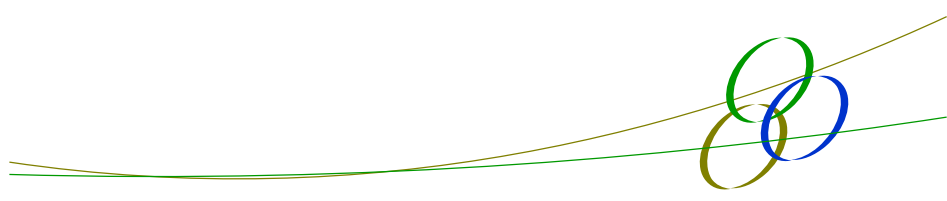


Appendix 15

*SLR March 2014: Proposed Rezoning and Expansion – Cumberland Plain
Woodland Assessment Report*





global environmental solutions

Glenfield Waste Services Site
Cambridge Avenue, Glenfield

Proposed Rezoning & Expansion

Cumberland Plain Woodland Assessment Report

28 March 2014



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Cumberland Plain Woodland Assessment Report

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Document Control

Reference	Status	Date	Prepared	Checked	Authorised
610.12154	Version 1.0	November 2013	FI	FDF	F Dominic Fanning
610.12154	Version 2.0	March 2014	FI	FDF	F Dominic Fanning

**GLENFIELD WASTE SERVICES SITE
CAMBRIDGE AVENUE, GLENFIELD**

PROPOSED REZONING & EXPANSION

CUMBERLAND PLAIN WOODLAND ASSESSMENT REPORT

28 March 2014

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**GLENFIELD WASTE SERVICES SITE
CAMBRIDGE AVENUE, GLENFIELD**

PROPOSED REZONING & EXPANSION

CUMBERLAND PLAIN WOODLAND ASSESSMENT REPORT

28 March 2014

1 INTRODUCTION

1.1 The Glenfield Waste Services Site

The Glenfield Waste Services Site is located at Cambridge Avenue, Glenfield (Figure 1), approximately 40 kilometres to the southwest of the Sydney Central Business District (CBD). The northern portion of the site is located in the Liverpool City Council Local Government Area (LGA), whilst the southern portion is located within the Campbelltown LGA.

The 'triangular' portion of land occupied by the Glenfield Waste Services operations is approximately 100ha in area, and comprises a total of thirteen lots (Figure 1):

- the southern part (south of the Glenfield-East Hills Railway Line) -
 - Lot 3 in DP 736881 (on each side of Cambridge Avenue)
 - Lot 1 in DP 113201, Lot 2 in DP 333578, Lot 3 in DP 733524 and most of Lot 91 in DP 1155962
- the northern part (north of the Glenfield-East Hills Railway Line) -
 - part Lot 91 in DP 1155962, Lot 92 in DP 1155962 and Lot 5 in DP 833516 – between the Glenfield-East Hills Railway Line and a Road Reserve
 - Lots 101, 102, 103 and 104 in DP 1143827, Lot 51 in DP 515696 and Lot 52 in DP 517310 – in the northernmost part of the land.

The southern portion of Lot 3 in DP 736881 (south of Cambridge Avenue) is occupied by a transmission line and easement (Figure 2), and is predominantly cleared grassland (except at its eastern part).

The East Hills Railway runs in an east-west direction through the centre of the Glenfield Waste Services Site (Figure 1). The land to the north currently operates as the landfill component of the operations (Figure 1), and is largely cleared - with some riparian vegetation along the Georges River and some grassed areas with a few scatters and patches of planted trees. The land to the south of the East Hills Railway Line (Figure 2) currently contains the recycling facility in its eastern portion, with a relatively large area of vegetated land in the west.

The Glenfield Waste Services Site is roughly triangular in shape (Figure 1), and is bound by:

- the Georges River - along its eastern boundary;
- the Main Southern Railway Line - along its western boundary; and
- residential development and part of the Georges River Nature Reserve (south of Cambridge Avenue) - along its southern boundary.

Much of the surrounding area is developed as residential and industrial land typical of western Sydney (Figure 1), although there are substantial portions of vegetated land to the southeast and along the Georges River to the north. Land to the east (east of the Georges River, is to be developed in part for a major transport intermodal facility.

1.2 The Subject Site

The “*subject site*” for the purposes of this assessment consists of the land to the south of the East Hills Railway Line and north of Cambridge Avenue (Figure 1). In particular, the surveys and assessment contained in this *Report* is focussed on the area of alleged or possible Cumberland Plain Woodland (CPW) in the western and southern vegetated portions of the subject site, north of Cambridge Avenue (Figure 2).

The “*subject site*” is approximately 40 hectares in area, and is bound by the East Hills Railway along its northern boundary, Cambridge Avenue along its southern boundary, and the Georges River at the eastern boundary (Figure 2).

This part of the Glenfield Waste Services site is located wholly within the Campbelltown LGA.

1.3 Future Development

The Glenfield Waste Services operations, particularly the recycling facility within the “*subject site*”, needs to be relocated and expanded - within the boundaries of the site. Having consulted with the NSW Environmental Protection Authority (EPA), as the regulator of waste management activities on the subject land, it is the desire of Glenfield Waste Services to expand those operations into the vacant portions of land - to the southwest of the existing operations.

In addition, there is a conceptual plan for the future re-zoning of the subject site for industrial purposes. The assessment of the vegetation present contained in this *Report* does not address future development of the “*subject site*” in any detail at this stage.

1.4 Definitions

Definitions for areas used in this *Cumberland Plain Woodland Assessment Report* include:

- *subject land* the Glenfield Waste Services Site at Cambridge Avenue, Glenfield (Figure 1)

- *subject site* the southern central portion of the subject land - which is being investigated to determine the presence or otherwise of the CPW community (Figure 2)
- *general locality* an area of 10km radius around the “*subject site*”

1.5 Brief from EPS

The brief from EPS for this project included the following points:

- *The aim of the proposed Cumberland Plain Woodland Assessment of the Glenfield Waste Services site southern section of land is to collect detailed information on the presence or otherwise of Cumberland Plain Woodland as part of the statutory requirements for a Development Application for a proposed recycling facility and for the proposed rezoning.*
- *Undertake a detailed field survey of the site in accordance with relevant legislation, policy and guidelines to identify the presence or absence of Cumberland Plain Woodland (CPW) and the condition or varying condition of the CPW.*
- *Map the location of the CPW on the site.*
- *Provide detailed discussion of the CPW including:*
 - *The condition or varying condition of the CPW;*
 - *Determining the precise distribution of vegetation that satisfies the CPW criteria and the vegetation that does not satisfy the criteria;*
 - *Assessing the CPW against the criteria in the Final Determination for the CPW community pursuant to the NSW Threatened Species Conservation Act 1995 (TSC Act) including any legal interpretation of the Final Determination for the CPW community; and*
 - *Assessing the possible CPW against the criteria in the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) including any legal interpretation of the criteria in the EPBC Act.*

1.6 Scope and Aims of this Report

The aims of this *Cumberland Plain Woodland Assessment Report* with respect to the subject site at Cambridge Avenue, Glenfield are to fulfil the brief of EPS as detailed above. In particular, this *Report* aims:

- to undertake background research regarding any existing vegetation mapping of the subject site;
- to undertake a site survey:
 - to verify the vegetation present;
 - to collect a detailed flora species list;
 - to undertake a series of flora survey quadrats;
- to determine likely ecological constraints to future rezoning and development of the site;

- to provide initial recommendations with respect to any restrictions to development activities that might apply and/or identifications of areas of vegetation that will or may need to be retained; and
- to provide an initial consideration of the requirement for, and extent of, any biodiversity offsets that may be required.

Consideration of the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act 1999) is also provided.

This *Cumberland Plain Woodland Assessment Report* has taken into account *inter alia* relevant statutory and planning policies, and agency *Guidelines*, including:

- the *Environmental Planning & Assessment Act 1979* (EP&A Act);
- the *Threatened Species Conservation Act 1995* (TSC Act);
- the *Native Vegetation Act 2003* (NV Act);
- the *Water Management Act 2000* (WM Act);
- the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act);
- the OEH *Principles for the Use of Biodiversity Offsets in NSW* (2011);
- the OEH *Threatened Species Survey & Assessment Guidelines* (dated 2004);
- OEH documents regarding the Cumberland Plain, including *inter alia*:
 - Sydney Catchment Management Authority and OEH vegetation mapping (CMA/OEH 2009 – Figure 4);
 - vegetation mapping of the subject site and surrounds by the OEH (Tozer *et al* 2010 – Figure 5);
 - the *Cumberland Plain Recovery Plan* (DECCW 2011);
 - *Recovering Bushland on the Cumberland Plain: Best Practice Guidelines for the Management and Restoration of Bushland* (DEC 2005); and
 - the NOW *Guidelines for Riparian Corridors on Waterfront Land* (July 2012).

2 INFORMATION BASE

Existing information regarding relevant threatened and other native biota was obtained from:

- previous investigations undertaken by Gunninah Environmental Consultants¹, Environmental InSites² and SLR Ecology on lands in the vicinity of the subject site (eg on Council land at Groundsel Avenue, Macquarie Fields and the Culgoa Circuit site at Wattle Grove);
- inspection of the NPWS 2002 vegetation mapping of vegetation in western Sydney (Figure 4), CMA/OEH 2009 vegetation mapping of the locality (Figure 5) and the Tozer *et al* 2010 vegetation mapping (Figure 6); and
- the general published literature on the Cumberland Plain Woodland (see *Bibliography*).

A detailed site survey was undertaken on the 30th of September and 1st of October 2013, to provide specific data and observations for this *Cumberland Plain Woodland Assessment Report*.

The site investigations involved:

- the conduct of a 'Random Meander' survey *sensu* Cropper 1993 (Figure 3);
 - to collect a series of photo points (Figure 2) - to document the various conditions of the vegetation across the site (Appendix A); and
 - to obtain a comprehensive flora species list (Appendix C); and
- the undertaking of 20m x 20m flora survey quadrats (Figure 3) – involving the identification of all species present by intensive walked survey, and the recording of Blaun–Blanquet ratings of abundance/cover for all species (Appendix D).

¹ The principal author of this *Report* was previously the owner and Director of Gunninah Environmental Consultants.

² The authors of this *Report* were previously the Environmental Division of Whelans InSites, Sydney.

3 FLORA and VEGETATION

3.1 Existing vegetation

The subject site is characterised by the existing recycling facility and its operations in its eastern half, and a series of paddocks with a dwelling and large artificial wetland in its western portion (Figure 2; Appendix A). Along the western side of the subject site there is a narrow band of riparian vegetation along the Georges River, which is heavily infested by noxious weeds (such as Wandering Jew, Privet, Lantana and African Olive).

There is also a canopy of Grey Box and occasionally other eucalypts (Forest Red Gum, Stringybark, Narrow-leaved Ironbark and Rough-barked Apple) in a band which extends along the southern central boundary and into the northwestern portion of the site. These trees are characteristic canopy species of the Cumberland Plain Woodland (CPW) community - which is a “*critically endangered ecological community*” (CEEC) listed in the NSW *Threatened Species Conservation Act 1995* (TSC Act), and part of a CEEC listed in the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act) – as discussed in detail in Chapter 4.

Detailed site surveys by SLR Ecology (Figures 2 and 3) have determined that there are varying degrees of disturbances to the understorey and groundcover through the subject site, resulting in areas of ‘Very Low’, ‘Low’ and ‘Moderate’ condition vegetation being mapped on the site (Figure 6).

In addition, the recent survey has determined that there are no areas of native grassland present. Areas of native grassland (were they to be present) could potentially constitute the CPW community.

The vegetation across the subject site includes:

- Red Gum – Stringybark Riparian Forest – all of which is in ‘Very Low’ condition because of the understorey of dense noxious weeds.
- Artificial Cumbungi Wetland – which is in ‘Low’ condition because of its artificial nature and because of the dominance of exotic species around its banks (notwithstanding the extent of Cumbungi and Water Primrose within the wetland).
- Grey Box–Red Gum Woodland - which is in:
 - ‘Very Low’ condition – where it possesses an entirely cleared understorey and groundcover, or areas of exotic groundcover; and/or
 - ‘Low’ condition – where there is a mixture of native and exotic species throughout the groundcover.
- Red Gum – Ironbark Woodland - which is in:
 - ‘Very Low’ condition – where it possesses a largely exotic groundcover; and
 - ‘Moderate’ condition – where there is a diverse native understorey and groundcover (notwithstanding areas of weed invasion and regular mowing).

The remainder of the subject site contains built and developed land and/or areas which have been subjected to clearing, turfing and planting of horticultural specimens.

3.1.1 Artificial Cumbungi Wetland

There are two artificial wetlands along the northern boundary of the subject site, which are bisected north-south by a bunded dirt track (Figure 7). These wetlands collect surface water from the subject site for treatment and/or re-use.

The western wetland comprises a large area of open water and is fringed by Cumbungi vegetation. The smaller eastern wetland contains dense Cumbungi and Water Primrose. There is also a narrow artificial channel entering from beneath the railway line which feeds into the northwestern corner of the large wetland. This area is dominated by dense Cumbungi and Pampas Grass.

The Cumbungi (*Typha* sp.) and Water Primrose which dominate the wetlands are native species, which are listed as 'characteristic' in the *Final Determination* for the *Freshwater Wetlands on Coastal Floodplains* (FWCF) community - which is listed as an "endangered ecological community" (EEC) in the TSC Act.

That EEC is not present, however, as detailed in Chapter 4.

3.1.2 Grey Box – Red Gum Woodland

The Grey Box – Red Gum Woodland occupies much of the vegetated band along the southern portion of the subject site and the paddocks in the centre of the subject site at Cambridge Avenue, Glenfield (Figure 6). The canopy in this vegetation is dominated by Grey Box, with some occasional Forest Red Gum. There is also a mid-canopy of *Melaleuca decora* in a small patch along the southern boundary of the site.

There is virtually no shrub layer throughout this area - with the exception of a few scattered specimens of Blackthorn, African Olive and Africa Boxthorn at the base of trees - which escaped the slashing and mowing for grazing and/or asset protection maintenance.

The groundcover generally comprises scattered and/or sparse patches of grasses and herbs including:

- native grasses (Weeping Grass, Stout Bamboo Grass) and herbs (Blue Trumpet, Kidney Weed, Berry Saltbush and other *Einadia* species); and/or
- exotic grasses (Prairie Grass, Perennial Rye Grass, Kikuyu and Common Couch) and weeds (Cobblers Pegs, Fishweed, Paddy's Lucerne, Red-flowered Mallow, Scarlet Pimpernel and Lamb's Tongue).

Five detailed flora survey quadrats were sampled within this vegetation type, to capture the varying condition of the groundcover throughout the site and to attempt to determine whether the groundcover layer was dominated by native species or exotic species.

The following notes provide a summary of the floristic information detailed in Appendix D for these five quadrats.

- Quadrat 1 -
 - 'Low-Moderate' condition - with 11 natives (all CPW species) and 11 exotics.
 - Dominated by Weeping Grass (native) and Perennial Rye Grass (exotic), with a substantial cover of Lamb's Tongue and *Petrorhagia velutina* (both exotics).

- Quadrat 2
 - 'Low' condition - with 8 natives (7 CPW species) and 11 exotics.
 - Dominated by Weeping Grass (native), Perennial Ryegrass and Lamb's Tongue (both exotics).
- Quadrat 3
 - 'Moderate' condition - with 17 natives (16 CPW) and 6 exotics.
 - Dominated by Wallaby Grass (*Rytidosperma racemosum*), Winter Apple, Plump Windmill Grass and Blue Trumpet.
- Quadrat 6
 - 'Low' condition - with 8 natives (7 CPW) and 11 exotics.
 - Dominated by Couch, Prairie Grass and Perennial Rye Grass (all exotics), and only scattered native species.
- Quadrat 7
 - 'Very Low' condition - with 8 natives (7 CPW) and 10 exotics.
 - Dominated by Stout Bamboo Grass, Panic Veldt Grass and Fishweed (all exotics), and only scattered specimens of native groundcover species.

3.1.3 Red Gum – Ironbark Woodland

The Red Gum – Ironbark Woodland is restricted to a small band along the northwestern boundary and at the western end of the subject site at Cambridge Avenue, Glenfield (Figure 7). The canopy is dominated by Forest Red Gum, Narrow-leaved Ironbark and Grey Box, with occasional specimens of Thin-leaved Stringybark and Rough-barked Apple.

In the northern strip of Red Gum-Ironbark Woodland there is a scattered and patchy shrub layer of mainly Black Wattle, Blackthorn and regrowth eucalypts, with a few patches of Native Cherry and scattered specimens of Gorse Bitter Pea, White Dogwood and *Dillwynia sieberi*. A number of exotic and noxious weed (such as African Olive) are also present.

The groundcover in the southern patch of this community (west of the residence – Quadrat 5) is mown and disturbed, but the northern patch (Quadrat 4) maintains a dense grassy groundcover dominated by Kangaroo Grass. A diversity of native species (including the Eastern Flame Pea, False Coral Pea, Tall Bluebell and *Bossiaea prostrate*) were found within this area of vegetation, but were not observed in any other areas on the subject site.

- Quadrat 4
 - 'Moderate' condition - with 19 natives (18 CPW) and 16 exotics.
 - Groundcover dominated by introduced African Love Grass and other weeds, with moderate cover of native (mostly CPW) species.
- Quadrat 5
 - 'Very Low' condition - with 4 natives (3 CPW) and 6 exotics.
 - Dominated by introduced Couch lawn grass (exotic).

3.1.4 Red Gum – Stringybark Riparian Forest

This strip of vegetation adjoins the Georges River - along the eastern boundary of the subject site (Figure 7). It is dominated by Forest Red Gum and Stringybark, with a dense tall mid-canopy of noxious African Olive and Privet, as well as specimens of Black Wattle and Coast Myall. Other weeds include Lantana and Cape Ivy through the shrub layer, and Wandering Jew in the groundcover.

This vegetation type would constitute a very highly degraded form of River-flat Eucalypt Forest on Coastal Floodplains (REFCF) - which is an “*endangered ecological community*” (EEC) listed in the TSC Act.

No flora survey quadrats were undertaken in the Red Gum-Stringybark Riparian Forest – because there is no prospect of any development activities in this area. The zoning of this strip of land (for *Environmental Protection* purposes) and the constraints imposed by the *Water Management Act 2000* would essentially prevent any activities other than vegetation rehabilitation works at this location.

3.2 Flora Species

Random Meander and systematic botanical surveys conducted as part of this investigation have recorded a total of 132 plant species from within the subject site (Appendix C). Of these, a total of 71 native species were recorded, along with 61 exotic species. A few of the exotic species (including Privet and African Olive) are also listed as noxious in NSW.

Forty nine of the plant species recorded on the subject site (Appendix C) are listed as “*characteristic*” species in the *Final Determination* (Scientific Committee website 2013) for the CPW community.

4 ENDANGERED ECOLOGICAL COMMUNITIES

The vegetation mapping of the subject site by the OEH/CMA 2009 (Figure 5) and by Tozer *et al* 2010 (Figure 6) indicate the presence of two “*threatened ecological communities*” (as listed in the TSC Act) - known as:

- Cumberland Plain Woodland (CPW) – which is listed as a “*critically endangered ecological community*” (CEEC) in the TSC Act, and as part of a CEEC listed in the EPBC Act; and
- River-flat Eucalypt Forest on Coastal Floodplains (REFCF) – which is listed as an EEC in the TSC Act.

Ground-truthing of the vegetation present on the subject site at Glenfield by SLR Ecology (Figure 7) has determined that:

- there is a highly disturbed narrow band of REFCF vegetation along the eastern boundary of the site (adjoining the Georges River); and
- there is a variously disturbed band of CPW vegetation along the southern boundary and in the western parts of the subject site.

4.1 Cumberland Plain Woodland

4.1.1 The CPW Community – TSC Act

The following points from the *Final Determination* are relevant in determining the presence (or otherwise) of CPW on the subject site at Glenfield:

- Paragraph 2 - “*Cumberland Plain Woodland .. typically comprises an open tree canopy, a **near-continuous groundcover dominated by [native] grasses and herbs**, sometimes with layers of shrubs and/or small trees*” (emphasis added);
- Paragraph 3 - the “*assemblage of species*” by which the “*Cumberland Plain Woodland is **characterised***” (emphasis added) does not contain any introduced or exotic plant species. All of the “*grasses and herbs*” which are characteristic of the CPW community are native species;
- Paragraph 5 - “*The ground cover **is dominated** by a diverse range of [native] grasses*” (emphasis added) and “*The ground cover also includes a **diversity** of [native] forbs*” (emphasis added);
- Paragraph 6 - “***Either or both** of the upper storey and mid-storey **may be absent** from the community*” (emphases added); and
- Paragraph 6 - “*Native grasslands derived from clearing of the woodland and forest are also part of this community if they contain characteristic non-woody species listed in paragraph 3*”.

Based on the above considerations, it is concluded that much of the woodland vegetation on the subject site does constitute the CPW community, despite being only in ‘Low’ to ‘Moderate’ condition.

However, some of the vegetation on the “*subject site*” arguably does not constitute the CPW community because, whilst there is a canopy of “*scattered trees*”, which are “*characteristic*” of the CPW community:

- the groundcover is **not** “*dominated by a diverse range of [native] grasses*”;
- the groundcover layer does **not** include “*a diversity of [native] forbs*”; and
- the *Final Determination*, whilst specifically allowing for the absence of the “*upper storey or mid-storey*”, does not countenance, anywhere, the absence of a native groundcover layer. Indeed, the antithesis is the case (*ie* ‘derived grassland’ = “*groundcover alone can constitute CPW*”).

The vegetation on the subject site mapped as ‘Very Low’ condition (Figures 7 and 8) is not considered by SLR Ecology to conform to the definitions outlined within the *Final Determination* for CPW - based on the scarcity of native groundcover and understorey plants, and the dominance of exotic species in the groundcover layer (as discussed above).

4.1.2 The CPW Community – EPBC Act

In addition to its listing as a CEEC in the TSC Act, the Cumberland Plain Woodland (CPW) community is listed as part of a CEEC in the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act).

However, unlike the TSC Act (in which trees are not necessary for the CPW community to be present), the EPBC Act explicitly states that trees are necessary for a stand of vegetation to be classified as CPW.

Importantly (and most valuably), the EPBC Act listing also provides *Threshold Criteria* for CPW vegetation, which requires *inter alia* that:

- the area of the patch of vegetation be larger than one hectare; and
- at least 30% of the groundcover species be native plants typical of the CPW community.

The patch of vegetation on the subject site at Glenfield certainly constitutes an area greater than 1 hectare in size.

Consideration of the criteria with respect to understorey species and groundcover species, pursuant to the EPBC Act listing and the criteria identified above, reveals a similar outcome to that identified above with respect to the TSC Act.

Those areas of vegetation which are in ‘Very Low’ condition are not regarded as satisfying the EPBC Act criteria for the CPW community (as part of a CEEC) – because they are dominated by introduced groundcover species, and have only scattered native groundcover species with low diversity. However, those areas of vegetation which are in ‘Low’ or ‘Moderate’ condition are considered likely to satisfy the criteria for the CPW community as listed in the EPBC Act.

Depending on the extent of vegetation proposed to be removed, it is possible (likely in fact) that a formal *Referral* of the project to the Commonwealth will be required. The success of any such *Referral* will be dependent on the extent of removal of CPW vegetation, and on the offsets proposed.

4.1.3 The Cumberland Plain Recovery Plan

The *Cumberland Plain Recovery Plan* is a document prepared by the then DECCW (2010) which *inter alia* identifies actions required for the recovery of threatened biota across the geographic region of the Cumberland Plain, including the Cumberland Plain Woodland CEEC and other “*threatened ecological communities*” (TECs), as well as threatened species associated with that vegetation.

As one element of the *Recovery Plan*, an array of areas have been identified as “*priority conservation lands*” (PCLs) - defined by DECCW (2010) as those which “*represent the best remaining opportunities in the region to maximise long-term biodiversity benefits for the lowest possible cost, including the least likelihood of restricting land supply*”. These areas occupy a total area within the Sydney Basin of approximately 25,566ha, and are considered by DECCW “*to be the highest priority for future efforts to conserve the threatened biodiversity of the region*”.

DECCW (2010) note that “*it is important that prioritisation and investment in the recovery program be guided by sound principles. These principles, based upon the best available ecological evidence, are that*”:

- “*the protection and management of large, intact remnants is more effective and efficient than for smaller, fragmented remnants*”;
- “*recovery efforts need to aim to ensure that a representative sample of biodiversity is conserved*”;
- “*active management to best practice standards is needed to prevent the degradation of bushland in a fragmented landscape*”; and
- “*where impacts on biodiversity cannot be avoided, they should be offset using appropriate means*”.

In regard to the retention of large intact patches of vegetation, the *Recovery Plan* notes:

- “*evidence clearly suggests that larger remnants have a better prospect for long-term survival. Larger remnants are usually more diverse and resilient than smaller remnants, and are less susceptible to ‘edge effects’, catastrophic events, and the expected impacts of climate change*”; and
- “*threatened woodland birds such as the Brown Treecreeper and Hooded Robin have persisted in the larger, better connected remnants. These remnants are not dominated by aggressive bird species and retain the characteristic habitat requirements for woodland bird fauna. Similarly, a number of mammal species have been recorded from the larger connected remnants*”.

The Georges River Nature Reserve and Holsworthy Military Reserve are located to the south of subject site (Figure 7), and include large contiguous areas of native vegetation. Some of the larger tracts of vegetation in the vicinity have been identified as *Priority Conservation Lands* (PCLs) in the *Cumberland Plain Recovery Plan* (DECCW 2010) – but vegetation on the subject land and the subject site has not been identified as a PCL (Figure 8).

In contrast to the PCLs, the vegetation on the subject site is small in extent, and is significantly modified and degraded (Appendix A). In addition, it is isolated from the nearby PCLs and other notable areas of vegetation by the existing uses of the eastern part of the site, and by other clearing, disturbance and development (Figures 1, 2 and 8).

It is noted that DECCW (2010) in the *Cumberland Plain Recovery Plan* excluded areas that were “zoned for residential and industrial purposes”, as well as areas “that have been identified for future urban growth”. This largely because of the difficulties in rezoning these areas for conservation purposes - due to their “higher land values and stronger development pressures”.

According to the *Recovery Plan*, a total of 39% of the extant Cumberland Plain Woodland vegetation is located within the PCLs, and is (theoretically at least) protected by the *Recovery Plan*. The subject site was not considered by DECCW to constitute even part of a PCL (Figure 8).

4.2 Cumberland Plain Woodland - Conclusions

On the basis of all of the considerations documented above, some of the open forest and woodland vegetation on the subject site at Glenfield would clearly satisfy the criteria identified in the *Cumberland Plain Recovery Plan* for the Cumberland Plain Woodland (CPW) community – as listed both in the TSC Act and EPBC Act. The areas which do constitute the CPW community, however, are moderately to highly disturbed, and have been so for a considerable period.

Some of the woodland vegetation present, however, is not considered to satisfy the criteria for the listing of the CPW community pursuant to either the TSC Act or EPBC Act. This view is based on:

- the depauperate nature portions of the vegetation present (particularly the dominance of introduced species in the groundcover layer);
- the deliberations within the *Cumberland Plain Recovery Plan*; and
- the mapping of vegetation in this part of Sydney by Tozer *et al* 2010 (Figure 6) – which indicates potential areas of vegetation which do not satisfy the criteria identified in the *Cumberland Plain Recovery Plan*.

There are a number of areas of vegetation which are very highly modified and degraded, which do not, in the opinion of SLR Ecology, satisfy the criteria for the CPW community (Figure 7).

4.3 Freshwater Wetlands on Coastal Floodplains

The *Final Determination* for the listing of the Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (FWCF) community as “*endangered ecological community*” (EEC) in the TSC Act, states *inter alia* (in paragraph 4) that:

- “*Artificial wetlands created on previously dry lands specifically for purposes such as sewage treatment, stormwater management and farm production, are not regarded as part of this community*”.

The watercourses and freshwater ponds contained within the Glenfield Waste Services site are all artificial in nature, and have been constructed specifically for the purposes of “*stormwater management*”. Notwithstanding the floristics of some of these features, which conform in part at least to the floristic assemblage for the FWCF community, that EEC is not present (because of the artificial nature of the relevant features).

5 CONCLUSIONS

A detailed investigation of vegetation within the “*subject site*” (ie part of the Glenfield Waste Services site at Glenfield) has been undertaken in order to determine the extent, nature and condition of native vegetation on the subject site. As discussed above in the *Report*, the subject site constitutes the land between Cambridge Avenue (to the south), the Georges River (to the east) and the Glenfield-East Hills railway line (to the north and northwest).

Significant portions of the subject site have long been cleared and modified, and have long been used in part for an existing waste recycling facility, as well as associated structures (offices, parking areas and a weigh bridge). However, there is a band of native vegetation in the southern, central and western parts of the subject site - which contain a tree canopy of eucalypts which are characteristic of the Cumberland Plain Woodland (CPW) community. There is also a narrow band of highly disturbed open forest along the western edge of the subject site, adjacent to the Georges River.

The CPW community is listed in the *Threatened Species Conservation Act 1995* (TSC Act) as a “*critically endangered ecological community*” (CEEC), and is also listed as part of a CEEC in the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act).

The detailed considerations of vegetation within the subject site by SLR Ecology have determined that some of the woodland vegetation in these areas would constitute an example of the CPW community – as listed both at state and federal level. The woodland vegetation in ‘Low’ to ‘Moderate’ condition would satisfy the criteria required to constitute an example of the CPW CEEC.

Conversely, there are areas of vegetation which retain a CPW canopy but which are highly degraded and depauperate. These are identified as being in ‘Very Low’ condition, and are not considered by SLR Ecology to satisfy the criteria for the CPW community, at either the state or federal level.

There are artificial ponds and drainage lines on parts of the subject site at Glenfield. These have been constructed for the purposes of “*stormwater management*”, and have been colonised by an array of native aquatic and semi-aquatic plant species. Notwithstanding their floristics, these features do not constitute an example of the Freshwater Wetlands on Coastal Floodplains (FWCF) EEC (listed in the TSC Act) - because of the artificial nature of these features.

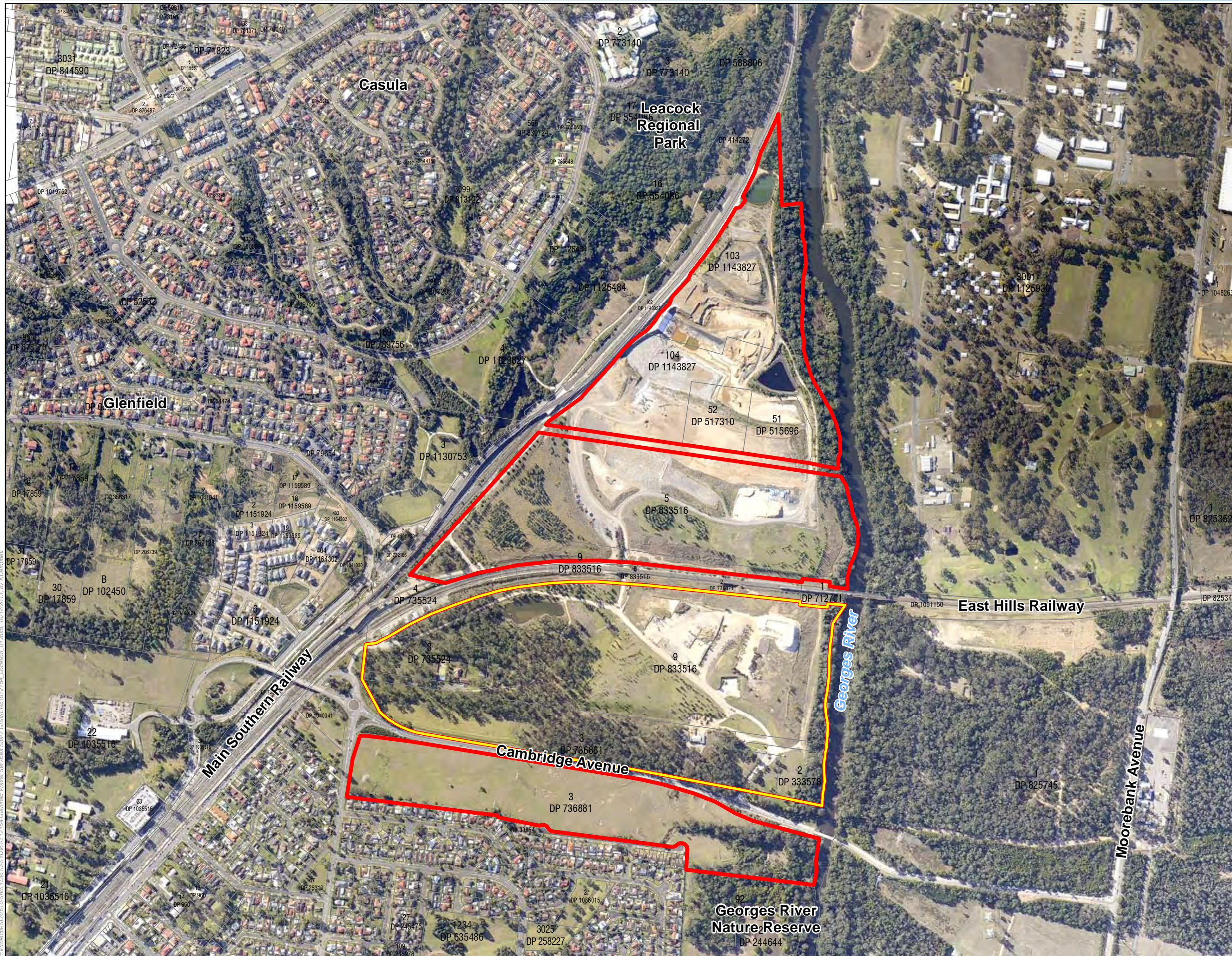
It is noted, however, that the mere presence of the CPW community does not prohibit development on the subject site, but requires further detailed consideration with respect to:

- the extent of vegetation which can reasonably be removed;
- the need for and quantity of “*biodiversity offsets*” required - to compensate for the removal of CPW vegetation; and
- the relevant considerations to be given to the retention, rehabilitation and long-term management of some of the areas of CPW on the site.

These matters will need further consideration in consultation with Council and the Office of Environment & Heritage (OEH).

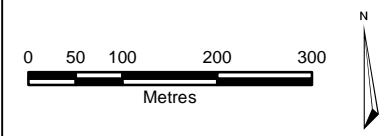
Figure 1

Location of the Glenfield Waste Services Site at Glenfield



LEGEND

- Glenfield Waste Services Site
- Subject Site
- Cadastre



NOTES

1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
3. Map locator courtesy of ESRI 'World Topo Map'
4. All features are approximate only and subject to detailed survey

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Project No:		610.12154	
Scale	1:750,000 @ A3	Date	10/12/2013
Drafted	Kelly Campbell	Approved	Fiona Iolini

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Figure 2

Details of the subject site at Glenfield



LEGEND

- Subject Site
- Water Feature Corridor
- Road Corridor
- Transmission Easement
- Cadastre
- Photo Points



NOTES

1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
3. Photo Point surveyed by SLR Ecology on the 30th of September and 1st of October 2013
4. All features are approximate only and subject to detailed survey



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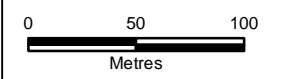
Figure 3

Recent flora surveys on the subject site at Glenfield



LEGEND

- Subject Site
- Flora Meander
- Flora Quadrats
- Cadastre



NOTES

1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
3. Flora Meander and Quadrats surveyed by SLR Ecology on the 30th of September and 1st of October 2013
4. All features are approximate only and subject to detailed survey

SLR

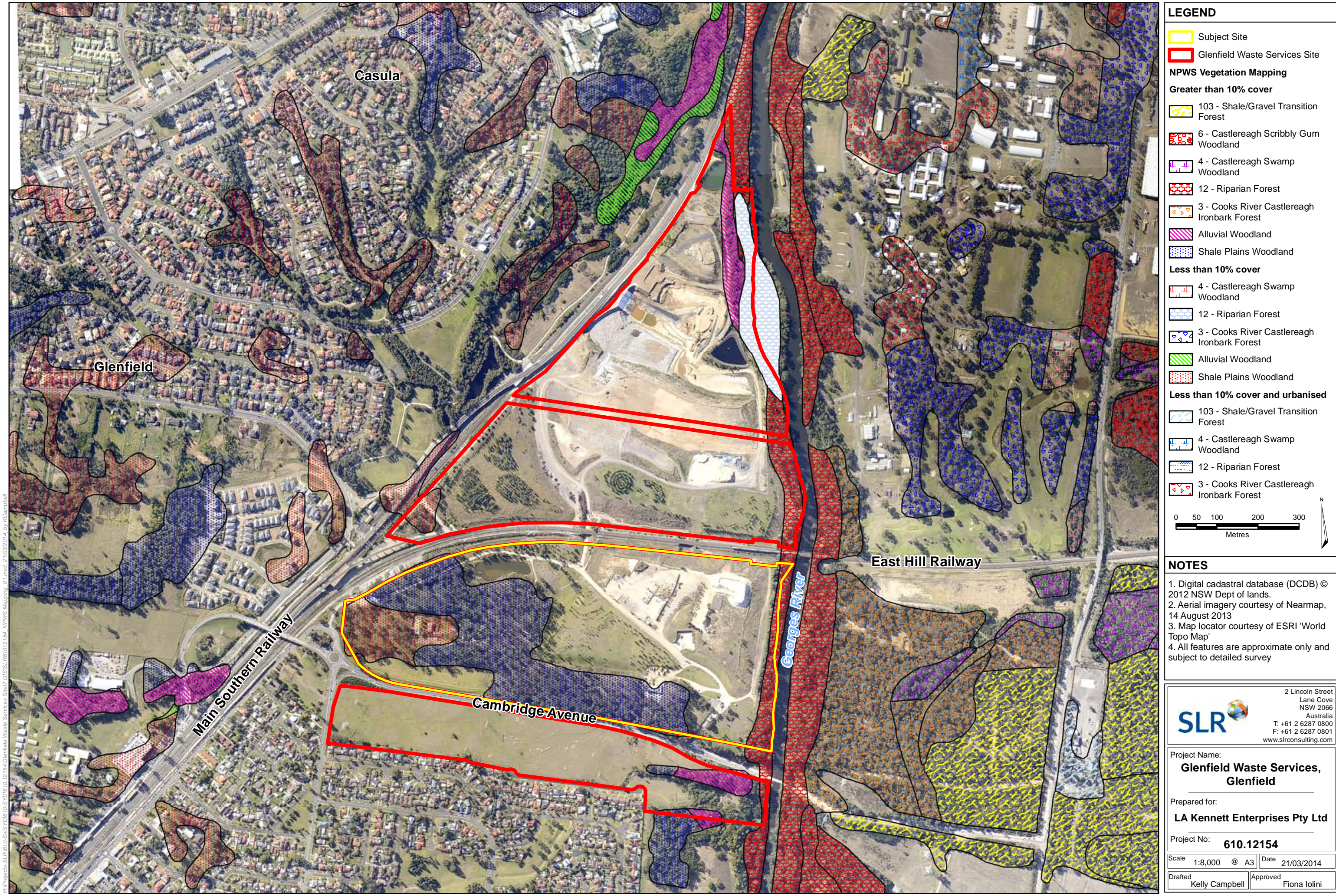
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Project No:		610.12154	
Scale	1:3,500 @ A3	Date	10/12/2013
Drafted	Kelly Campbell	Approved	Fiona Iolini

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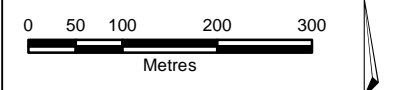
Figure 4

Vegetation mapping by NPWS (2002) of the subject site and surrounds at Glenfield



LEGEND

- Subject Site
- Glenfield Waste Services Site
- NPWS Vegetation Mapping**
- Greater than 10% cover**
- 103 - Shale/Gravel Transition Forest
- 6 - Castlereagh Scribbly Gum Woodland
- 4 - Castlereagh Swamp Woodland
- 12 - Riparian Forest
- 3 - Cooks River Castlereagh Ironbark Forest
- Alluvial Woodland
- Shale Plains Woodland
- Less than 10% cover**
- 4 - Castlereagh Swamp Woodland
- 12 - Riparian Forest
- 3 - Cooks River Castlereagh Ironbark Forest
- Alluvial Woodland
- Shale Plains Woodland
- Less than 10% cover and urbanised**
- 103 - Shale/Gravel Transition Forest
- 4 - Castlereagh Swamp Woodland
- 12 - Riparian Forest
- 3 - Cooks River Castlereagh Ironbark Forest



NOTES

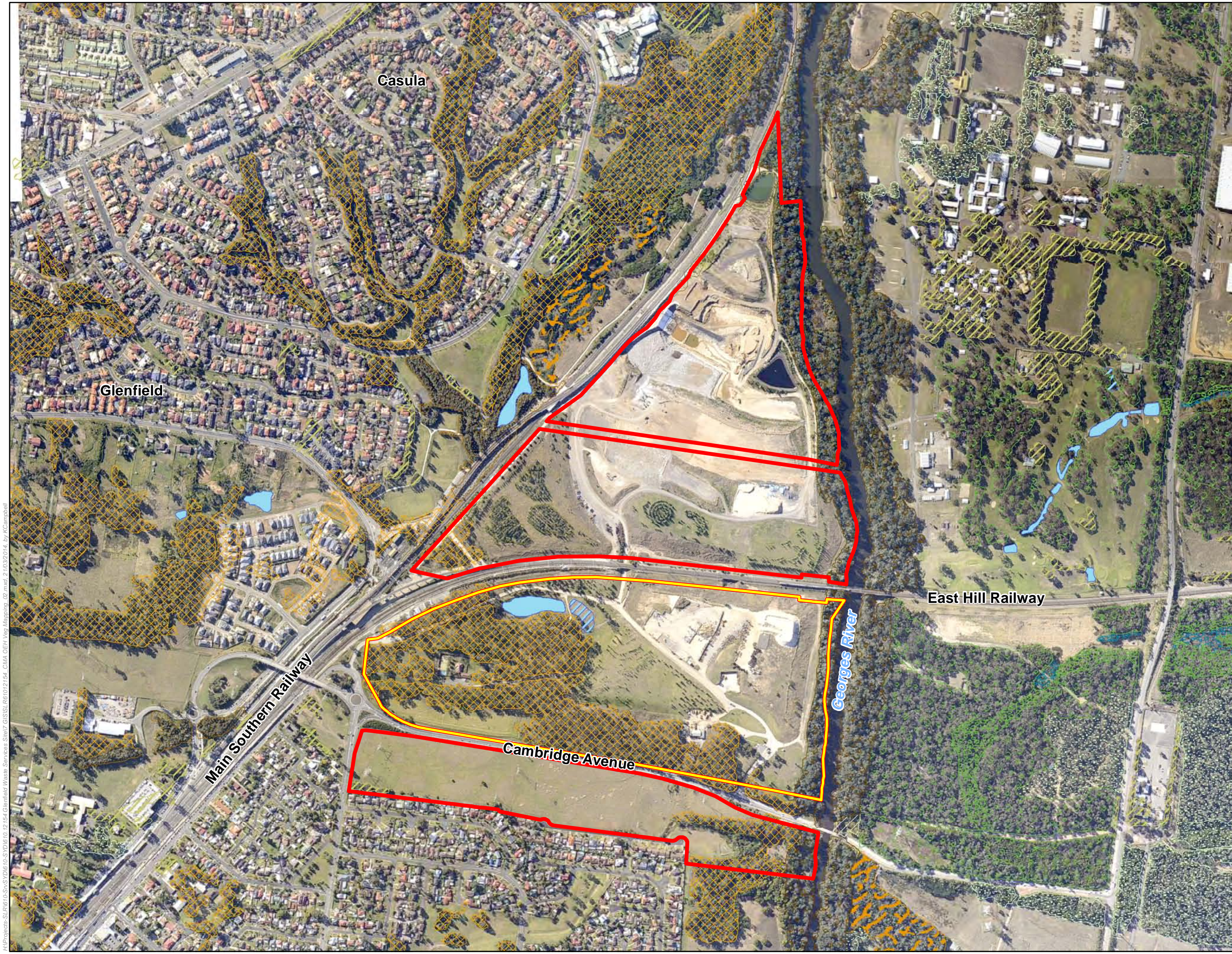
1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
3. Map locator courtesy of ESRI 'World Topo Map'
4. All features are approximate only and subject to detailed survey

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Project No:		610.12154	
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Figure 5 Vegetation mapping by the CMA/OEH (2009) of the subject site and surrounds at Glenfield



LEGEND

- Subject Site
- Glenfield Waste Services Site
- Cumberland Moist Shale Woodland
- Cumberland Shale Plains Woodland
- Castlereagh Shale-Gravel Transition Forest
- Castlereagh Scribbly Gum Woodland
- Castlereagh Swamp Woodland
- Coastal Freshwater Reedland
- Cumberland Riverflat Forest
- Cumberland Swamp Oak Riparian Forest
- Hinterland Flats Eucalypt Forest
- Urban Exotic/Native
- Weeds and Exotics
- Artificial Wetland
- Water

0 50 100 200 300
Metres

NOTES

1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
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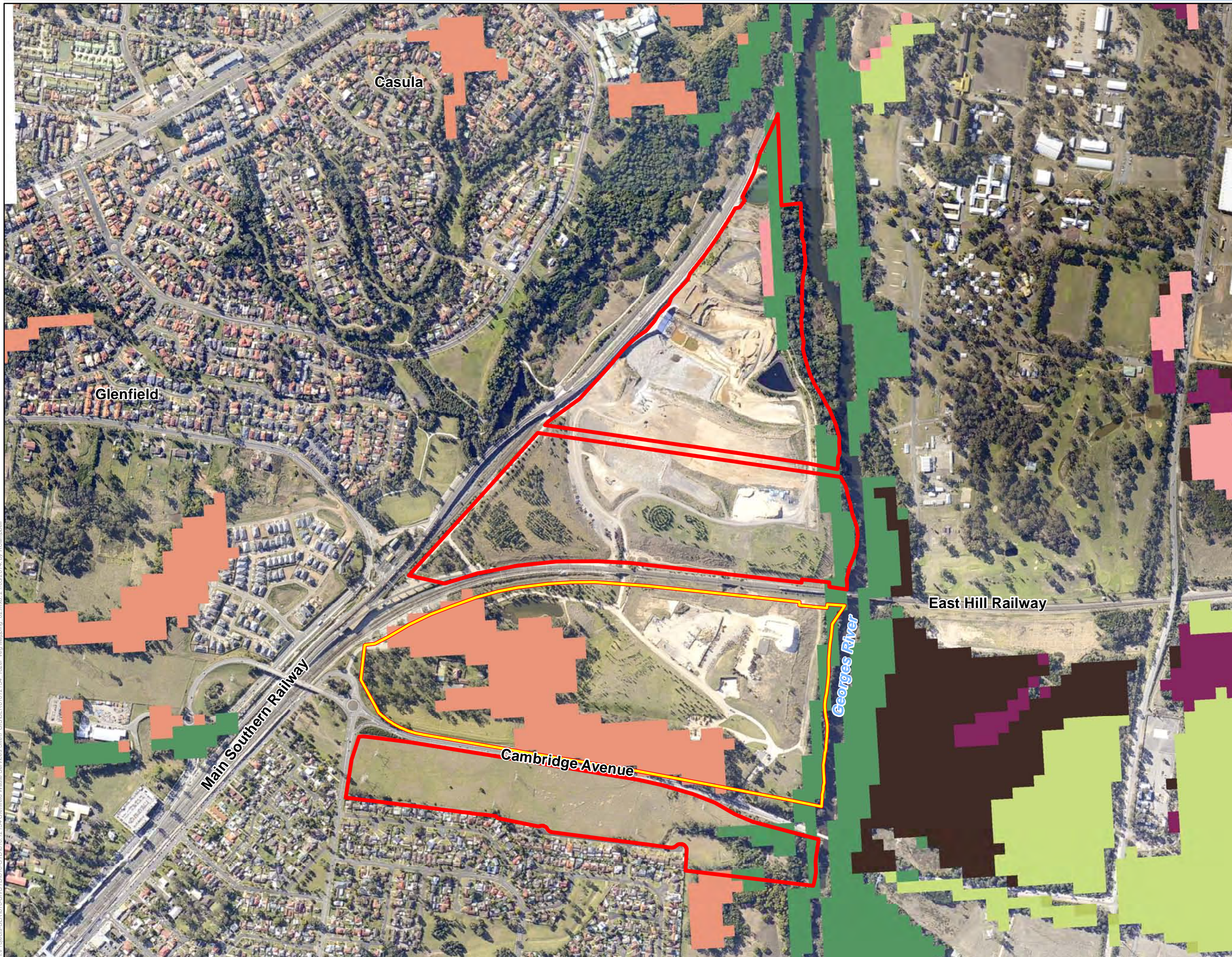
Scale: 1:8,000 @ A3 Date: 21/03/2014

Drafted: Kelly Campbell Approved: Fiona Iolini

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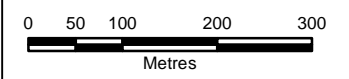
Figure 6

Vegetation mapping by the Tozer (2010) of the subject site and surrounds at Glenfield



LEGEND

- Subject Site
- Glenfield Waste Services Site
- Castlereagh Ironbark Forest
- Castlereagh Scribbly Gum Woodland
- Castlereagh Shale-Gravel Transition Forest
- Castlereagh Swamp Woodland
- Cleared
- Coastal Sandstone Plateau Heath
- Cumberland River Flat Forest
- Cumberland Shale Plains Woodland
- Cumberland Shale Sandstone Transition Forest



NOTES

1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
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Drafted	Kelly Campbell	Approved	Fiona Iolini

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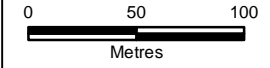
Figure 7

SLR Ecology vegetation condition mapping on the subject site at Glenfield



LEGEND

- Subject Site
- Cadastre
- Artificial Cumbungi Wetland**
- Very low (1.34Ha)
- Grey Box - Red Gum Woodland**
- Very Low (3.48Ha)
- Low - Moderate (7.55Ha)
- Red Gum - Ironbark Woodland**
- Very Low (0.9Ha)
- Low (0.06Ha)
- Moderate (0.63Ha)
- Red Gum - Stringybark Riparian Forest**
- Very low (1.41Ha)



NOTES

1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
3. Vegetation mapping undertaken by SLR Ecology on the 30th of September and 1st of October 2013
4. All features are approximate only and subject to detailed survey



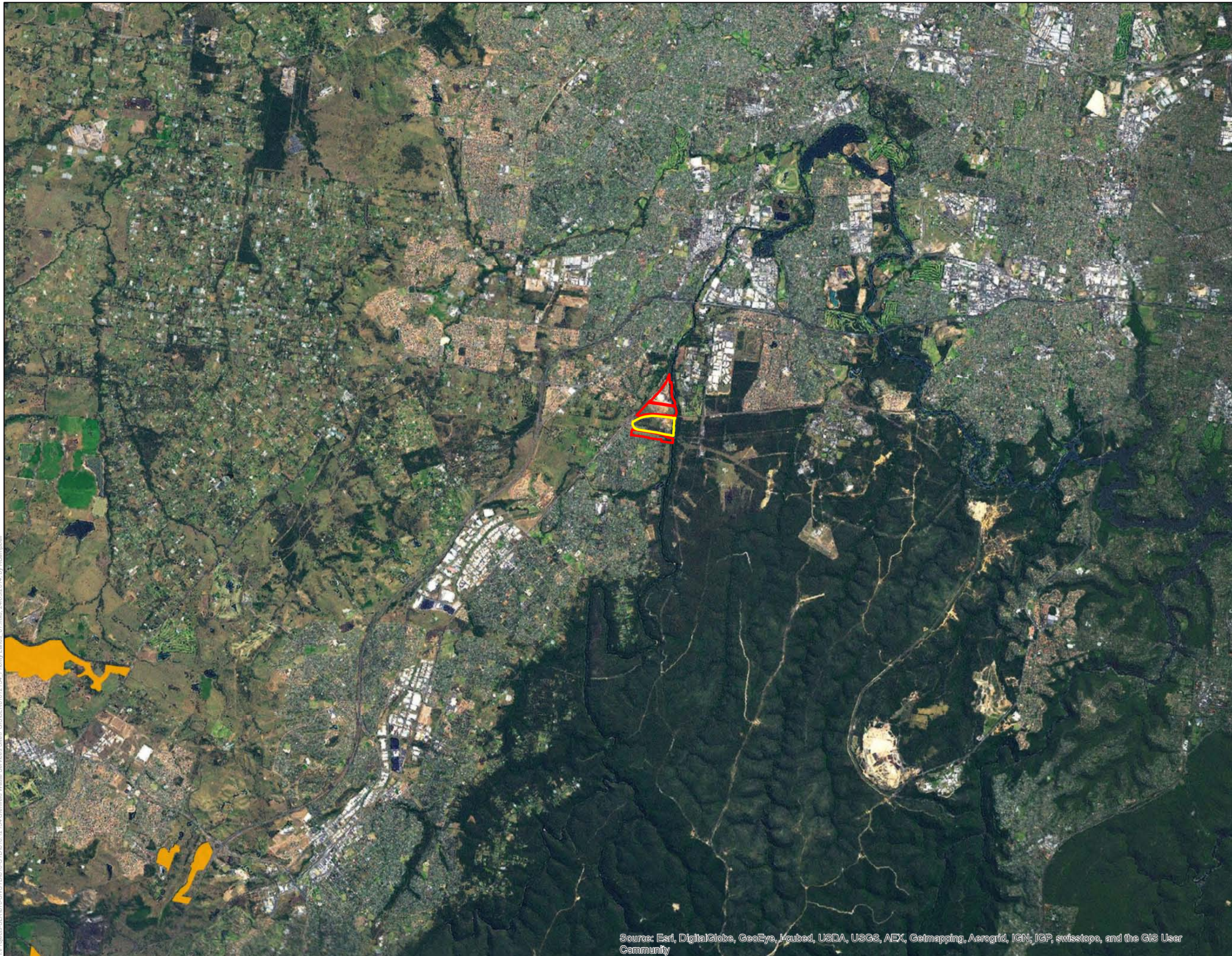
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Project Name:		Glenfield Waste Services, Glenfield	
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Drafted	Louise Hibbert	Approved	Fiona Iolini

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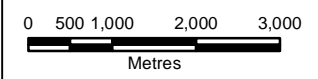
Figure 8

Priority Conservation Lands



LEGEND

-  Glenfield Waste Services Site
-  Subject Site
-  Priority Conservation Lands



NOTES

1. Digital cadastral database (DCDB) © 2012 NSW Dept of lands.
2. Aerial imagery courtesy of Nearmap, 14 August 2013
3. Map locator courtesy of ESRI 'World Topo Map'
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Project Name:
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Project No: **610.12154**

Scale	1:90,000 @ A3	Date	24/03/2014
Drafted	Kelly Campbell	Approved	Fiona Iolini

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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global environmental solutions

Glenfield Waste Services Site
Cambridge Avenue, Glenfield

Proposed Rezoning & Expansion

Cumberland Plain Woodland Assessment Report

Appendix A
Photographs of the Subject Site

March 2014



Photo Point 1

- NW – exotic grass area with Grey Box and some Red Gum



Photo Point 2

- S – patch of Cobblers Pegs along fence



Photo Point 3

- Couch Grass along fence



Photo Point 4

- Bund with exotic Nasella Grass ?



Photo Point 5

- NE – highly disturbed groundcover in the vicinity of the compound



Photo Point 6

- Grey Box with highly disturbed groundcover - maintained for asset protection to the landfill



Photo Point 7

- NW – from on top of the bund showing the Grey Box with *Melaleuca decora* at this location



Photo Point 8

- W – areas dominated by Weeping Grass



Photo Point 9

- W – asset protection involving complete removal of groundcover for approximately 50m south of the landfill



Photo Point 10

- SW – Grey Box woodland with mixed native and exotic groundcover and colour bond fence along southern boundary (Cambridge Avenue)



Photo Point 11

- W – Grey Box with dry grassy groundcover



Photo Point 12

- N – mesh fence running north-south here. Note – colourbond fence along southern boundary stops at the mesh fence, but bund continues to the west.



Photo Point 13

- W – grass is mostly Weeping Grass at this point



Photo Point 14

- W – paddock wire fencing to the mesh fence



Photo Point 15

- NW - all exotic grass



Photo Point 16

- W – almost entirely exotic grasses



Photo Point 17

- Grey Box trees with exotic grasses



Photo Point 18

- Grey Box trees with Kikuyu and Couch



Photo Point 19

- W - Grey Box trees with exotic grasses and weeds



Photo Point 20

- NW - Grey Box trees with exotic grasses (mainly Kikuyu) and row of planted Swamp Oaks at entrance gates



Photo Point 21

- E - Driveway planted out with exotic deciduous trees



Photo Point 22

- S - planted trees



Photo Point 23

- NE - paddock of exotic lawn grass with Grey Box, Narrow-leaved Ironbark and Stringybark



Photo Point 24

- NW - small wedge of regrowth eucalypts, Wattles and Weeping Grass



Photo Point 25

- E – exotic lawn



Photo Point 26

- SW - Exotic paddock



Photo Point 27

- E – mainly exotic grasses



Photo Point 28

- E – two rows of planted Swamp Oaks



Photo Point 29

- SE – Grey Box with mixed native/exotic grassland



Photo Point 30

- S – exotic lawn with scattered trees in the vicinity of the house



Photo Point 31

- S – Grey Box with mixed native/exotic grassland



Photo Point 32

- NE – Grey Box with mixed native/exotic grassland



Photo Point 33

- S – fairly exotic grass cover along this boundary where it is lower lying



Photo Point 34

- W – band of regrowth and/or planted eucalypts and Swamp Oaks with exotic grass and weeds



Photo Point 35

- Exotic lawn grass and plantings



Photo Point 36

- NW – drainage channel enters site from under train line and flows south to artificial wetland



Photo Point 37

- SE – artificial wetland with Cumbungi



Photo Point 38

- NE – Red Gum, Stringybark, Ironbark and Rough-barked Apple with some native understorey and mown mixed native/exotic grassland



Photo Point 39

- W – moderate condition CPW vegetation, which is highly diverse but mown, with some weed invasion



Photo Point 40

- E – lower slope is exotic



Photo Point 41

- W – artificial wetland with exotic grasses and weeds around edges



Photo Point 42

- N – riparian Red Gum and Stringybark with Wattles, African Olive and Lantana



Photo Point 43

- NE – riparian vegetation is highly disturbed by weed invasion and rubbish



Photo Point 44

- S – Georges River



Photo Point 45

- N – riparian vegetation with similar dry CPW species to the remainder of the site



global environmental solutions

Glenfield Waste Services Site
Cambridge Avenue, Glenfield

Proposed Rezoning & Expansion

Cumberland Plain Woodland Assessment Report

Appendix B
Final Determination for CPW

March 2014



You are here: [Home](#) > [Threatened species](#) > [Scientific Committee](#) > [Determinations](#)

Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing

NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Cumberland Plain Woodland in the Sydney Basin Bioregion as a CRITICALLY ENDANGERED ECOLOGICAL COMMUNITY in Part 2 of Schedule 1A of the Act and as a consequence, to omit reference to Cumberland Plain Woodland from Part 3 of Schedule 1 (Endangered Ecological Communities) of the Act. The listing of Critically Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Cumberland Plain Woodland was listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995* in June 1997 (NSW Scientific Committee 1997). Since this listing, a large volume of new data and analyses have become available. In addition, a nomination to change the status of Cumberland Woodland to Critically Endangered status has been received. This Determination addresses additional information now available in accordance with current listing criteria under the *Threatened Species Conservation Regulation 2002*.

2. Cumberland Plain Woodland is the name given to the ecological community in the Sydney Basin bioregion associated with clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain, a rainshadow area to the west of Sydney's Central Business District. The mean annual rainfall of this area is typically in the range of 700-900 mm, and is generally lower than that received on more elevated terrain that partially surrounds the Plain. The community typically occurs on flat to undulating or hilly terrain up to about 350 m elevation but may also occur on locally steep sites and at slightly higher elevations. Cumberland Plain Woodland is characterised by the assemblage of species listed in paragraph 3 and typically comprises an open tree canopy, a near-continuous groundcover dominated by grasses and herbs, sometimes with layers of shrubs and/or small trees. Shrubs may sometimes occur in locally dense stands. Less disturbed stands of the community may have a woodland or forest structure. Small trees or saplings may dominate the community in relatively high densities after partial or total clearing, and the groundcover may be relatively sparse, especially where densities of trees or shrubs are high. The community also includes 'derived' native grasslands which result from removal of the woody strata from the woodlands and forests.

3. Cumberland Plain Woodland is characterised by the following assemblage of species:

<i>Acacia implexa</i>	<i>Ajuga australis</i>
<i>Aristida ramosa</i>	<i>Aristida vagans</i>
<i>Arthropodium milleflorum</i>	<i>Arthropodium minus</i>
<i>Asperula conferta</i>	<i>Austrodanthonia caespitosa</i>
<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	<i>Austrodanthonia tenuior</i>
<i>Bossiaea prostrata</i>	<i>Bothriochloa decipiens</i>
<i>Bothriochloa macra</i>	<i>Brunoniella australis</i>
<i>Bursaria spinosa</i>	<i>Carex inversa</i>
<i>Centaureum spicatum</i>	<i>Centella asiatica</i>
<i>Cheilanthes distans</i>	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>
<i>Chloris truncata</i>	<i>Chloris ventricosa</i>
<i>Chorizema parviflorum</i>	<i>Chrysocephalum apiculatum</i>
<i>Clematis glycinoides</i> var. <i>glycinoides</i>	<i>Commelina cyanea</i>
<i>Crassula sieberiana</i>	<i>Cymbonotus lawsonianus</i>
<i>Cymbopogon refractus</i>	<i>Cyperus gracilis</i>
<i>Daucus glochidiatus</i>	<i>Daviesia ulicifolia</i>

Appendix B Final Determination for the Cumberland Plain Woodland

19/09/2013 Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing | NSW Environment & Heritage

<i>Desmodium brachypodium</i>	<i>Desmodium varians</i>
<i>Dianella longifolia</i>	<i>Dichanthium sericeum</i>
<i>Dichelachne micrantha</i>	<i>Dichelachne parva</i>
<i>Dichondra repens</i>	<i>Dichopogon fimbriatus</i>
<i>Dichopogon strictus</i>	<i>Digitaria diffusa</i>
<i>Dillwynia sieberi</i>	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>
<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	<i>Echinopogon ovatus</i>
<i>Einadia hastata</i>	<i>Einadia nutans</i>
<i>Einadia polygonoides</i>	<i>Einadia trigonos</i>
<i>Elymus scaber</i> var. <i>scaber</i>	<i>Eragrostis leptostachya</i>
<i>Eremophila debilis</i>	<i>Eriochloa pseudoacrotricha</i>
<i>Eucalyptus crebra</i>	<i>Eucalyptus eugenioides</i>
<i>Eucalyptus moluccana</i>	<i>Eucalyptus tereticomis</i>
<i>Euchiton sphaericus</i>	<i>Exocarpus cupressiformis</i>
<i>Fimbristylis dichotoma</i>	<i>Galium migrans</i>
<i>Galium propinquum</i>	<i>Geranium homeanum</i>
<i>Geranium solanderi</i> var. <i>solanderi</i>	<i>Glossogyne tannensis</i>
<i>Glycine clandestina</i>	<i>Glycine microphylla</i>
<i>Glycine tabacina</i>	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>
<i>Hardenbergia violacea</i>	<i>Hypericum gramineum</i>
<i>Hypoxis hygrometrica</i>	<i>Hypoxis pratensis</i> var. <i>pratensis</i>
<i>Indigofera australis</i>	<i>Juncus usitatus</i>
<i>Lachnagrostis avenacea</i> var. <i>avenacea</i>	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	<i>Mentha diemenica</i>
<i>Microlaena stipoides</i> var. <i>stipoides</i>	<i>Opercularia diphylla</i>
<i>Oxalis perennans</i>	<i>Panicum effusum</i>
<i>Paspalidium distans</i>	<i>Phyllanthus virgatus</i>
<i>Plantago debilis</i>	<i>Plantago gaudichaudii</i>
<i>Plectranthus parviflorus</i>	<i>Poa labillardieri</i> var. <i>labillardieri</i>
<i>Pratia purpurascens</i>	<i>Pultenaea microphylla</i>
<i>Rubus parvifolius</i>	<i>Scleria mackaviensis</i>
<i>Scutellaria humilis</i>	<i>Senecio diaschides</i>
<i>Senecio hispidulus</i> var. <i>hispidulus</i>	<i>Sida corrugata</i>
<i>Solanum cinereum</i>	<i>Solanum prinophyllum</i>
<i>Sorghum leiocladum</i>	<i>Sporobolus creber</i>
<i>Sporobolus elongatus</i>	<i>Stackhousia viminea</i>
<i>Themeda australis</i>	<i>Tricoryne elatior</i>
<i>Vernonia cinerea</i> var. <i>cinerea</i>	<i>Veronica plebeia</i>
<i>Wahlenbergia gracilis</i>	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>
<i>Wurmbea dioica</i> subsp. <i>dioica</i>	<i>Zornia dyctiocarpa</i> var. <i>dyctiocarpa</i>

Other tree species occurring less frequently in this community include:

<i>Angophora bakeri</i>	<i>Angophora floribunda</i>
<i>Angophora subvelutina</i>	<i>Corymbia maculata</i>
<i>Eucalyptus amplifolia</i>	<i>Eucalyptus baueriana</i>
<i>Eucalyptus bosistoana</i>	<i>Eucalyptus fibrosa</i>
<i>Eucalyptus globoidea</i>	<i>Eucalyptus longifolia</i>
<i>Eucalyptus paniculata</i>	<i>Eucalyptus punctata</i>
<i>Syncarpia glomulifera</i>	

4. The total species list of the community is larger than that given above, with many species present in only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including grazing, land clearing and fire) history. The number and relative abundance of species will change with time since fire, and may also change in response to changes in fire frequency or grazing regime. At any one time, above-ground individuals of some species may be absent, but the species may be represented below-ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. Benson and Howell (2002) and Benson & von Richter (2008) document the temporal variability in the species composition of the community. The list of species given above is mainly of vascular plant species, however the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. The mammalian and avian components of the fauna have been described by Leary (*in litt.* August 2007) and Farrell (*in litt.* June 2007). Other components of the community are poorly documented (although see Benson & von Richter 2008).

5. Cumberland Plain Woodland is characterised by an upper-storey that is usually dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), often with *E. crebra* (Grey Ironbark), *E. eugenioides* (Narrow-leaved Stringybark), *Corymbia maculata* (Spotted Gum) or other less frequently occurring eucalypts, including *Angophora floribunda*, *A. subvelutina* (Broad-leaved Apple), *E. amplifolia* (Cabbage Gum) and *E. fibrosa* (Broad-leaved Ironbark). The community may have an open stratum of small trees that may include any of these eucalypts, as well as species such as *Acacia decurrens* (Black Wattle), *A. parramattensis* (Parramatta Wattle), *A. implexa* (Hickory Wattle) or *Exocarpos cupressiformis* (Native Cherry). Shrubs are typically scattered in the understorey but may be absent or locally dense as a result of clearing activity or changes in grazing or fire regimes. *Bursaria spinosa* (Blackthorn) is usually dominant, while other species include *Daviesia ulicifolia* (Gorse Bitter Pea), *Dillwynia sieberi*, *Dodonaea viscosa* subsp. *cuneata* and *Indigofera australis* (Native Indigo). The ground cover is dominated by a diverse range of grasses including *Aristida ramosa* (Purple Wiregrass), *A. vagans* (Threeawn Speargrass), *Cymbopogon refractus* (Barbed Wire Grass), *Dichelachne micrantha* (Plumegrass), *Echinopogon caespitosus* (Forest Hedgehog Grass), *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Grass), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass), and with graminoids *Carex inversa* (Knob Sedge), *Cyperus gracilis*, *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush) and *L. multiflorus* subsp. *multiflorus* (Many-flowered Mat-rush). The ground cover also includes a diversity of forbs such as *Asperula conferta* (Common Woodruff), *Brunoniella australis* (Blue Trumpet), *Desmodium varians* (Slender Tick Trefoil), *Dianella longifolia* (Blue Flax Lily), *Dichondra repens* (Kidney Weed), *Opercularia diphylla*, *Oxalis perennans* and *Wahlenbergia gracilis* (Australian Bluebell), as well as scramblers, *Glycine* spp. and *Hardenbergia violacea* (Native Sarsaparilla) and the fern *Cheilanthes sieberi* (Poison Rock Fern).

6. The structure of the community varies depending on past and current disturbances, particularly clearing, fire and grazing. Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy groundcover. At some sites, mature trees may exceed 30m tall, although regrowth stands may be shorter than 10 m tall. After total or partial clearing, the tree canopy may remain sparse or may regrow to form dense stands of saplings and small trees, which are typically associated with a ground layer of reduced cover and diversity. Either or both of the upper-storey and mid-storey may be absent from the community. Native grasslands derived from clearing of the woodland and forest are also part of this community if they contain characteristic non-woody species listed in paragraph 3.

7. Cumberland Plain Woodland includes: 'Shale Hills Woodland' (map unit 9) and 'Shale Plains Woodland' (map unit 10) of Tozer (2003); 'Spotted Gum Forest' (map unit 9b), 'Grey Box Woodland' (map unit 10c) and 'Grey Box - Ironbark Woodland' (map unit 10d) of Benson (1992); and 'Cumberland Plain Woodlands' of Benson & Howell (1990a; b). Tindall *et al.* (2004) and Tozer *et al.* (2006) subsequently reproduced Tozer's (2003) classification and mapping, re-labelling map units 9 and 10 as 'Cumberland Shale Hills Woodland' (map unit GW p28) and 'Cumberland Shale Plains Woodland' (map unit GW p29), respectively. Cumberland Plain Woodland belongs to the Coastal Valley Grassy Woodlands vegetation class (Keith 2004).

8. Several other ecological communities listed under the *Threatened Species Conservation Act* 1995 may intergrade with Cumberland Plain Woodland. These include Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion; Moist Shale Woodland in the Sydney Basin Bioregion; Shale / Sandstone Transition Forest; Shale Gravel Transition Forest in the Sydney Basin Bioregion; and Sydney Turpentine-Ironbark Forest. While Tozer (2003) provides information on the features that distinguish these communities, some transitional stands will be difficult to assign to a single community with a high level of confidence (Keith 2009). Transitional stands between Cumberland Plain Woodland and other communities listed under the *Threatened Species*

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Conservation Act 1995 are considered part of a listed community, and should be assigned to the community with which they share greatest resemblance in species composition and other properties.

9. Cumberland Plain Woodland in the Sydney Basin Bioregion is included within the critically endangered ecological community listed under the *Environment Protection and Biodiversity Conservation Act* as "Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest". However the Commonwealth listing advice excludes some patches, here regarded as Cumberland Plain Woodland, on the basis of condition or structure thresholds.

10. The following threatened species have been recorded from Cumberland Plain Woodland:

Invertebrates

Cumberland Land Snail *Meridolum comeovirens* Endangered

Birds

Gang Gang Cockatoo	<i>Callocephalon fimbriatum</i>	Vulnerable
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	Vulnerable
Brown Treecreeper	<i>Climacteris picumnus</i>	Vulnerable
Painted Honeyeater	<i>Grantiella picta</i>	Vulnerable
Swift Parrot	<i>Lathamus discolor</i>	Endangered
Square-tailed Kite	<i>Lophoictinia isura</i>	Vulnerable
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	Vulnerable
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	Vulnerable
Turquoise Parrot	<i>Neophema pulchella</i>	Vulnerable
Barking Owl	<i>Ninox connivens</i>	Vulnerable
Powerful Owl	<i>Ninox strenua</i>	Vulnerable
Speckled Warbler	<i>Pyrholaemus sagittatus</i>	Vulnerable
Diamond Firetail	<i>Stagonopleura guttata</i>	Vulnerable
Masked Owl	<i>Tyto novaehollandiae</i>	Vulnerable
Sooty Owl	<i>Tyto tenebricosa</i>	Vulnerable
Regent Honeyeater	<i>Xanthomyza phrygia</i>	Endangered

Mammals

Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Vulnerable
Spotted-tail Quoll	<i>Dasyurus maculata</i>	Vulnerable
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Vulnerable
Eastern Bent-wing Bat	<i>Miniopterus schreibersii</i>	Vulnerable
Eastern Freetail Bat	<i>Mormopterus norfolkensis</i>	Vulnerable
Southern Myotis	<i>Myotis macropus</i>	Vulnerable
Yellow-bellied Glider	<i>Petaurus australis</i>	Vulnerable
Squirrel Glider	<i>Petaurus norfolkensis</i>	Vulnerable
Koala	<i>Phascolarctos cinereus</i>	Vulnerable
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Vulnerable
Yellow-bellied Sheathtail Bat	<i>Saccolaimus flaviventris</i>	Vulnerable
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	Vulnerable

Plants

Downy Wattle	<i>Acacia pubescens</i>	Vulnerable
Juniper-leaved Grevillea	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Vulnerable
Native Pear	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Endangered Population
Narrow-leaved Geebung	<i>Persoonia nutans</i>	Endangered
Spiked Riceflower	<i>Pimelea spicata</i>	Endangered
Matted Bush-pea	<i>Pultenaea pedunculata</i>	Endangered
Sydney Plains Greenhood	<i>Pterostylis saxicola</i>	Endangered

11. Cumberland Plain Woodland is restricted to the Sydney Basin Bioregion (*sensu* Thackway and Cresswell) and is currently known to occur within the local government areas of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly, but may occur elsewhere within the bioregion. Using map data from Tozer (2003), Cumberland Plain Woodland was estimated to occur within an extent of occurrence of 2810 km², and an area of occupancy of just under 2 100 km² based on 2 x 2 km grid cells, the spatial scale recommended by IUCN (2008) for assessing areas of occupancy for species.

12. Small areas of Cumberland Plain Woodland have been recorded from Kemps Creek, Mulgoa and Windsor Downs Nature Reserves, Scheyville National Park, and Leacock, Rouse Hill and Western Sydney Regional Parks.

13. Based on aerial photography flown in November 1998, Tozer (2003) estimated the total extent of woody vegetation referred to as Cumberland Plain Woodland was 11 054 (±1 564) ha (upper and lower plausible bounds, *sensu* Keith et al. 2009), representing 8.8 (±1.2)% of the pre-European distribution of the community. Patches of the community lacking woody vegetation are very small in extent and can be considered to be included within the plausible bounds. For that part of the community's distribution to the east of the Hawkesbury-Nepean River, earlier mapping at coarser resolution by Benson & Howell (1990b) suggests a similar level of depletion, with an estimated 6 420 ha of 'Cumberland Plain Woodlands', representing 6% of the pre-European distribution east of the Hawkesbury-Nepean River. An update of Tozer's (2003) map, based on interpretation of imagery flown in January-March 2007 shows that the extent of Cumberland Plain Woodland east of the Hawkesbury - Nepean River had declined by 442±46 ha, a reduction of 5.2±0.6% in 9 years (NSW Scientific Committee & Simpson 2008). These estimates indicate that the geographic distribution of the community has undergone a very large reduction over a time frame appropriate to the life cycle and habitat characteristics of its component species.

14. Some areas of Cumberland Plain Woodland subjected to a history of partial clearing and grazing have recently undergone a change in management to conserve the community. Examples include Mt Annan Botanic Garden, Scheyville National Park, Western Sydney Regional Park, Elizabeth Macarthur Agricultural Institute, Orchard Hills Defence Site and the former Australian Defence Industries site at St Marys. Experience from these areas suggests that the community is capable of some recovery, provided the soil has not been disturbed by earthworks, cultivation, fertiliser application or other means of nutrient or moisture enrichment (Benson & Howell 2002; Pellow 2003; Keith et al. 2005; J. Howell *in litt.* August 2007; J. Sanders *in litt.* January 2008). In contrast, restoration of Cumberland Plain Woodland has proved to be problematic on sites that have been exposed to such soil disturbance. At Western Sydney Regional Park, for example, Wilkins et al. (2003), Nichols (2005) and Nichols et al. (2005) studied the recovery of abandoned pastures that had been planted with more than 20 native tree and shrub species of Cumberland Plain Woodland. Over 10 years they found no evidence of convergence in species composition with nearby remnant stands of the community and the species composition of restored areas remained indistinguishable from untreated pastures. There was some evidence that restored vegetation had begun to develop more species-rich assemblages of moths and butterflies compared to untreated pastures, although after 10 years, it lacked a number of species characteristic of remnant woodland (Lomov et al. 2006). Ant communities also showed marked differences between restored and remnant vegetation although some ecological processes, such as pollination and seed dispersal, showed some evidence of development at restored sites (Lomov 2005). These results suggest that sites with a history of soil disturbance will be extremely slow to recover characteristics of Cumberland Plain Woodland, if at all, and that experimentation with alternative restoration technologies is required. As a large proportion of the former distribution of the community has either undergone similar histories of soil disturbance or are now occupied by urban development, opportunities for restoration of the community across

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 significant areas appear limited.

15. The reduction in the geographic distribution of Cumberland Plain Woodland was initially due to tree-felling for timber and clearing for crops and pastures (Benson & Howell 1990a). Benson & Howell (1990b) estimated that the community had been reduced to approximately half of its pre-European extent by 1850. Following World War II, there was a marked acceleration in urban and industrial development, which continues to deplete the distribution of the community to the present day. These trends appear likely to continue into the future as the urban area continues to expand to accommodate Sydney's increasing population, which is projected to grow by 1.0-1.1 million people during the 20 years 2007-2026 and 2.2-3.3 million during the 50 years 2007-2056 (Australian Bureau of Statistics 2008). Recent draft plans to develop growth centres in north-west and south-west Sydney, for example, identify staged release of land for residential and employment development over the next 25 years. These areas contain approximately 2000 ha (one-fifth) of the estimated remaining Cumberland Plain Woodland based on Tozer (2003), of which about two-thirds will be available for development, the loss of which is planned for offsetting through voluntary land acquisition and/or the establishment of conservation agreements on lands outside the Growth Centres (Growth Centres Commission 2007) for the primary purpose of biodiversity conservation. While important examples of Cumberland Plain Woodland are represented within conservation reserves, much of the remaining area of the community occurs on private land or on public easements, where it is at risk from small-scale clearing associated with housing, industrial development and transport infrastructure. There are significant logistic and technological constraints and time lags associated with efforts to restore the community (Wilkins *et al.* 2003; Nichols 2005; Nichols *et al.* 2005). 'Clearing of native vegetation' is listed as a Key Threatening Process under the *Threatened Species Conservation Act 1995*.

16. Fragmentation of habitat associated with clearing has resulted in a very large reduction in the ecological function of Cumberland Plain Woodland. The remaining area of the community is severely fragmented, with more than half of the remaining tree cover mapped by Tozer (2003) occurring in patches of less than 80 ha and half of all mapped patches being smaller than 3 ha (Tozer *in litt.* October 2007). The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations (Young *et al.* 1996; Young & Clarke 2000). The impacts of fragmentation and associated processes are most evident in the loss of vertebrate fauna from the community (Farrell 2005; Farrell *in litt.* June 2007; Leary 2005; *in litt.* August 2007). As well, some invertebrate species, such as the Endangered Cumberland Land Snail, appear to be in decline, at least in the smaller fragments (M. Shea *in litt.* June 2007). The dieback of eucalypt canopies observed in stands of Cumberland Plain Woodland at Scheyville (D. Keith pers. comm. October 2008) may be a result of complex interactions involving insect attack, weed invasion, nutrient enrichment and drought, in which fragmentation also plays a role (Reid & Landsberg 2000; Wardell-Johnson *et al.* 2006). Despite their history of fragmentation, some very small and apparently degraded remnants may contain a surprisingly high diversity of species and important examples of rare species, particularly plants (James *et al.* 1999; Benson & Keith 1984; McBarron *et al.* 1988; Benson & Howell 1990a; Kirkpatrick & Gilfedder 1995). However, clearing and continuing degradation of these patches reduces the likelihood that all of these species will persist, particularly because a large proportion of species are known from very few locations which are not clustered in predictable ways (Benson & Howell 2002; Tozer 2003). Fragmentation also results in reduced fire frequencies within some patches, which may reduce the viability of some native plant populations, and hence the diversity of species within the patches (Clarke 2000; Watson 2005).

17. Changes in structure contribute to a very large reduction in the ecological function of Cumberland Plain Woodland. Almost all of the remaining area of the community is regrowth forest and woodland from past clearing activities (Benson & Howell 1990a). Mean tree densities in contemporary stands of the community were found to be substantially higher than historical estimates and tree sizes were thought to be smaller (Benson 1992). Large trees approximating the stature of the community prior to European settlement occur very sparsely within remnant patches of vegetation or remain as isolated individuals within paddocks or urban areas. Scheyville National Park, for example, which contains a large remnant of Cumberland Plain Woodland, was extensively logged and partially cleared over many decades prior to its reservation and is thought to contain as few as five large old trees likely to date from pre-European times (J. Sanders, *in litt.* January 2008). Loss of these large trees, which provide habitat resources for a range of fauna, is associated with declines and local extinctions of numerous birds and mammals that were once more common on the Cumberland Plain (Farrell 2005; T. Leary *in litt.* August 2007). Changes in understorey are difficult to assess, as responses to anthropogenic disturbances are confounded with responses to climatic variability (Benson & Howell 2002). Nevertheless, other structural changes to the community include the removal of fallen woody debris and standing dead trees, the removal of woody understorey plants, or conversely the development of regrowth stands with very high densities of eucalypt saplings or shrubs, notably *Bursaria spinosa*, which

may suppress the ground flora. Botanist Allan Cunningham noted high densities of *B. spinosa* in farmland near Liverpool as early as 1817 (Lee 1927; Benson 1992), while similar phases of high shrub abundance have been observed recently at Mt Annan and Scheyville in response to abandonment of farming practices (Benson & Howell 2002; J. Sanders, *in litt.* January 2008). Some areas of the community now devoid of woody plant species may retain a substantial suite of native grasses and herbs in the ground layer. The Orchard Hills Defence Site includes outstanding examples of this phenomenon (Pellow 2003; Keith *et al.* 2005). 'Loss of hollow-bearing trees' and 'Removal of dead wood and dead trees' are listed as Key Threatening Processes under the *Threatened Species Conservation Act 1995*.

18. While a sample of the original fauna of Cumberland Plain Woodland persists, some components have already been lost and others continue to decline (Leary 2005; *in litt.* Aug. 2008). The original mammal fauna of the Cumberland Plain was estimated to include approximately 60 species (NPWS 1997), of which less than 40 were detected in recent intensive surveys and only 14 species are now considered to be relatively common and widespread (Leary 2005; *in litt.* August 2008). The majority of these latter species are micro-bats, while small ground-dwelling mammals are unexpectedly scarce. A systematic survey involving 22 000 trap nights and 14 000 hair tube nights across conservation reserves containing Cumberland Plain Woodland failed to detect any native rodents or dasyurids, except at sites on the periphery of the plain, close to larger vegetated areas on sandstone (Leary 2005; *in litt.* August 2008). Long-nosed Bandicoots have recently been recorded in inner western Sydney (NSW Scientific Committee 2008), but remain scarce and have not been recorded during the systematic fauna surveys of Cumberland Plain Woodland. A number of bird species have also disappeared from or markedly declined on the Cumberland Plain (Keast 1995; Farrell 2005; Leary 2005; *in litt.* August 2008). A sequence of repeated surveys in Scheyville National Park, the largest remnant of Cumberland Plain Woodland, have documented disappearance of the Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Zebra Finch, Hooded Robin, Red-capped Robin, Scarlet Robin, Flame Robin and Black-eared Cuckoo, while declines have been observed in populations of the Speckled Warbler, Fuscous Honeyeater, Jacky Winter, Weebill and Buff-rumped Thornbill (Farrell 2005; *in litt.* June 2008). Repeated surveys of Nurragingy Reserve near Blacktown indicate that all of these species have also been lost from the reserve, except for the Fuscous Honeyeater and Weebill (Farrell 2005; *in litt.* June 2008). Many of these species either feed or nest on or near the ground. Declines of reptiles and amphibians on the Cumberland Plain have been less well documented, but include at least three species of frog, one species of turtle, one skink, possibly two species of goanna and one species of snake (Leary 2005; *in litt.* August 2008). Two species of plants, *Swainsona monticola* and *Thesium australe*, are presumed to have gone extinct in Cumberland Plain Woodland (Benson & Howell 2002), while James *et al.* (1999) list many other species that have undergone substantial declines, including threatened species such as *Acacia pubescens*, *Pimelea spicata* and *Pterostylis saxicola*. In addition to these losses and declines across a wide range of biota within the community, Benson & Howell (1990a; 2002) describe other changes in species composition that indicate a very large reduction in the ecological function of Cumberland Plain Woodland.

19. Weed invasion also poses a major threat to Cumberland Plain Woodland. While very large numbers of weed species have invaded many different areas of the community, principal weed species include (Benson 1992; Tozer 2003; Benson & von Richter 2008):

<i>Anagallis arvensis</i>	Scarlet Pimpernel
<i>Araujia serciflora</i>	Moth Vine
<i>Asparagus asparagoides</i>	Bridal Creeper
<i>Aster subulatus</i>	Wild Aster, Bushy Starwort
<i>Centaurium tenuiflorum</i>	
<i>Chloris gayana</i>	Rhodes Grass
<i>Cyclosporum leptophyllum</i>	Slender Celery
<i>Cirsium vulgare</i>	Thistle
<i>Conyza sumatrensis</i>	Tall Fleabane
<i>Ehrharta erecta</i>	Panic Veldtgrass
<i>Eragrostis curvula</i>	African Lovegrass
<i>Heliotropium amplexicaule</i>	Blue Heliotrope
<i>Hypochaeris radicata</i>	Catsear
<i>Lantana camara</i>	Lantana
<i>Leontodon taraxacoides</i> subsp. <i>taraxacoides</i>	Lesser Hawkbit, Hairy Hawkbit
<i>Ligustrum sinense</i>	Small-leaf Privet
<i>Nassella neesiana</i>	Chilean Needlegrass
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive
<i>Paspalum dilatatum</i>	Paspalum

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<i>Plantago lanceolata</i>	Lamb's Tongues, Plantain
<i>Richardia stellaris</i>	
<i>Senecio madagascariensis</i>	Fireweed
<i>Setaria gracilis</i>	Slender Pigeon Grass
<i>Sida rhombifolia</i>	Paddy's Lucerne
<i>Solanum</i> spp.	Nightshades
<i>Sonchus oleraceus</i>	Common Sowthistle
<i>Sporobolus africanus</i>	Parramatta Grass

Several of these species, particularly grasses, form a dense ground layer capable of smothering indigenous plants, reducing both reproduction and survival, and inhibiting emergence and establishment of their seedlings. The propagules of weeds are spread into Cumberland Plain Woodland by stormwater, dumping of refuse, frugivorous birds and wind (Benson & Howell 1990b), making it difficult to abate the invasion process, especially for those species capable of establishing in sites that have been exposed to relatively little disturbance (J. Sanders, *in litt.* January 2008). Hill *et al.* (2005) found that high species richness and abundance of weeds was associated with remnants that either had a history of clearing and grazing, were in close proximity to creeks or downslope from sealed roads. They also found some relationship between weeds and elevated total soil phosphorus, conductivity and water retention capacity, but relationships with these soil properties were weak and varied between sites with different types of disturbance history. The dramatic recent expansion of African Olive poses the greatest invasive threat to Cumberland Plain Woodland. Initially introduced to south-western Sydney in the 1820s, it was generally confined to the Camden-Picton area until the 1970s and now occurs frequently throughout the distribution of the community (Tozer 2003; Cuneo & Leishman 2006). Roberts (1999) mapped approximately 1000 ha of Cumberland Plain Woodland (c. 10% of total remaining) which had a dense understorey of African Olive that was visible on aerial photographs flown in November 1997. Tozer (2003) recorded African Olive in 43% of 198 plots surveyed throughout the distribution of Cumberland Plain Woodland. Cuneo *et al.* (2009) found that 837 ha of Cumberland Plain Woodland in south-west Sydney was invaded by African Olive (8.5% of the area assessed). The species is highly fecund, with fleshy fruit spread widely by a range of frugivorous birds, and seedlings establish readily in relatively undisturbed bushland, as well as fragmented edges (Cuneo & Leishman 2006). As shrubs grow, their canopies cast deep shade and suppress and ultimately eliminate most native shrub and groundcover species. Cook *et al.* (2005) and Tozer (*in litt.* October 2007, based on data from Tozer 2003), both recorded strong inverse relationships between the cover abundance of African Olive and the diversity and cover of native ground layer species. Other weeds that pose future threats to the community include *Ailanthus altissima*, *Asparagus asparagoides*, *Acer negundo*, *Gleditsia triacanthos* and *Macfadyena unguis-cati* (Benson & Howell 2002; J. Howell *in litt.* August 2007; J. Sanders *in litt.* January 2008; L. Harrold pers comm. 2009). The invasion and establishment of exotic weeds is resulting in a very large reduction in the ecological function of Cumberland Plain Woodland. 'Invasion of exotic perennial grasses' and 'Invasion and establishment of exotic vines and scramblers' are listed as Key Threatening Processes under the *Threatened Species Conservation Act 1995*.

20. Moderate to heavy grazing of Cumberland Plain Woodland by livestock and rabbits results in the decline and disappearance of palatable plant species, including shrubs and herbs, and compaction and erosion of topsoil, making re-establishment of a diverse native understorey problematic. The effects of such overgrazing may be exacerbated under drought conditions. Habitat degradation associated with overgrazing and erosion contributes to a large reduction in ecological function of the community.

21. The soils of Cumberland Plain Woodland have undergone chemical and structural modification associated with agricultural land uses. Trampling by livestock has resulted in localised areas of soil compaction, primarily around watering points. Research carried out at the University of Western Sydney found that mean soil inorganic nitrogen levels were two to three times higher in areas of former agricultural land use than in remnant woodland, but was unable to detect differences in other soil properties (E. C. Morris *in litt.* June 2007). Addition of carbon and burning reduced soil inorganic nitrogen and reduced growth of exotic ground layer species relative to native species, suggesting that elevated soil inorganic nitrogen could favour exotics to the detriment of natives in Cumberland Plain Woodland (E. C. Morris *in litt.* June 2007). Hill *et al.* (2005) found elevated levels of phosphorus and conductivity in former agricultural areas compared to remnant woodland, but did not examine soil nitrogen. The sources of nutrient addition to soils of Cumberland Plain Woodland include addition of fertilisers during previous agricultural land use, deposition of livestock dung, rubbish dumping and stormwater runoff from urban areas. Expansion of urban land uses across the Cumberland Plain is likely to increase urban runoff from sealed surfaces into remaining bushland fragments, resulting in further nutrient enrichment of soils and associated replacement of native

flora by exotic species. Disruption of ecological processes and degradation of habitat associated with nutrient enrichment contributes to a very large reduction in ecological function of the community.

22. Fire regimes influence the plant species composition and vegetation structure of Cumberland Plain Woodland (Benson & Howell 2002; Watson 2005) and are also likely to influence other components of the biota. Based on a study of Cumberland Plain Woodland remnants with varying fire histories, Watson (2005) found that variable intervals of 4 - 12 years between successive fires are likely to maintain populations of most understorey species in the community, including resprouting and obligate-seeding shrubs, grasses and herbs. Fragmentation of Cumberland Plain Woodland may exclude fire from some patches for extended periods by reducing fire spread. The consequent reduction in fire frequency sometimes leads to increased dominance of shrubs and associated declines in diversity of grasses and herbs (Watson 2005), as well as increased abundance of woody exotic species, such as African Olive (Benson & Howell 2002; Watson 2005; von Richter *et al.* 2005), which is likely to further reduce the flammability of the community. Conversely, high frequencies of fires may result where fragmentation increases the interface between urban areas and bushland, as this results in increased arson, car dumping, planned fuel-reduction fires and accidental ignitions. High fire frequencies are associated with reduced diversity of native plant species in Cumberland Plain Woodland (Watson 2005). 'High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the *Threatened Species Conservation Act 1995*. The season of fire, which may be altered as a consequence of hazard reduction fires, may also influence the species composition of the grassy woodland understorey (Knox & Clarke 2006; Benson & von Richter 2008). Disruption of ecological processes associated with alteration of fire regimes contributes to a very large reduction in ecological function of the community.

23. Cumberland Plain Woodland in the Sydney Basin Bioregion is eligible to be listed as a Critically Endangered Ecological Community as, in the opinion of the Scientific Committee, it is facing an extremely high risk of extinction in New South Wales in the immediate future, as determined in accordance with the following criteria as prescribed by the *Threatened Species Conservation Regulation 2002*:

Clause 25

The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:

- (a) a very large reduction in geographic distribution.

Clause 27

The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:

- (a) a very large reduction in ecological function, as indicated by any of the following:
 - (d) a change in community structure
 - (e) a change in species composition
 - (f) disruption of ecological processes
 - (g) invasion and establishment of exotic species
 - (h) degradation of habitat
 - (i) fragmentation of habitat.

Dr Richard Major
Chairperson
Scientific Committee

Proposed Gazettal date: 18/12/09
Exhibition period: 18/12/09 – 05/03/10

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Appendix B Final Determination for the Cumberland Plain Woodland

19/09/2013 Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing | NSW Environment & Heritage

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Appendix B Final Determination for the Cumberland Plain Woodland

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Page last updated: 28 February 2011



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Glenfield Waste Services Site
Cambridge Avenue, Glenfield

Proposed Rezoning & Expansion

Cumberland Plain Woodland Assessment Report

Appendix C
Flora Species List

March 2014

KEY	
Symbol	Description
Status	
*	Exotic species
**	Noxious species declared in the Campbelltown LGA
+	Native but not endemic
CPW	Species is listed as “ <i>characteristic</i> ” within the <i>Final Determination</i> (Scientific Committee 2009) for the Cumberland Plain Woodland (CPW), which is listed as a “ <i>critically endangered ecological community</i> ” on the TSC Act and <i>Environmental Protection & Biodiversity Conservation Act 1999</i> (EPBC Act)
Location - the location of a species record where habitat was restricted on the subject site at Glenfield	
MC	Species detected only in the more floristically diverse area of ‘Moderate Condition’ woodland along the northern boundary
GR	Species detected within the riparian vegetation along the ‘Georges River’
AW	Species detected within the ‘Artificial Wetlands’ near the northern boundary
Frequency - the frequency at which each species was observed across the subject site at Glenfield	
C	Common
M	Moderately common
U	Uncommon
R	Rare

Status	Species name	Common name	Location	Frequency
CPW	Acanthaceae <i>Brunoniella australis</i>	Blue Trumpet		C
	Amaranthaceae <i>Alternanthera denticulata</i>	Lesser Joyweed		U
CPW	Antheriaceae <i>Arthropodium milleflorum</i>	Pale Vanilla-lily		M
CPW	<i>Arthropodium minus</i>	-		U
	Apiaceae <i>Foeniculum vulgare</i>	Fennel		R
	Apocynaceae <i>Araujia sericifera</i>	Moth Vine		M
	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush		R
	<i>Vinca major</i>	Greater Periwinkle		R
	Arecaceae <i>Phoenix canariensis</i>	Canary Island Date Palm		U
	Asparagaceae <i>Asparagus aethiopicus</i>	Asparagus 'Fern'		U
	<i>Asparagus asparagoides</i>	Bridal Creeper		M
	<i>Asparagus officinalis</i>	Asparagus		R

Status	Species name	Common name	Location	Frequency
	Asteraceae			
*	<i>Arctotheca calendula</i>	Capeweed		R
*	<i>Bidens pilosa</i>	Cobblers Peg		C
*	<i>Cirsium vulgare</i>	Spear Thistle		M
*	<i>Conyza bonariensis</i>	Flaxleaf Fleabane		R
*	<i>Delairea odorata</i>	Cape Ivy	GR	U
CPW	<i>Euchiton sphaericus</i>	-	MC	R
*	<i>Gamochaeta calviceps</i>	Cudweed		U
*	<i>Gamochaeta purpurea</i>	Purple Cudweed		U
*	<i>Hypochaeris radicata</i>	Catsear		M
**	<i>Onopordum acanthium</i>	Scotch Thistle		U
	<i>Ozothamnus diosmifolius</i>	White Dogwood	MC	R
*	<i>Senecio madagascariensis</i>	Fireweed		M
	<i>Senecio quadridentatus</i>	Cotton Fireweed		R
*	<i>Sonchus oleraceus</i>	Common Sowthistle		U
*	<i>Taraxacum officinale</i>	Dandelion		M
CPW	<i>Vernonia cinerea</i>	-		U
	<i>Vittadinia cuneata</i>	Fuzzweed	MC	R
	Brassicaceae			
*	<i>Lepidium africanum</i>	-		R
	Cactaceae			
**	<i>Opuntia stricta</i>	Common Prickly Pear		R
	Campanulaceae			
CPW	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	Tall Bluebell	MC	R
	Caryophyllaceae			
*	<i>Cerastium glomeratum</i>	Mouse-ear Chickweed		M
*	<i>Petrorhagia velutina</i>	-		C
	Casuarinaceae			
+	<i>Casuarina glauca</i>	Swamp Oak		U
	Celastraceae			
	<i>Maytenus silvestris</i>	Narrow-leaved Orangebark	GR	R
	Chenopodiaceae			
CPW	<i>Einadia hastata</i>	Berry Saltbush		C
CPW	<i>Einadia nutans</i> subsp. <i>linifolia</i>	-		C
CPW	<i>Einadia trigonos</i>	Fishweed		C
	Clusiaceae			
**	<i>Hypericum perforatum</i>	St. Johns Wort		U
	Commelinaceae			
CPW	<i>Commelina cyanea</i>	Native Wandering Jew		R
*	<i>Tradescantia fluminensis</i>	Wandering Jew	GR	C
	Convolvulaceae			
	<i>Convolvulus erubescens</i>	Blushing Bindweed		R
CPW	<i>Dichondra repens</i>	Kidney Weed		C
	Crassulaceae			
**	<i>Bryophyllum delagoense</i>	Mother-of-millions		U

Status	Species name	Common name	Location	Frequency
	Fabaceae – Faboideae			
CPW	<i>Bossiaea prostrata</i>	-	MC	R
CPW	<i>Chorizema parviflorum</i>	Eastern Flame Pea	MC	R
CPW	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	MC	R
CPW	<i>Dillwynia sieberi</i>	-	MC	R
CPW	<i>Glycine clandestina</i>	-		M
CPW	<i>Glycine tabacina</i>	-		M
CPW	<i>Hardenbergia violaceae</i>	False Sarsaparilla	MC	R
CPW	<i>Indigofera australis</i>	Australian Indigo		R
*	<i>Lotus angustissimus</i>	Slender Birds-foot Trefoil		M
*	<i>Trifolium arvense</i>	Haresfoot Clover		M
*	<i>Trifolium repens</i>	White Clover		M
*	<i>Vicia sativa</i> subsp. <i>nigra</i>	Narrow-leaved Vetch		M
	Fabaceae – Mimosoideae			
	<i>Acacia binervia</i>	Coast Myall	GR	M
	<i>Acacia decurrens</i>	Black Wattle		M
	<i>Acacia parramattensis</i>	Parramatta Wattle		U
	Lamiaceae			
CPW	<i>Plectranthus parviflorus</i>	Cockspur Flower		U
	Lauraceae			
**	<i>Cinnamomum camphora</i>	Camphor Laurel		R
	Linaceae			
*	<i>Linum trigynum</i>	French Flax		U
	Lomandraceae			
CPW	<i>Lomandra multiflora</i>	Many-flowered Mat-rush	MC	U
	Loranthaceae			
	<i>Amyema miquelii</i>	-		U
	Malvaceae			
*	<i>Modiola caroliniana</i>	Red-flowered Mallow		C
*	<i>Sida rhombifolia</i>	Paddy's Lucerne		C
	Myrsinaceae			
*	<i>Anagallis arvensis</i>	Scarlet Pimpernel		C
	Myrtaceae			
CPW	<i>Angophora floribunda</i>	Rough-barked Apple	MC	R
+	<i>Corymbia maculata</i>	Spotted Gum		R
CPW	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		U
CPW	<i>Eucalyptus eugenoides</i>	Thin-leaved Stringybark		U
CPW	<i>Eucalyptus moluccana</i>	Grey Box		C
CPW	<i>Eucalyptus tereticornis</i>	Forest Red Gum		M
+	<i>Lophostemon confertus</i>	Brush Box		R
	<i>Melaleuca decora</i>	-		M
	Oleaceae			
**	<i>Ligustrum lucidum</i>	Large-leaved Privet		M
**	<i>Ligustrum sinense</i>	Small-leaved Privet		C
**	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive		C
	Onagraceae			
	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Water Primrose	AW	M
	Oxalidaceae			
CPW	<i>Oxalis perennans</i>	-	MC	R

Status	Species name	Common name	Location	Frequency
	Phormiaceae			
CPW	<i>Dianella longifolia</i>	Blueberry Lily		U
	<i>Dianella revoluta</i>	Blueberry Lily		U
	Pinaceae			
*	<i>Pinus radiata</i>	Radiata Pine		R
	Pittosporaceae			
	<i>Billardiera scandens</i>	Hairy Apple Berry	GR	R
CPW	<i>Bursaria spinosa</i>	Blackthorn		C
	Plantaginaceae			
*	<i>Plantago lanceolata</i>	Lamb's Tongue		C
	Poaceae			
CPW	<i>Aristida ramosa</i>	Purple Wire Grass	MC	R
CPW	<i>Aristida vagans</i>	Threeawn Spear Grass		R
	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass		C
*	<i>Avena barbata</i>	Bearded Oats		M
*	<i>Briza subaristida</i>	-		U
*	<i>Bromus catharticus</i>	Prairie Grass		C
*	<i>Chloris gayana</i>	Rhodes Grass		C
CPW	<i>Chloris truncata</i>	Windmill Grass		R
CPW	<i>Chloris ventricosa</i>	Plump Windmill Grass		M
**	<i>Cortaderia selloana</i>	Pampas Grass	AW	U
CPW	<i>Cymbopogon refractus</i>	Barbed Wire Grass	MC	R
+	<i>Cynodon dactylon</i>	Common Couch		C
CPW	<i>Echinopogon caespitosus</i> <i>var. caespitosus</i>	Tufted Hedgehog Grass		U
CPW	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass		U
*	<i>Ehrharta erecta</i>	Panic Veldt Grass		M
**	<i>Eragrostis curvula</i>	African Love Grass		M
	<i>Entolasia stricta</i>	Wiry Panic		R
CPW	<i>Eragrostis leptostachys</i>	Paddock Love Grass		U
	<i>Lachnagrostis aemula</i>	Blowngrass		R
*	<i>Lolium perenne</i>	Perennial Rye Grass		C
CPW	<i>Microlaenea stipoides</i>	Weeping Grass		M
CPW	<i>Panicum effusum</i>	Hairy Panic		U
CPW	<i>Paspalidium distans</i>	-		R
*	<i>Paspalum dilatatum</i>	Paspalum		U
*	<i>Pennisetum clandestinum</i>	Kikuyu		C
*	<i>Poa annua</i>	Winter Grass		U
CPW	<i>Rytidosperma</i> <i>racemosum var. racemosum</i>	-		U
CPW	<i>Rytidosperma tenuius</i>	-		U
*	<i>Setaria parviflora</i>	-		M
CPW	<i>Themeda australis</i>	Kangaroo Grass	MC	U
*	<i>Vulpia muralis</i>	-		M
	Pteridaceae			
CPW	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Poison Rock Fern	MC	R
	Ranunculaceae			
CPW	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	Headache Vine		M
	Rubiaceae			
*	<i>Galium murale</i>	Small Bedstraw		U
CPW	<i>Opercularia diphylla</i>	-		U

Status	Species name	Common name	Location	Frequency
CPW	Santalaceae <i>Exocarpos cupressiformis</i>	Cherry Ballart	MC	R
CPW	Scrophulariaceae <i>Eremophila debilis</i>	Winter Apple		M
**	Solanaceae <i>Lycium ferocissimum</i>	African Boxthorn		M
*	<i>Solanum chenopodioides</i>	Whitetip Nightshade		M
*	<i>Solanum nigrum</i>	Black-berry Nightshade		M
CPW	<i>Solanum prinophyllum</i>	Forest Nightshade		U
*	<i>Solanum pseudocapsicum</i>	Madeira Winter		U
	Typhaceae <i>Typha</i> sp.	Cumbungi	AW	C
**	Verbenaceae <i>Lantana camara</i>	Lantana	GR	M
*	<i>Verbena bonariensis</i>	Purpletop		U
	Total native	71		
	Total exotic	61		
	Total CPW	49		



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Proposed Rezoning & Expansion

Cumberland Plain Woodland Assessment Report

Appendix D
Flora Quadrat Data

March 2014

KEY	
Symbol	Description
Status	
*	Exotic species
**	Noxious species declared in the Campbelltown LGA
+	Native but not endemic
CPW	Species is listed as “ <i>characteristic</i> ” within the Final Determination (Scientific Committee 2013) for the Cumberland Plain Woodland (CPW), which is listed as a “ <i>critically endangered ecological community</i> ” on the TSC Act and <i>Environmental Protection & Biodiversity Conservation Act 1999</i> (EPBC Act)
Record	
Q1	Quadrat 1 sampled from the ‘Low’ condition Grey Box – Red Gum Woodland (Figure 3)
Q2	Quadrat 2 sampled from the ‘Very Low’ condition Grey Box – Red Gum Woodland (Figure 3)
Q3	Quadrat 3 sampled from the ‘Low’ condition Grey Box – Red Gum Woodland (Figure 3)
Q4	Quadrat 4 sampled from the ‘Moderate’ condition Red Gum – Ironbark Woodland (Figure 3)
Q5	Quadrat 5 sampled from the ‘Very Low’ condition Red Gum – Ironbark Woodland (Figure 3)
Q6	Quadrat 6 sampled from the ‘Low’ condition Grey Box – Red Gum Woodland (Figure 3)
Q7	Quadrat 7 sampled from the ‘Very low’ condition Grey Box – Red Gum Woodland (Figure 3)
	* Quadrat of Braun-Blanquet Cover Abundance from the subject site; <ul style="list-style-type: none"> • 1 (<5% uncommon); • 2 (<5% common); • 3 (5-25% common); • 4 (25-50%); • 5 (50-75%); • 6 (75-100%)

Quadrat 1 For location, see Figure 3

Status	Species name	Common name	Q
*	<i>Araujia sericifera</i>	Moth Vine	1
CPW	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily	2
*	<i>Bromus catharticus</i>	Prairie Grass	2
CPW	<i>Brunoniella australis</i>	Blue Trumpet	2
CPW	<i>Bursaria spinosa</i>	Blackthorn	1
CPW	<i>Chloris ventricosa</i>	Plump Windmill Grass	1
CPW	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	Headache Vine	1
CPW	<i>Dichondra repens</i>	Kidney Weed	2
*	<i>Ehrharta erecta</i>	Panic Veldt Grass	2
CPW	<i>Einadia hastata</i>	Berry Saltbush	2
CPW	<i>Eremophila debilis</i>	Winter Apple	2
CPW	<i>Eucalyptus moluccana</i>	Grey Box	3
*	<i>Lolium perenne</i>	Perennial Rye Grass	4
CPW	<i>Microlaenea stipoides</i>	Weeping Grass	4
**	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	2
*	<i>Petrorhagia velutina</i>	-	3
*	<i>Plantago lanceolata</i>	Lamb's Tongue	3
*	<i>Senecio madagascariensis</i>	Fireweed	2
*	<i>Sida rhombifolia</i>	Paddy's Lucerne	2
*	<i>Solanum chenopodioides</i>	Whitetip Nightshade	1
*	<i>Sonchus oleraceus</i>	Common Sowthistle	1
CPW	<i>Vernonia cinerea</i>	-	1
	Total native species	11	
	Total exotic species	11	
	Total CPW species	11	



Quadrat 2 For location, see Figure 3

Status	Species name	Common name	Q
*	<i>Anagallis arvensis</i>	Scarlet Pimpernel	1
*	<i>Araujia sericifera</i>	Moth Vine	1
CPW	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily	1
*	<i>Bidens pilosa</i>	Cobblers Pegs	2
*	<i>Bromus catharticus</i>	Prairie Grass	5
CPW	<i>Brunoniella australis</i>	Blue Trumpet	1
CPW	<i>Commelina cyanea</i>	Native Wandering Jew	1
+	<i>Cynodon dactylon</i>	Common Couch	2
CPW	<i>Dichondra repens</i>	Kidney Weed	2
*	<i>Ehrharta erecta</i>	Panic Veldt Grass	2
CPW	<i>Einadia nutans</i> subsp. <i>linifolia</i>	-	1
CPW	<i>Eucalyptus moluccana</i>	Grey Box	4
*	<i>Lolium perenne</i>	Perennial Rye Grass	3
CPW	<i>Microlaenea stipoides</i>	Weeping Grass	3
*	<i>Modiola caroliniana</i>	Red-flowered Mallow	2
**	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	1
*	<i>Paspalum dilatatum</i>	Paspalum	1
*	<i>Plantago lanceolata</i>	Lamb's Tongue	3
*	<i>Solanum chenopodioides</i>	Whitetip Nightshade	1
Total native species		8	
Total exotic species		11	
Total CPW species		7	



Quadrat 3 For location, see Figure X

Status	Species name	Common name	Q
*	<i>Araujia sericifera</i>	Moth Vine	1
CPW	<i>Aristida vagans</i>	Three-awn Spear Grass	2
CPW	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily	2
*	<i>Asparagus aethiopicus</i>	Asparagus 'Fern'	1
**	<i>Asparagus asparagoides</i>	Bridal Creeper	2
CPW	<i>Brunoniella australis</i>	Blue Trumpet	3
CPW	<i>Bursaria spinosa</i>	Blackthorn	2
CPW	<i>Chloris ventricosa</i>	Plump Windmill Grass	3
CPW	<i>Dichondra repens</i>	Kidney Weed	2
CPW	<i>Einadia hastata</i>	Berry Saltbush	2
CPW	<i>Einadia nutans</i> subsp. <i>linifolia</i>	-	2
CPW	<i>Einadia trigonos</i>	Fishweed	2
CPW	<i>Eremophila debilis</i>	Winter Apple	3
CPW	<i>Eucalyptus moluccana</i>	Grey Box	3
CPW	<i>Indigofera australis</i>	Australian Indigo	1
	<i>Melaleuca decora</i>	-	2
CPW	<i>Microlaenea stipoides</i>	Weeping Grass	2
**	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	1
CPW	<i>Panicum effusum</i>	Hairy Panic	2
CPW	<i>Paspalidium distans</i>	-	1
CPW	<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	-	3
*	<i>Senecio madagascariensis</i>	Fireweed	1
*	<i>Vinca major</i>	Greater Periwinkle	1
	Total native species	17	
	Total exotic species	6	
	Total CPW species	16	



Quadrat 4 For location, see Figure 3

Status	Species name	Common name	Q
	<i>Acacia decurrens</i>	Black Wattle	2
*	<i>Araujia sericifera</i>	Moth Vine	1
CPW	<i>Aristida ramosa</i>	Purple Wire Grass	1
**	<i>Asparagus asparagoides</i>	Bridal Creeper	2
*	<i>Avena barbata</i>	Bearded Oats	1
*	<i>Bidens pilosa</i>	Cobblers Peg	2
CPW	<i>Bossiaea prostrata</i>	-	1
CPW	<i>Brunoniella australis</i>	Blue Trumpet	2
CPW	<i>Bursaria spinosa</i>	Blackthorn	3
*	<i>Chloris gayana</i>	Rhodes Grass	1
CPW	<i>Chloris ventricosa</i>	Plump Windmill Grass	1
CPW	<i>Chorizema parviflorum</i>	Eastern Flame Pea	1
*	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	1
CPW	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	2
CPW	<i>Dichondra repens</i>	Kidney Weed	2
CPW	<i>Einadia hastata</i>	Berry Saltbush	1
**	<i>Eragrostis curvula</i>	African Love Grass	5
CPW	<i>Eragrostis leptostachys</i>	Paddock Love Grass	1
CPW	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	1
CPW	<i>Eucalyptus moluccana</i>	Grey Box	1
CPW	<i>Eucalyptus tereticornis</i>	Forest Red Gum	3
CPW	<i>Euchiton sphaericus</i>	-	1
CPW	<i>Glycine clandestina</i>	-	2
**	<i>Hypericum perforatum</i>	St. Johns Wort	1
*	<i>Hypochaeris radicata</i>	Cats-ear	2
*	<i>Linum trigynum</i>	French Flax	1
*	<i>Lolium perenne</i>	Perennial Rye Grass	1
CPW	<i>Lomandra multiflora</i>	Many-flowered Mat-rush-	1
*	<i>Paspalum dilatatum</i>	Paspalum	1
*	<i>Plantago lanceolata</i>	Lamb's Tongue	2
*	<i>Senecio madagascariensis</i>	Fireweed	2
*	<i>Setaria parviflora</i>	-	1
*	<i>Sida rhombifolia</i>	Paddy's Lucerne	2
CPW	<i>Themeda australis</i>	Kangaroo Grass	3
CPW	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	Tall Bluebell	2
	Total native species	19	
	Total exotic species	16	
	Total CPW species	18	



Quadrat 5 For location, see Figure 3

Status	Species name	Common name	Q
*	<i>Bidens pilosa</i>	Cobblers Peg	2
+	<i>Cynodon dactylon</i>	Common Couch	6
CPW	<i>Dichondra repens</i>	Kidney Weed	2
CPW	<i>Eucalyptus moluccana</i>	Grey Box	3
CPW	<i>Eucalyptus tereticornis</i>	Forest Red Gum	2
*	<i>Lolium perenne</i>	Perennial Rye Grass	2
*	<i>Modiola caroliniana</i>	Red-flowered Mallow	2
*	<i>Plantago lanceolata</i>	Lamb's Tongue	2
*	<i>Senecio madagascariensis</i>	Fireweed	2
*	<i>Sida rhombifolia</i>	Paddy's Lucerne	2
Total native species		4	
Total exotic species		6	
Total CPW species		3	



Quadrat 6 For location, see Figure 3

Status	Species name	Common name	Q
CPW	<i>Arthropodium minus</i>	-	1
*	<i>Bidens pilosa</i>	Cobblers Peg	2
*	<i>Bromus catharticus</i>	Prairie Grass	3
+	<i>Cynodon dactylon</i>	Common Couch	5
CPW	<i>Dichondra repens</i>	Kidney Weed	2
*	<i>Ehrharta erecta</i>	Panic Veldt Grass	1
CPW	<i>Einadia trigonos</i>	Fishweed	2
**	<i>Eragrostis curvula</i>	African Love Grass	2
CPW	<i>Eucalyptus moluccana</i>	Grey Box	2
CPW	<i>Glycine clandestina</i>	-	1
*	<i>Lolium perenne</i>	Perennial Rye Grass	3
**	<i>Lycium ferocissimum</i>	African Boxthorn	1
*	<i>Modiola caroliniana</i>	Red-flowered Mallow	1
*	<i>Plantago lanceolata</i>	Lamb's Tongue	2
CPW	<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	-	2
*	<i>Senecio madagascariensis</i>	Fireweed	2
*	<i>Sida rhombifolia</i>	Paddy's Lucerne	2
*	<i>Solanum chenopodioides</i>	Whitetip Nightshade	1
CPW	<i>Vernonia cinerea</i>	-	1
	Total native species	8	
	Total exotic species	11	
	Total CPW species	7	



Quadrat 7 For location, see Figure 3

Status	Species name	Common name	Q
*	<i>Araujia sericifera</i>	Moth Vine	2
**	<i>Asparagus asparagoides</i>	Bridal Creeper	2
	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass	6
CPW	<i>Brunoniella australis</i>	Blue Trumpet	2
CPW	<i>Bursaria spinosa</i>	Blackthorn	2
CPW	<i>Dichondra repens</i>	Kidney Weed	2
*	<i>Ehrharta erecta</i>	Panic Veldt Grass	3
CPW	<i>Einadia trigonos</i>	Fishweed	3
CPW	<i>Eucalyptus moluccana</i>	Grey Box	4
**	<i>Lycium ferocissimum</i>	African Boxthorn	1
*	<i>Modiola caroliniana</i>	Red-flowered Mallow	1
**	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	1
*	<i>Plantago lanceolata</i>	Lamb's Tongue	2
CPW	<i>Plectranthus parviflorus</i>	Cockspur Flower	1
*	<i>Senecio madagascariensis</i>	Fireweed	2
*	<i>Sida rhombifolia</i>	Paddy's Lucerne	2
*	<i>Solanum chenopodioides</i>	Whitetip Nightshade	1
CPW	<i>Solanum prinophyllum</i>	Forest Nightshade	1
	Total native species	8	
	Total exotic species	10	
	Total CPW species	7	

