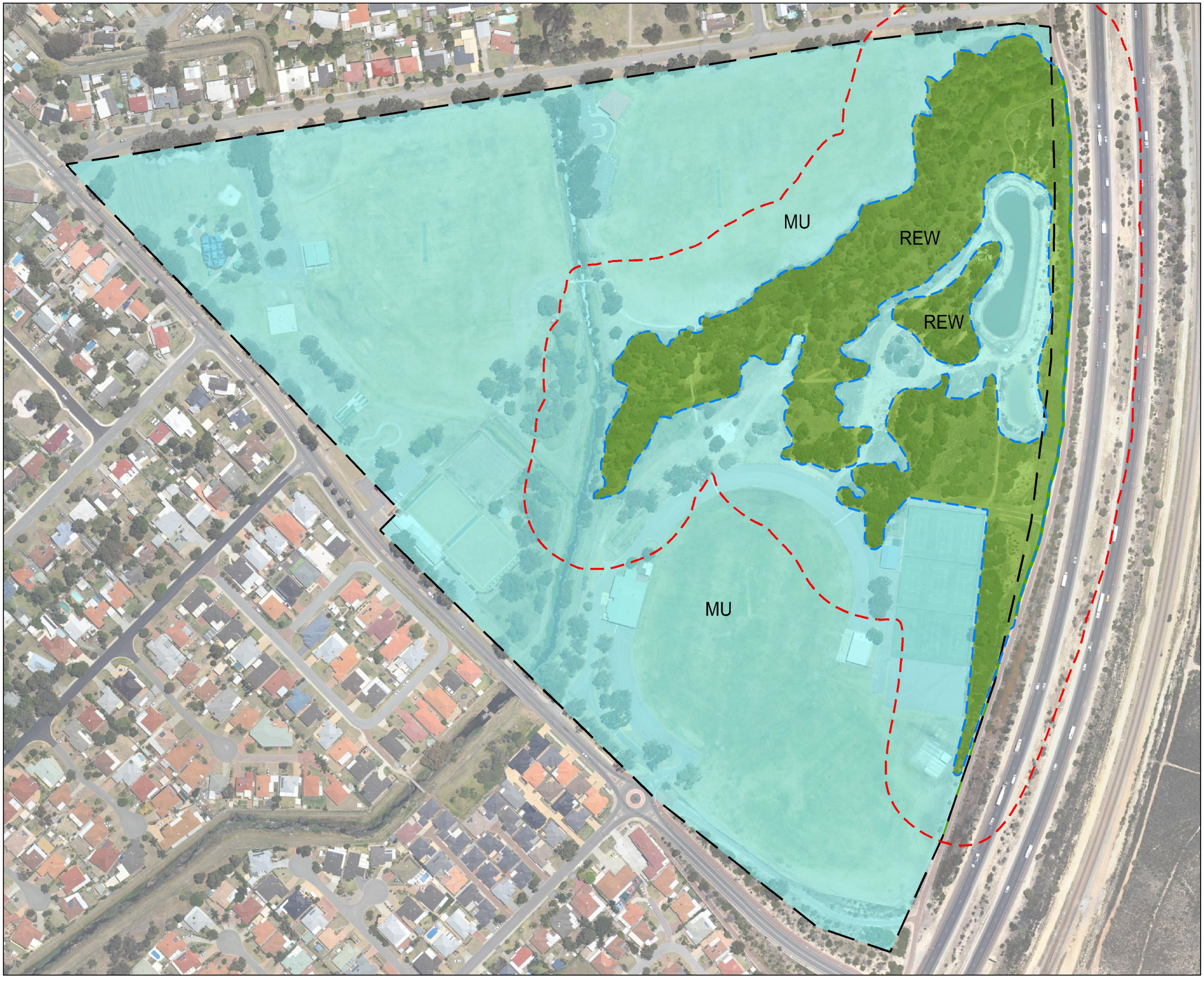
Drawing:
Figure 11-Proposed Amendment to Wetland Boundary

Client:
CITY OF GOSNELLS

0 20 40 60 100 200
Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG11	A



LEGEND

- DEC Revised Boundary for Resource Enhancement (RE) Wetland
- Multiple Use (MU) Wetland
- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 12-DEC Revised Wetland Boundary

Client:
CITY of GOSNELLS

0 20 40 60 100 200
Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG12	A

LEGEND

- Tree to be Removed
- Vegetation to be Cleared (subject to detailed site survey)
- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 13-Areas of Proposed Clearing

Client:
CITY OF GOSNELLS

0 20 40 60 100 200
Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG13	A

LEGEND

Wetland Management Zones

- Wetland (RE) Zone A
- Wetland (RE) Zone B
- Wetland (RE) Zone C
- Wetland Buffer Zone 1
- Wetland Buffer Zone 2

- Wetland Boundary
- Wetland Management 50m Buffer
- Site Boundary

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Project:
Mills Park Wetland Management Plan

Drawing:
Figure 14-Wetland Management Zones

Client:
CITY OF GOSNELLS

0 20 40 60 100 200
Scale 1:2500 @ A3

Designed by:	Drawn by:	Checked:	
EV	SB	MC	

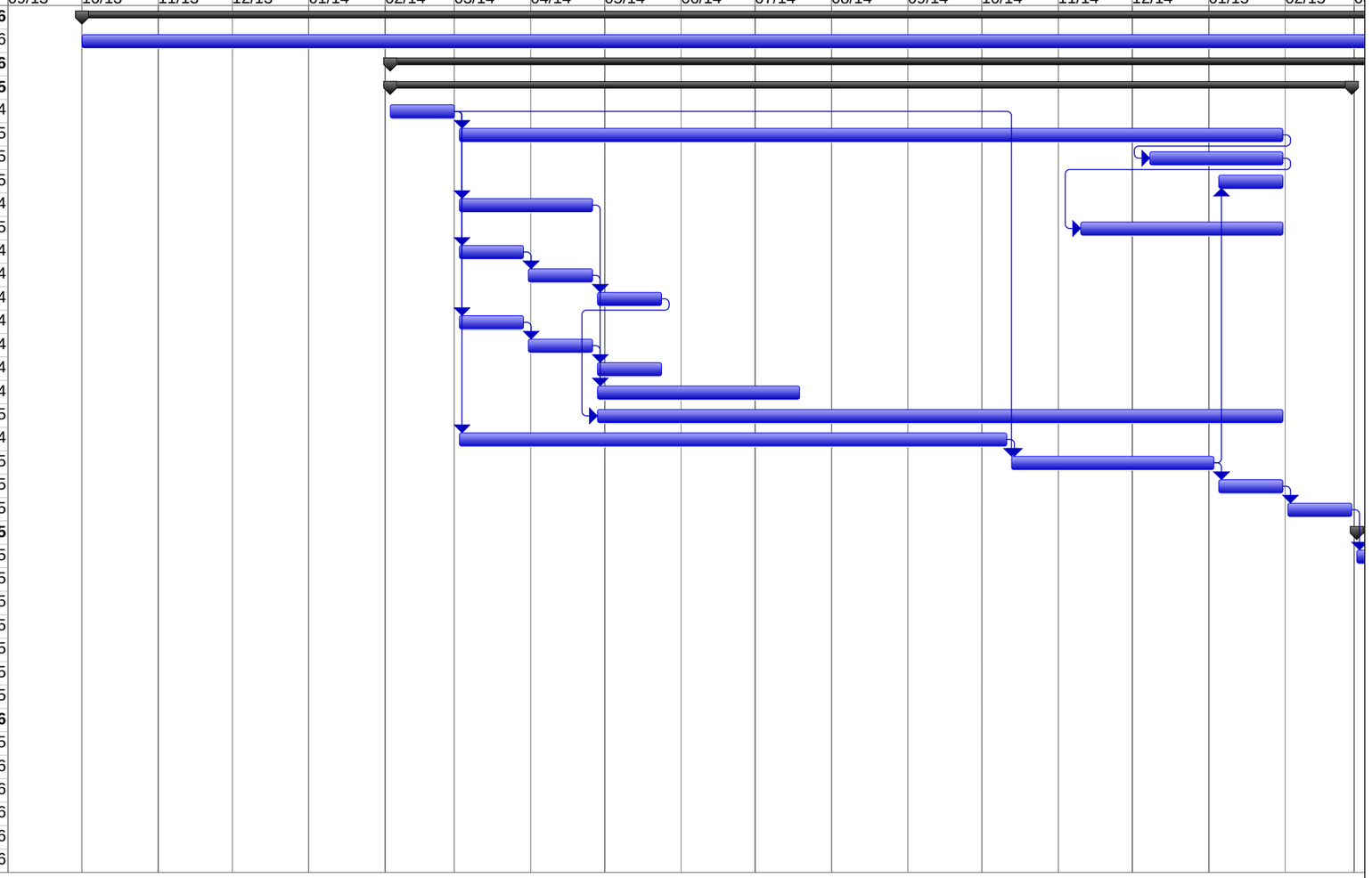
Drawing No.:	Project No.:	Sheet No.:	Issue:
	V13002	FIG14	A

Mills Park, Beckenham

APPENDIX A
SCHEDULE OF WORKS

Cardno
Shaping the Future

ID	Task Name	Duration	Start	Finish
1	**Contract 1**	**720 days**	**Tue 1/10/13**	**Mon 4/07/16**
2	Wetland Rehabilitation	36 mons	Tue 1/10/13	Mon 4/07/16
3	**Contract 2 (Mills 3 Area)**	**620 days**	**Mon 3/02/14**	**Fri 17/06/16**
4	**Seperable Portion 1 (Mills 3 Area)**	**280 days**	**Mon 3/02/14**	**Fri 27/02/15**
5	Demolition of Mills 3 Area	1 mon	Mon 3/02/14	Fri 28/02/14
6	Community Facility	12 mons	Mon 3/03/14	Fri 30/01/15
7	Community Facility Car Park	2 mons	Mon 8/12/14	Fri 30/01/15
8	Soccer/Tennis Car Park	1 mon	Mon 5/01/15	Fri 30/01/15
9	Green Bridge to Mills 1	2 mons	Mon 3/03/14	Fri 25/04/14
10	Regional Play Space	3 mons	Mon 10/11/14	Fri 30/01/15
11	Local Play Space	1 mon	Mon 3/03/14	Fri 28/03/14
12	Skate Precinct	1 mon	Mon 31/03/14	Fri 25/04/14
13	Toilet Block	1 mon	Mon 28/04/14	Fri 23/05/14
14	Sydenham St Roundabout	1 mon	Mon 3/03/14	Fri 28/03/14
15	Bickley Street Car Parking	1 mon	Mon 31/03/14	Fri 25/04/14
16	Brixton Street Busbay	1 mon	Mon 28/04/14	Fri 23/05/14
17	Drainage Pipe Rediversion	3 mons	Mon 28/04/14	Fri 18/07/14
18	Main Services	10 mons	Mon 28/04/14	Fri 30/01/15
19	Synthetic Soccer Pitch	8 mons	Mon 3/03/14	Fri 10/10/14
20	Bowling Greens	3 mons	Mon 13/10/14	Fri 2/01/15
21	Tennis Courts	1 mon	Mon 5/01/15	Fri 30/01/15
22	Local Sevices	1 mon	Mon 2/02/15	Fri 27/02/15
23	**Seperable Portion 2 (Mills 2 Area)**	**140 days**	**Mon 2/03/15**	**Fri 11/09/15**
24	Demolition of Mills 2 Area	1 mon	Mon 2/03/15	Fri 27/03/15
25	Small Ball Sports Pitch	4 mons	Mon 30/03/15	Fri 17/07/15
26	Changing Room/Kiosk	2 mons	Mon 20/07/15	Fri 11/09/15
27	Car Parking	1 mon	Mon 20/07/15	Fri 14/08/15
28	Green Bridge to Mills 2	2 mons	Mon 27/04/15	Fri 19/06/15
29	Floating Walkway	2 mons	Mon 22/06/15	Fri 14/08/15
30	Local Sevices	6 mons	Mon 30/03/15	Fri 11/09/15
31	**Seperable Portion 3 (Mills 1 Area)**	**200 days**	**Mon 14/09/15**	**Fri 17/06/16**
32	Demolition of Mills 1 Area	1 mon	Mon 14/09/15	Fri 9/10/15
33	Aussie Rules Ovals	6 mons	Mon 12/10/15	Fri 25/03/16
34	Changing Room/Kiosk	2 mons	Mon 28/03/16	Fri 20/05/16
35	Internal Roads	2 mons	Mon 25/04/16	Fri 17/06/16
36	Car Parking	1 mon	Mon 28/03/16	Fri 22/04/16
37	Local Sevices	8 mons	Mon 12/10/15	Fri 20/05/16



Project: 2013-07-02 Mills Park Construction Programme.Alt1
Date: 2 July 2013

Task	External Tasks	Manual Task	Finish-only
Split	External Milestone	Duration-only	Progress
Milestone	Inactive Task	Manual Summary Rollup	Deadline
Summary	Inactive Milestone	Manual Summary	
Project Summary	Inactive Summary	Start-only	

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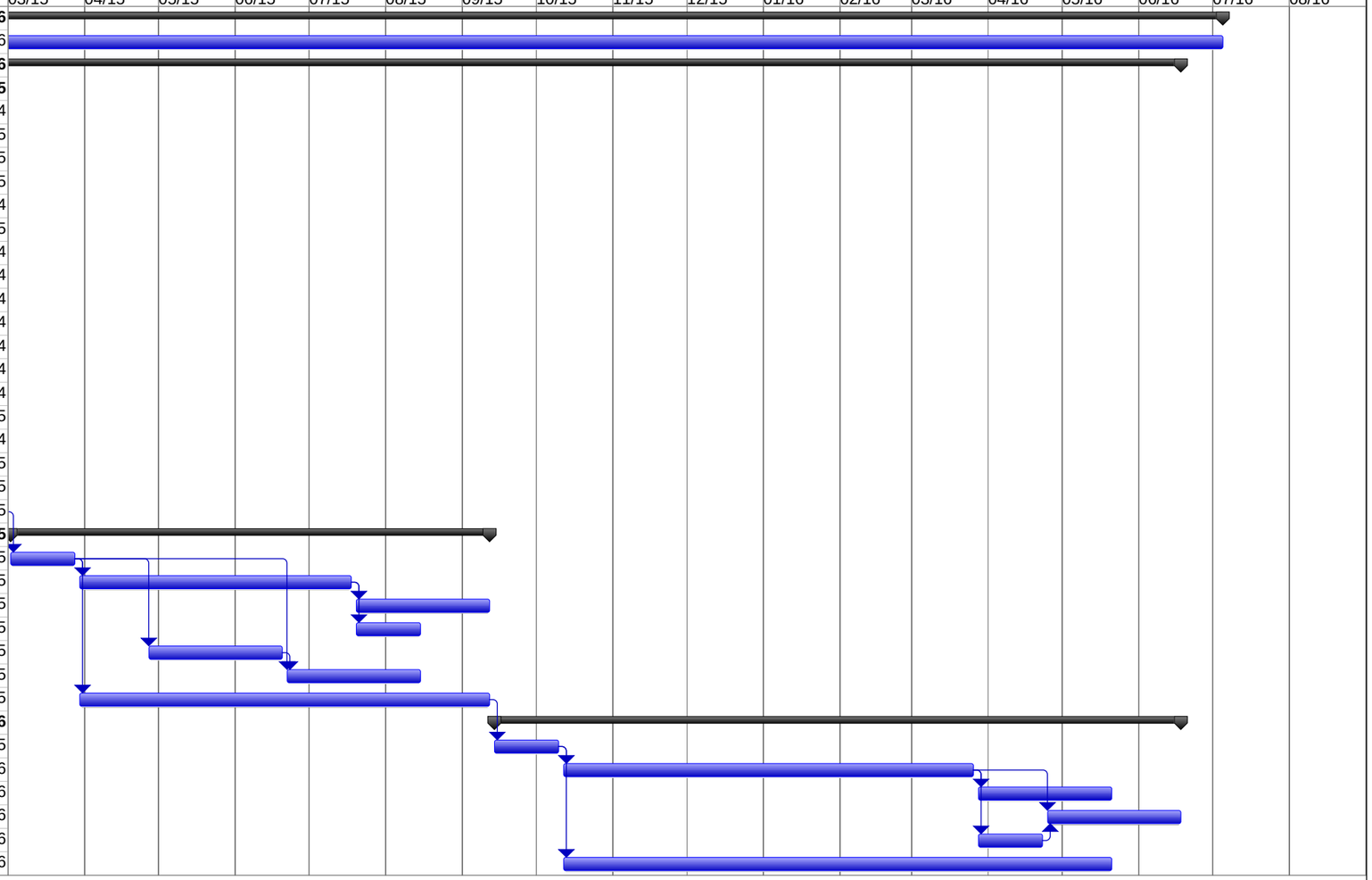

Project: 2013-07-02 Mills Park Construction Programme.Alt1
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Task	External Tasks	Manual Task	Finish-only
Split	External Milestone	Duration-only	Progress
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Project Summary	Inactive Summary	Start-only	

About Cardno

Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

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