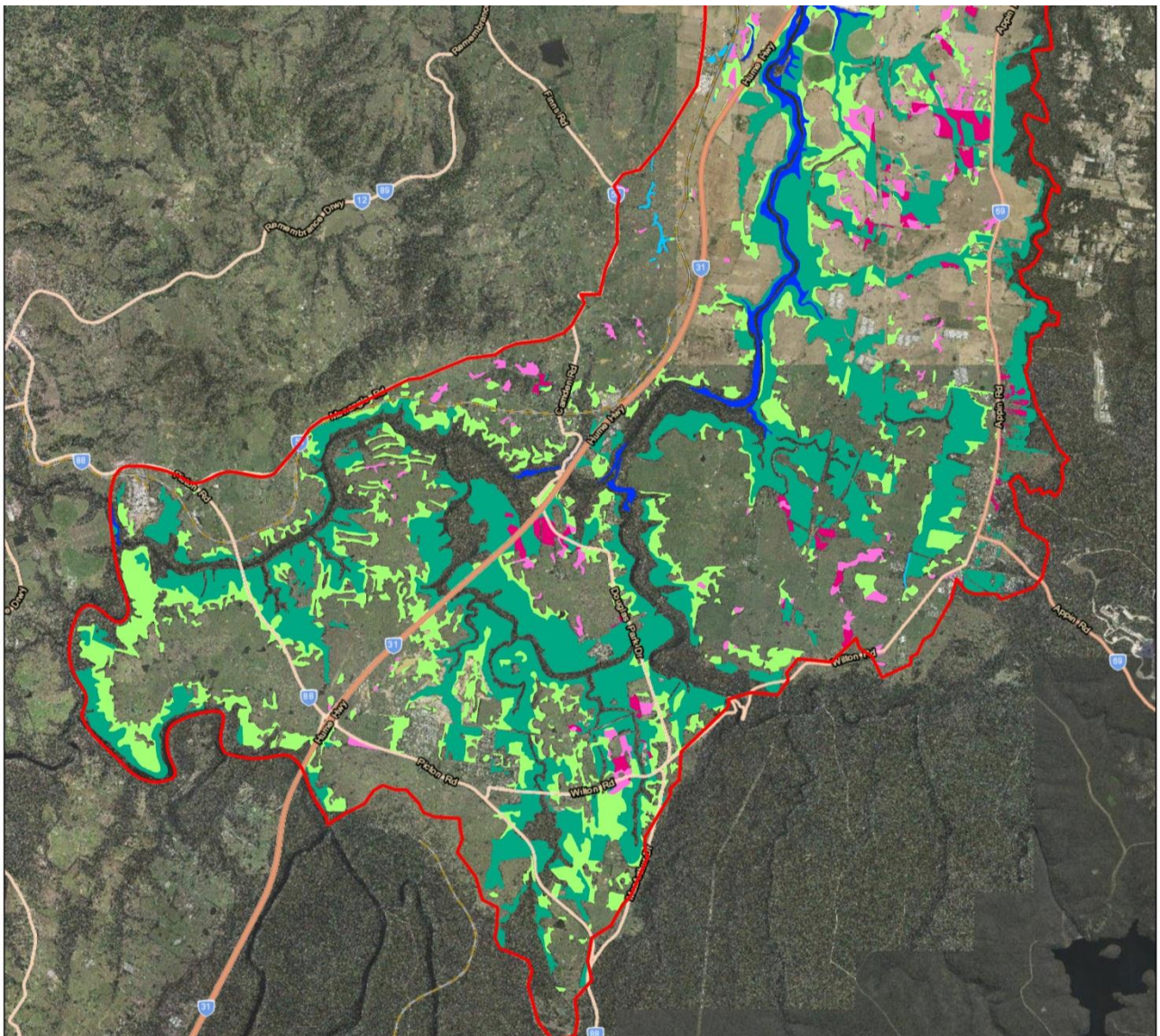


Greater Macarthur Investigation Area

Biodiversity Assessment Report

Prepared for
NSW Department of Planning and Environment

September 2015



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Abbreviations

Abbreviation	Description
BCAM	Biodiversity Certification Assessment Method
CEEC	Critically Endangered Ecological Community
CPW	Cumberland Plain Woodland
DP&E	NSW Department of Planning and the Environment
EEC	Endangered Ecological Community
EPBC Act	Environment Protection and Biodiversity Conservation Act
GMIA	Greater Macarthur Investigation Area
NPWS	NSW National Parks and Wildlife Service
SCMA	Sydney Catchment Management Authority
SSTF	Sydney Sandstone Transition Forest
TSC	Threatened Species Conservation Act

1 Introduction

1.1 Project Brief

Eco Logical Australia (ELA) were engaged by the NSW Department of Planning and Environment (DP&E) to undertake a broad strategic biodiversity assessment of the Greater Macarthur Investigation Area based on a desktop analysis of existing information relating to the study area. The specific scope of works for the study included the following.

Desktop ecological assessment and baseline situation

- a. Undertake an audit of existing ecological databases including the Atlas of NSW Wildlife, Vegetation Mapping of the Cumberland Plain and Commonwealth Protected Matters Database;
- b. Review any available background information, previous studies and GIS documentation. This will include background information present from development proposals, landowners and other technical data;
- c. Identify any species, populations or ecological communities listed under the *Threatened Species Conservation Act 1995* (TSC Act), the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), or the *Fisheries Management Act 1994* (Fisheries Act);
- d. Identify local and regional habitat linkages through analysis of aerial photographs; and
- e. Identify any areas within the study area targeted for further investigation through field surveys.

Analysis

Based on desktop information, identify areas of high, moderate and low conservation value and areas deferred or requiring further field assessment.

Recommend a framework to manage the biodiversity of the Greater Macarthur Investigation Area including:

- a. Areas of high, moderate and low conservation value, including areas with no ecological constraints and areas that should be considered for retention;
- b. Areas of biodiversity value that should be considered for further detailed investigation;
- c. Measures to protect biodiversity values;
- d. Priority areas that could be considered for restoration, regeneration or revegetation;
- e. The best mechanism for the implementation of these recommendations; and
- f. Measures to control ecological impacts identified on site.

Prepare a Biodiversity Assessment Report that documents the findings of Steps above including maps where applicable.

The outcomes of the assessment will assist in supporting the development of a suitable planning framework for the area and identify suitable directions for conservation of biodiversity within a developing region.

Where possible, the report uses terminology associated with the Biodiversity Certification Assessment Methodology (BCAM). As discussed in the final chapter, the BCAM is a policy and planning tool under the NSW Threatened Species Conservation Act 1995 that can be used to provide certainty for conservation and development outcomes at the strategic planning stage. The use of BCAM terminology is used to here so that the report can guide further consideration of BCAM. Planning Context and Study Area

The Greater Macarthur Investigation Area (GMIA) is identified in 'A Plan for Growing Sydney' (NSW Government, 2014) as a potential priority urban area. Action 2.4.2 of the Plan is to 'Develop a framework for the identification of new Growth Centres' and identifies the area south and south-west of Campbelltown-Macarthur as an area to investigate issues such environmental constraints and natural hazards.

During the investigation, preliminary analysis determined an urban capable boundary which was then used for the scope of all technical studies, including this Biodiversity report.

2 Methods

2.1 Information Audit and Review

An audit and review was carried out for existing biodiversity related information and data within the region. Information and data sought included:

- Previous studies – includes previous ecological assessments and offset strategies carried out across parts of the GMIA. Key biodiversity values and assessment outcomes were reviewed and summarised.
- Available spatial data – including:
 - the most recent vegetation mapping covering the area (Wollondilly vegetation mapping, Western Sydney vegetation mapping, Sydney Metropolitan Catchment vegetation mapping),
 - Hawkesbury Nepean Catchment Regional Biodiversity Corridors
 - Western Sydney Priority Conservation Lands – strategic areas identified to support the endangered vegetation communities of the Cumberland Plain,
 - Reserved lands – includes NPWS estate and Sydney Catchment special areas
- Bionet and NES matters search – to identify recorded threatened species across the area as well as species with potential to occur

2.2 Desktop Assessment

A preliminary desktop assessment was carried out to identify areas of significant or sensitive biodiversity values which may prove to be a constraint for development in the area. The key components of the assessment include:

- **Determine best available vegetation mapping** – combine vegetation mapping from Sydney Catchment Management Authority (SCMA – now Greater Sydney Local Land Services) and Wollondilly LGA to cover the extent of the study area.
- **Update vegetation extent** – a broad assessment of the vegetation mapping was carried out to update vegetation extent where significant areas had been cleared since the mapping was produced
- **Vegetation Zones** – The updated vegetation mapping classification was standardised to align to biometric vegetation mapping. This includes aligning all vegetation communities to a Biometric Vegetation Type (BVT) and standardising vegetation condition across the combined data set. EECs and CEECs were identified as part of this process.
- **Biodiversity Constraint** – Preliminary analysis was carried out to identify key areas of biodiversity constraint across the GMIA. The analysis includes the combination of the following constraints:
 1. SCA special areas / NPWS reserves
 2. Identified priority conservation lands
 3. Regional biodiversity corridors
 4. Vegetation that would be ‘red flagged’ under the Biodiversity certification Assessment Methodology (BCAM).
 5. EECs and CEECs
- **Long Term Management Viability** – a patch size analysis to consider the longer term viability of a vegetation remnant patch based on principles of habitat fragmentation and viability.

3 Results

3.1 Previous Studies

A number of assessments and offset strategies have been prepared that consider the biodiversity values of the Greater Macarthur Investigation Area (GMIA) as part of proposed development in the area. There are currently additional studies currently being carried out (ie Mt Gilead) which once completed will also contribute to the refined knowledge of biodiversity values across the GMIA. Studies that are most relevant to the whole of this area and their key outcomes are included in **Table 1**. The location of each of these studies is shown in **Figure 1** below.

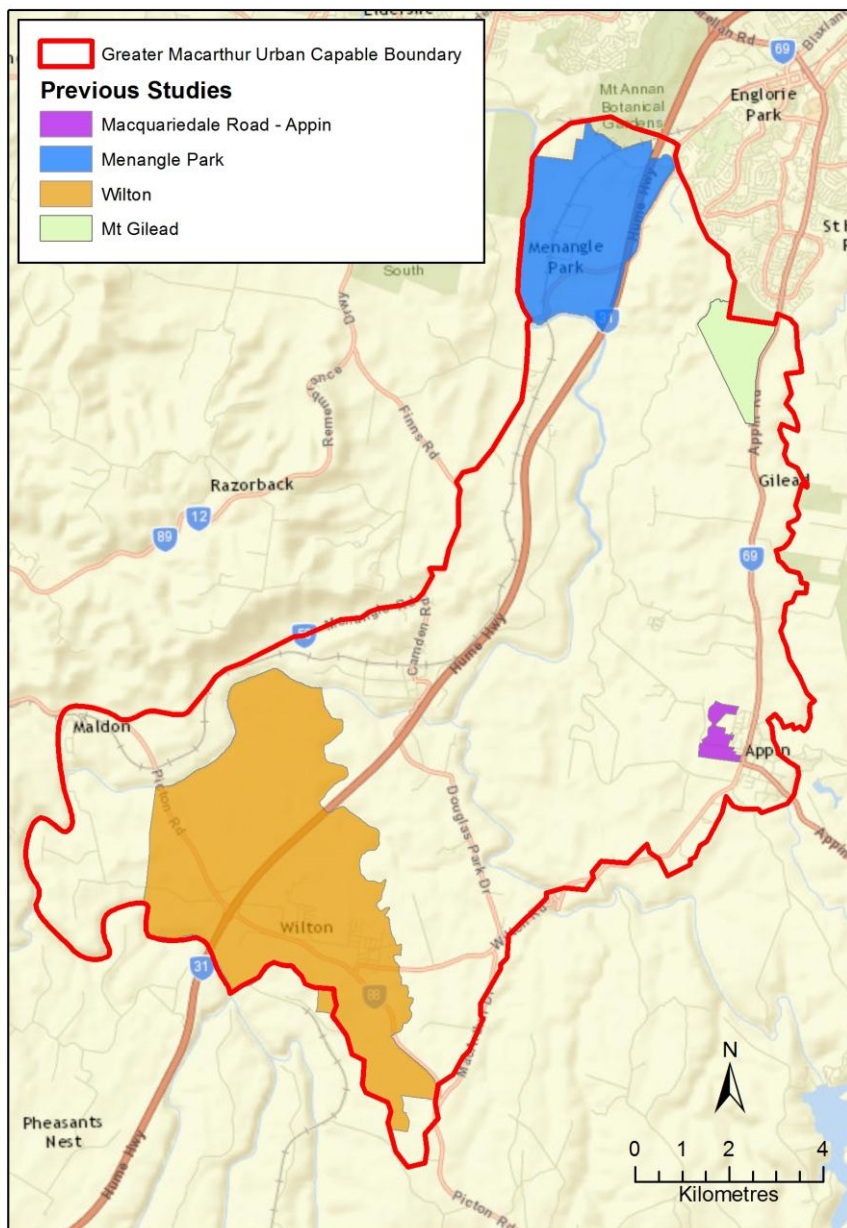


Figure 1: Previous biodiversity studies in the GMIA

Table 1: Previous Biodiversity Studies

Document	Key Outcomes
<p>Macquariedale Road, Appin</p> <p>Ecological Assessment, Proposed Residential Rezoning, Macquariedale Road, Appin, (Travers Bushfire and Ecology 2014)</p>	<ul style="list-style-type: none"> • Survey detected 11 threatened fauna species, including the Cumberland Plain Land Snail. • While not found, potential habitat exists for <i>Acacia bynoeana</i> and <i>Grevillea parviflora</i> subsp. <i>parviflora</i> • 2 EEC's present – 3.78ha of Cumberland Plain Woodland (CPW) and 46.2ha Shale Sandstone Transition Forest (SSTF). • Proposed rezoning would result in 27% removal of SSTF and 100% removal of CPW • Vegetation conservation significance mapped most of the vegetation as high • All the vegetation was mapped as Red Flag • Site contains potential Koala habitat (as defined by SEPP 44), but no evidence of usage by koala and therefore site does not contain core koala habitat. • EPBC referral required for significant impact to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. • Seeking Biodiversity Certification with a 54.7ha offset proposed onsite and to the west at Elladale Road
<p>Macquariedale Road, Appin</p> <p>Biodiversity Offset Strategy, Proposed Residential Rezoning, Macquariedale Road, Appin, (Travers Bushfire and Ecology 2014)</p>	<ul style="list-style-type: none"> • In addition to onsite mitigation measures, biodiversity offsets are recommended to offset the loss of: <ul style="list-style-type: none"> ○ Cumberland Plain Woodland (CPW), ○ Shale Sandstone Transition Forest (SSTF), and ○ threatened species habitat. • To ensure that the proposed offsets achieve a “maintain or improve” outcome a target 4.4:1 offset ratio has been applied for SSTF and a 3.4:1 offset ratio has been applied for CPW. • The proposed biodiversity offset areas (54.7ha) include: <ul style="list-style-type: none"> ○ 34.81ha (SSTF only) onsite conservation areas – Macquariedale Road, Appin ○ 19.85ha (SSTF and CPW) offsite biodiversity offset – Elladale Road, Appin
<p>Menangle Park</p> <p>Flora, Fauna and Aquatic Assessments (ELA 2009)</p>	<ul style="list-style-type: none"> • A flora, fauna and aquatic ecological assessment was undertaken for Campbelltown City Council and Landcom (now UrbanGrowth) as a technical component of a Local Environmental Study. • The study area of 890ha includes the Menangle Park residential area and surrounding rural areas. • It is intended that part, or all, of the study site be rezoned to permit a major urban release for residential and/or industrial development. <p>Main results included:</p> <ul style="list-style-type: none"> • 121ha of remnant EEC vegetation, including CPW, River-flat eucalypt forest (RFEF) and Freshwater Wetlands. • Potential habitat for <i>Eucalyptus benthamii</i> and <i>Pomaderris brunnea</i> within the RFEF along the Nepean River and potential habitat for

Document	Key Outcomes
	<p><i>Pimelea spicata</i> in the CPW patches.</p> <ul style="list-style-type: none"> • Potential habitat for 18 threatened and/or migratory species • Vegetation was ranked as high, moderate, low or very low recovery potential - larger patches of RFEF and CPW were assigned a high and moderate rating. • Fauna habitat was mapped. • Vegetation and fauna constraints were mapped as high, moderate and low. • Layers were combined to map the overall ecological constraints. • The areas of high and moderate ecological constraint were grouped into management units (eg. Nepean River Banks, Glenless Wetlands, North Creek, Northern Corridor and Racecourse Woodlands), each with its own ecological justification and recommendations. <p>The mapping used for this assessment, which is based on Western Sydney mapping (NPWS 2002), Sydney metropolitan CMA vegetation mapping (OEH 2013) and updated Wollondilly vegetation mapping (ELA 2013), differs due to the absence of mapped freshwater wetland EEC's. Some polygons mapped as RFEF by ELA (2009) are now mapped as CPW in the Menangle study.</p>
<p>Menangle Park</p> <p>Rezoning <i>Pimelea spicata</i> Survey and Results (GHD, 2009)</p>	<ul style="list-style-type: none"> • Targeted surveys of <i>Pimeilea spicata</i> were conducted by Teresa James, requested by DECCW prior to endorsing a proposed offset strategy • 4 sites, each of about 2-3ha in size were surveyed and no individuals were found. • Only one of the sites (eastern side of Cummins Road – 3ha) was considered to have a moderate chance of the species being present within the soil seed bank or as rootstock. Future sampling would be best undertaken after rain. •
<p>Menangle Park</p> <p>Offsetting Strategy for Landcom (GHD 2010).</p>	<ul style="list-style-type: none"> • 25.4ha of existing vegetation will be impacted by the proposed rezoning of Menangle Park. • To compensate for this, a total of 47.2 ha of remnant vegetation will be retained and rehabilitated on site and 51.2 ha replanted. • The offset area to be retained and rehabilitated includes 20.5ha of vegetation, listed as EEC's, in a landscape currently impacted by agricultural activities. Rehabilitation of all conserved vegetation will equate to condition improvement of 47.2ha;
<p>Mt Gilead Planning Proposal, Campbelltown City Council 2015</p> <p>References Ecological Assessment Report prepared by Eco Logical Australia</p>	<ul style="list-style-type: none"> • Ecological assessment of a Planning proposal for residential development at Mt Gilead. • Confirmed presence of Cumberland Plain Woodland (9 ha), Shale Sandstone Transition Forest (24.5 ha) and Riverflat Eucalypt Forest (1 ha). • Confirmed presence of seven threatened fauna including <i>Glossopsitta puilla</i> (Little Lorikeet), <i>Ardea ibis</i> and micro-bats • No koala found on site, nor does site contain potential koala habitat under SEPP 44.

Document	Key Outcomes
<p>Wilton Junction</p> <p>Proposed New Town, Ecological Assessment & Environmental Offsets Strategy (SLR Consulting, 2014)</p>	<ul style="list-style-type: none"> • No threatened flora recorded. <p>Ecological assessment of proposed rezoning application and conservation outcome options developed using several principles from the NSW Offset Policy for Major Projects.</p> <p>The proposed Wilton Junction new town envisages:</p> <ul style="list-style-type: none"> • the development of between 11,000 and 13,000 residential lots, as well as a town centre, neighbourhood centres, schools and community facilities; • the removal of 150ha of open forest and woodland. Of this: <ul style="list-style-type: none"> ○ 111ha or 74% is mapped as either “Thinned or disturbed” (66.3ha) or “Small Copses and Narrow Strips (44.6ha); ○ 39ha of 26% is in a “Good to moderate” condition • the creation of a Conservation Area of approximately 614.5 hectares in total <p>The report provides a justification towards the site being located south of the Cumberland Plain and the margins of the Cumberland Plain and therefore, does not contain any EEC’s.</p> <p><i>Note that whilst this assessment has been submitted, its conclusion regarding the distribution of Shale Sandstone Transition Forest has not been accepted by OEHL at this point in time.</i></p> <p>Field surveys in 2013 and 2014 identified:</p> <ul style="list-style-type: none"> • 3 threatened flora species: <ul style="list-style-type: none"> ○ The Bargo Geebung <i>Persoonia bargoensis</i> (E – TSC; V-EPBC) ○ Brown Pomaderris <i>Pomaderris brunnea</i> (V – TSC and EPBC) ○ <i>Epacris purpurascens</i> var. <i>purpurascens</i> (V – TSC) <p>All known occurrences will be contained within the conservation area.</p> <ul style="list-style-type: none"> • 12 threatened fauna species (TSC Act) <ul style="list-style-type: none"> ○ Spotted Harrier – one observed in grassland near a farm dam on northern part of study area ○ Scarlet Robin – one individual in woodland habitat in southern part of study area. ○ Glossy Black Cockatoo – observed at several locations ○ Little Lorikeet – several small flocks observed in the northern part of study area. ○ Powerful Owl – detected twice in southern part of study area ○ Common Bent-wing Bat <i>Miniopterus schreibersii</i> ○ Little Bent-wing Bat <i>Miniopterus australis</i>, ○ Large-eared Pied Bat <i>Chalinolobus dwyeri</i>, ○ Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>, ○ Yellow-bellied Sheath-tail Bat <i>Saccolaimus flaviventris</i>, ○ Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> and

Document	Key Outcomes
	<ul style="list-style-type: none"> ○ Eastern Freetail Bat <i>Mormopterus norfolkensis</i>. <p>Habitat for these threatened species will be mostly protected within the proposed conservation areas, apart from the spotted harrier and scarlet robin, which use grassland habitat.</p> <ul style="list-style-type: none"> ● In addition, 4 EPBC listed threatened bird species have been previously recorded on or adjacent to the Wilton Junction Study area: <ul style="list-style-type: none"> ○ Diamond Firetail ○ Barking Owl ○ Regent Honeyeater ○ Black-chinned Honeyeater <p>The site contains habitat suitable for the Broad-headed Snake and Red-crowned Toadlet – although neither were observed during the survey.</p> <p>Parts of the Wilton Junction study area have been identified to contribute to existing fauna habitat corridors.</p> <p>The report states that the most significant element of the natural environment and therefore, the key ecological constraint, is the substantial expanse of open forest and woodland vegetation communities in moderate to good condition, particularly along the peripheries (along the Nepean River and Allens Creek) and along some of the more notable minor watercourses through the subject land. The only corridors are located along the Nepean River and Allens Creek. The other bands of open forest and woodland terminate in open grassy paddocks.</p>
<p>Cumberland Plain Recovery Plan DECCW (2010)</p>	<p>A number of Priority Conservation Lands (PCL) were identified across the Cumberland Plain that represent the best remaining opportunities in the region to secure long-term biodiversity benefits for the lowest possible cost.</p> <p>The areas falling within the GMIA have been incorporated into this assessment</p>
<p>Hawkesbury Nepean Catchment Regional Biodiversity Corridors</p>	<p>Regional biodiversity corridors were mapped within and connecting to outside of the Hawkesbury Nepean Catchment area. Corridors were identified by fauna assessment work conducted in the Greater Southern Sydney Region as well as by interpretation of relevant satellite imagery and other environmental layers; to connect continuous vegetation between regional landscape features.</p> <p>Relevant parts of this GIS layer are incorporated into this assessment to provide context for important regional biodiversity connectivity.</p>
<p>Wollondilly Council Reserves Bushfire Risk Prioritisation (ELA, 2012)</p>	<p>Compilation of several vegetation datasets covering the Wollondilly LGA. Updated canopy cover vegetation mapping extent based on 2011 aerial photography.</p>

3.2 Vegetation Communities

The following describes the mapped vegetation community information from existing data (NPWS, 2002). A total of 9 biometric vegetation types have been mapped across the GMIA, covering an area of 6719 ha. A breakdown of the vegetation communities, their mapped condition and biometric vegetation type equivalence is described in **Table 3** and mapped in **Figure 2**.

The community type and its condition have not been field validated. NPWS (2002) used basic condition classification where-by vegetation is classified in A, B, C or TX condition as described in **Table 2** below. For the purposes of this regional scale study it has been assumed that vegetation in the 'A, B, C' category are generally in moderate to good condition, whilst TX is generally in low condition. It is important to acknowledge that Biodiversity Certification and Biobanking Assessment Methods (discussed later) have very specific criteria for the terms 'moderate to good' and 'low', and that field survey may conclude that some areas mapped as TX (or low condition) may be in moderate to good condition. However, for the purposes of broad strategic planning (and in the absence of field work), the assumption above is useful for differentiating areas of higher condition and conservation value.

Seven of the mapped vegetation communities in the GMIA are likely to meet the definition of one of three Endangered or Critically Endangered Ecological Communities under the Threatened Species Conservation (TSC) Act covering an area of 5101 hectares (ha) (**Figure 3 and Table 3**). Five vegetation communities also potentially meet the definition of *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* or *Shale Sandstone Transition Forest of the Sydney Basin Bioregion* which are listed under the EPBC Act.

Table 2 NPWS (2002) Vegetation Condition classification

Code	Area (ha)	CCPD (%)	Description
A	>0.5	>10	Relatively intact native tree canopy. Dominant canopy species and understorey characteristics identified
B	> 5	5-10	Larger areas of remnant vegetation with a low or discontinuous canopy. Often found on the disturbed edges of larger remnants. Assessed to identify the dominant canopy species only, and understorey characteristics not assessed. However, native shrub and grass layer often present, indicating understorey integrity
C	> 0.5		Areas of native vegetation that do not have a Eucalypt canopy cover. Understorey appears dominated by native vegetation, and codes were applied to identify patches of Melaleuca, Casuarina etc
Tx	>0.5	<10	Areas of native trees with very discontinuous canopy cover. Boundaries difficult to define from API due to low densities. Surrounding land use predominantly agricultural. Most have dominant canopy species assessed.

CCPD = the Crown Cover Projection Density

Table 3: GMIA Vegetation Communities

Vegetation Community	NSW Status	Biometric Vegetation Type	Condition		Total
			A, B or C (Moderate-Good)	TX (Low)	
Moist Shale Woodland		Forest Red Gum - Narrow-leaved Ironbark open forest of the southern Blue Mountains gorges, Sydney Basin Bioregion (HN525)	7	41	48
Alluvial Woodland	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (HN526)	40	37	77
Riparian Forest			181	7	188
Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)**	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (HN528)	129	146	275
Shale Hills Woodland		Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (HN529)	73	132	205
Cumberland Shale-Sandstone Ironbark Forest	Shale/Sandstone Transition Forest (CEEC)*	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion (HN556)	186	-	186
Shale Sandstone Transition Forest (High Sandstone Influence)			2238	1176	3414
Shale Sandstone Transition Forest (Low Sandstone Influence)			368	388	756
Sydney Hinterland Exposed Sandstone Woodland		Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion (HN564)	22	-	22
Sydney Hinterland Grey Gum Ridgetop Forest			117	-	117
Upper Georges River Sandstone Woodland			300	30	330
Nepean Sandstone Gully Forest		Red Bloodwood - Sydney Peppermint - Blue-leaved Stringybark heathy forest of the southern Blue Mountains, Sydney Basin Bioregion (HN568)	<1	-	<1

Vegetation Community	NSW Status	Biometric Vegetation Type	Condition		Total
			A, B or C (Moderate-Good)	TX (Low)	
Sydney Hinterland Apple-Blackbutt Gully Forest		Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion (HN586)	135	-	135
Western Sandstone Gully Forest			815	36	851
Coastal Sandstone Riparian Scrub		Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion (HN607)	8	-	8
Cumberland Riparian Scrub			106	-	106
Riparian Scrub			<1	<1	<1
Total			4726	1993	6719

Moderate-Good: Includes A, B & C condition vegetation. Generally good condition with greater than 10% canopy cover. Low: Includes Cmi, TX, TXR & TXU condition vegetation. Urban remnant trees or scattered trees of lesser condition with less than 10% canopy cover. Areas of vegetation mapping with no condition class assigned have been assumed to be in Moderate-Good condition.

**Potential endangered community under the EPBC Act*

***Potential critically endangered community under the EPBC Act*

3.2.1 Potential Red Flagged Vegetation

Part 7AA of the Threatened Species Conservation Act provides a statutory approach for determining whether strategic land use planning processes achieve an ‘improve or maintain’ outcome with regard to threatened species and endangered ecological communities. The Biodiversity Certification Assessment Methodology (BCAM) can also be used to guide strategic biodiversity outcomes even if the project does not result in Biodiversity Certification under the TSC Act. One of the critical steps in the BCAM is to determine what vegetation communities or threatened species are found within the area and whether they can sustain further loss or whether their loss can be offset to achieve an ‘improve or maintain’ outcome. The BCAM uses the term ‘red flag’ to describe those communities and species which are to avoid further loss. These in effect become highly constrained lands. The following table and map identifies likely ‘red flagged’ vegetation and landscape features according to the BCAM and based on desktop information. Note however that field work was not undertaken and therefore several assumptions were made regarding condition:

- All vegetation mapped as an EEC or CEEC in either A, B or C condition was assumed to fall into the Moderate-Good condition and therefore would be potentially red-flagged
- All vegetation with mapped condition of TX (including EECs and CEECs) were considered to be in low condition and therefore is not considered to be red flagged. It is possible and indeed likely that some areas mapped as TX are actually in moderate to good condition and would also be red flagged. Field work is necessary to make this determination.

Table 4: Endangered Ecological Communities and Red-flagged vegetation

NSW Status	Biometric Vegetation Type	Condition		Total
		A, B, C (Moderate-Good)	TX (Low)	
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (HN526)	221	44	265
Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)**	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (HN528)	129	146	275
	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (HN529)	73	132	205
Shale/Sandstone Transition Forest (CEEC)*	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion (HN556)	2792	1564	4356
Total		3215	1886	5101

*Potential endangered community under the EPBC Act

**Potential critically endangered community under the EPBC Act

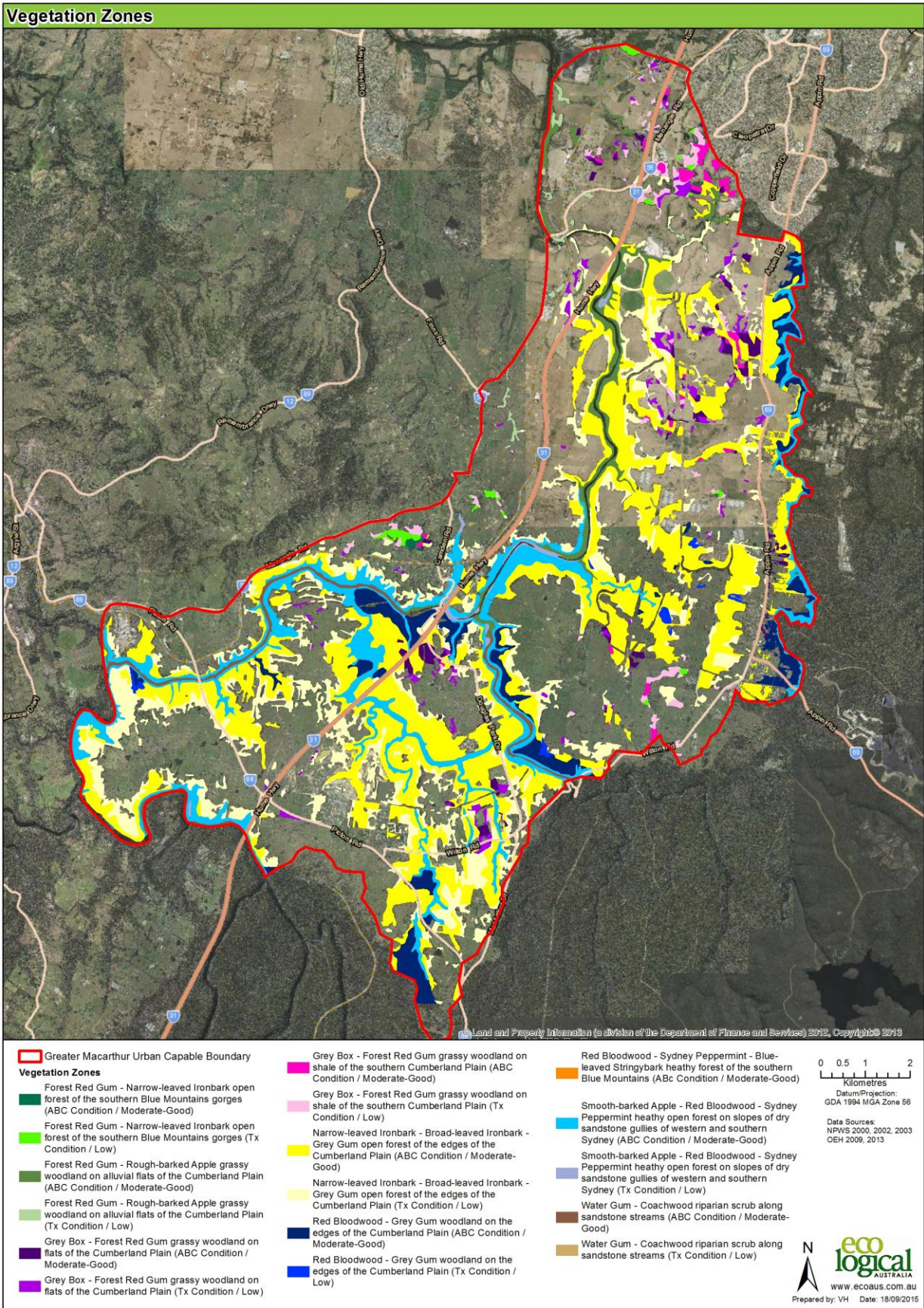


Figure 2: Biometric Vegetation Types / Zones

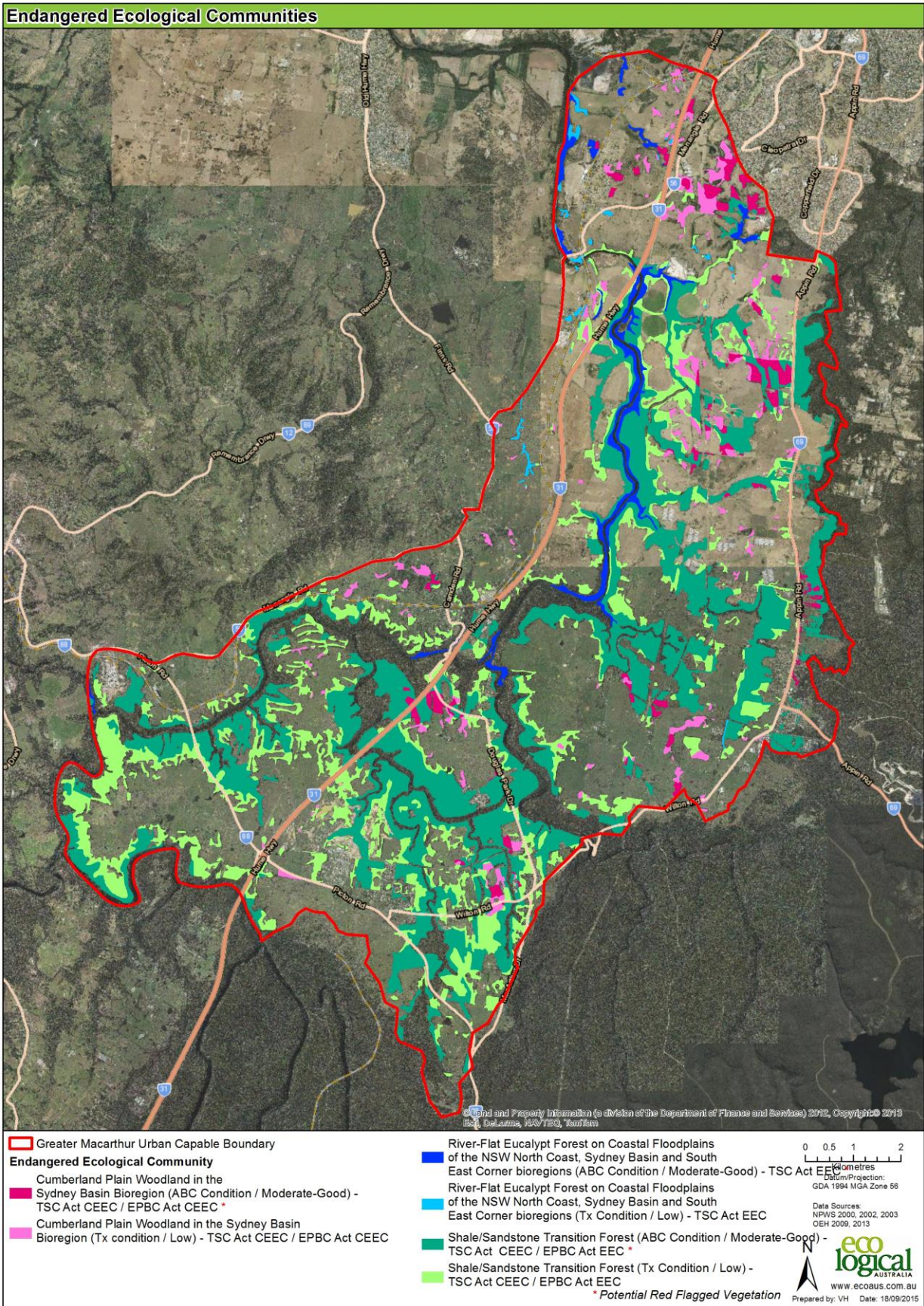


Figure 3: Endangered Ecological Communities

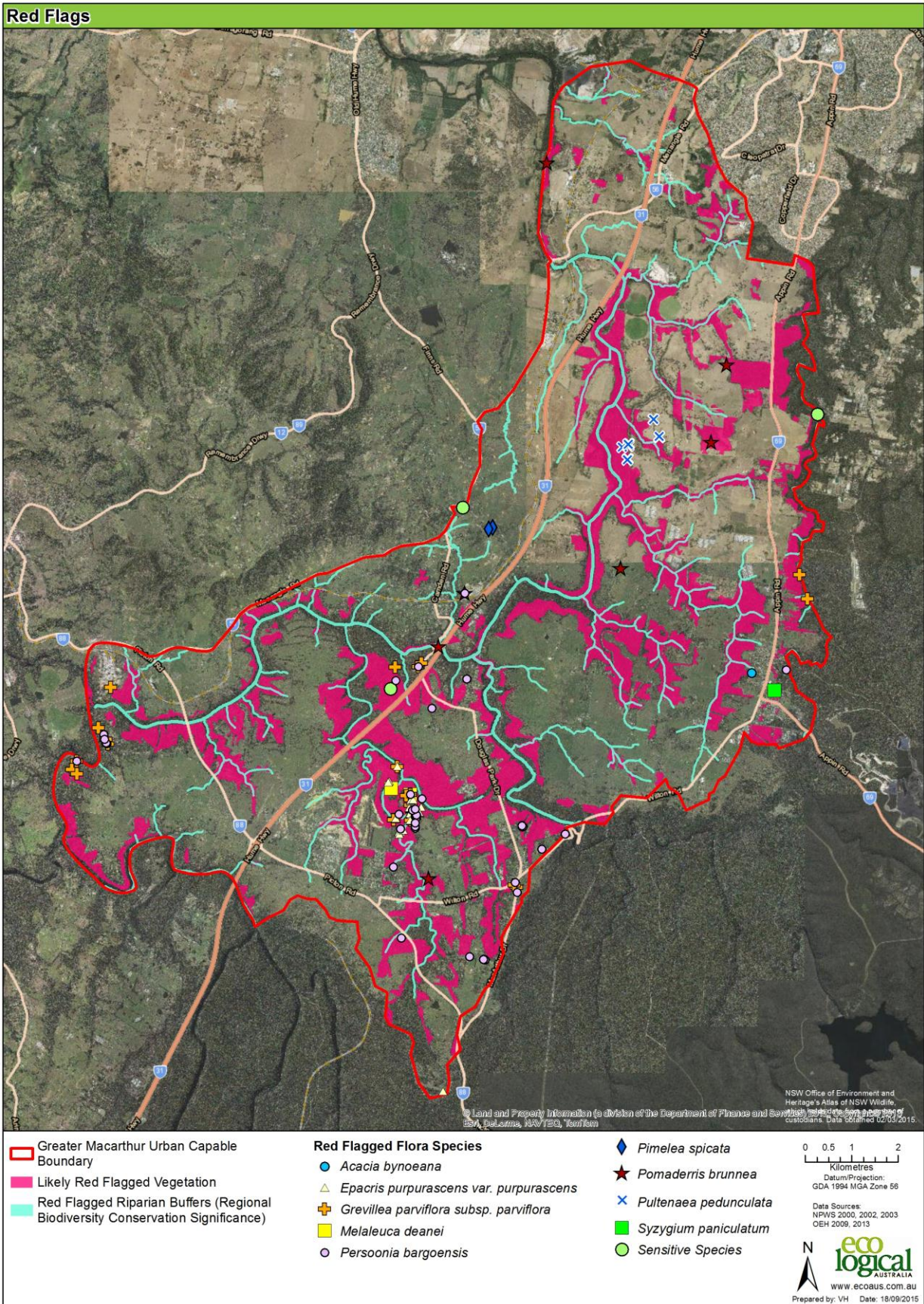


Figure 4: Red Flags

3.3 Threatened Species

The GMIA area is also likely to contain habitat for a number of threatened flora and fauna species.

Table 5 and **Table 6** below, show the predicted threatened species most likely to occur in the area, including those red flagged species that have been recorded within the area (shaded).

Table 5: GMIA Predicted Threatened Flora

Botanical Name	Common Name	TSC Status	EPBC Status
<i>Acacia bynoeana</i> *	Bynoe's Wattle	E	V
<i>Allocasuarina glareicola</i>	-	E	E
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	E	V
<i>Callistemon linearifolius</i> *	Netted Bottle Brush	V	-
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E
<i>Epacris purpurascens</i> var. <i>purpurascens</i> *	-	V	-
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	E	E
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> *	Small-flower Grevillea	V	V
<i>Gyrostemon thesioides</i> *	-	E	-
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Wingless Raspwort	V	V
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V
<i>Melaleuca deanei</i> *	Deane's Paperbark	V	V
<i>Pelargonium</i> sp. <i>Striatellum</i> (G.W.Carr 10345)	Omeo Stork's-bill	E	E
<i>Persoonia bargoensis</i> *	Bargo Geebung	E	V
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E
<i>Persoonia nutans</i>	Nodding Geebung	E	E
<i>Pimelea spicata</i> *	Spiked Rice-flower	E	E
<i>Pomaderris brunnea</i> *	Brown Pomaderris	E	V
<i>Pterostylis saxicola</i> *	Sydney Plains Greenhood	E	E
<i>Pultenaea aristata</i>	Prickly Bush-pea	V	V
<i>Pultenaea pedunculata</i> *	Matted Bush-pea	E	-
<i>Streblus pendulinus</i>	Siah's Backbone	-	E
<i>Syzygium paniculatum</i> *	Magenta Lilly Pilly	E	V
<i>Thelymitra kangaloonica</i>	Kangaloon Sun Orchid	CE	CE
<i>Thesium australe</i>	Austral Toadflax	V	V

CE – critically endangered; E – endangered; V – vulnerable; X – extinct

* Red flagged species recorded within the GMIA

Table 6: GMIA Predicted Threatened Fauna

Scientific Name	Common Name	TSC Status	EPBC Status
AMPHIBIANS			
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V
<i>Litoria raniformis</i>	Southern Bell Frog	E	V
<i>Mixophyes balbus</i>	Stuttering Frog	E	V
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-
BIRDS			
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V	-
<i>Circus assimilis</i>	Spotted Harrier	V	-
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E
<i>Ephippiorhynchus asiaticus*</i>	Black-necked Stork	E	-
<i>Falco subniger</i>	Black Falcon	V	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-
<i>Lathamus discolor</i>	Swift Parrot	E	E
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-
<i>Neophema pulchella</i>	Turquoise Parrot	V	-
<i>Ninox connivens</i>	Barking Owl	V	-
<i>Ninox strenua</i>	Powerful Owl	V	-
<i>Petroica boodang</i>	Scarlet Robin	V	-
<i>Petroica phoenicea</i>	Flame Robin	V	-
<i>Rostratula australis</i>	Australian Painted Snipe	E	E
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-
<i>Tyto novaehollandiae</i>	Masked Owl	V	-

Scientific Name	Common Name	TSC Status	EPBC Status
BIRDS – MIGRATORY			
<i>Apus pacificus</i>	Fork-tailed Swift	-	M
<i>Ardea alba</i>	Great Egret	-	M
<i>Ardea ibis</i>	Cattle Egret	-	M
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	M
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	M
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M
MAMMALS			
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot (Eastern)	E	E
<i>Miniopterus australis*</i>	Little Bentwing-bat	V	-
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-
<i>Myotis macropus</i>	Southern Myotis	V	-
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V
<i>Phascolarctos cinereus</i>	Koala	V	V
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V
<i>Pteropus poliocephalus*</i>	Grey-headed Flying-fox	V	V
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-
INVERTEBRATES			
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-
REPTILES			
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V

CE – critically endangered; E – endangered; V – vulnerable; M – migratory; X – extinct

* Red flagged species recorded within the GMIA

3.4 Priority Conservation Lands (PCL)

Priority Conservation Lands (PCL), identified as part of the Cumberland Plain Recovery Plan (DECCW 2010), occur within the GMIA and are shown in **Figure 5**. The PCL were identified as priority areas that represent the best remaining opportunities in the region to secure long-term biodiversity benefits for the lowest possible cost in an environment which is becoming increasingly urbanised. These areas have also been targeted as contributing to suitable offsets for identified development across the Cumberland Plain in western Sydney, such as the north west and south west Growth Centres.

A total of 3,197 ha of native vegetation has been identified within these lands, made up of a number of vegetation types and much of the significant biodiversity across the GMIA (includes red-flagged vegetation).

3.5 Biobank Sites

The GMIA contains two areas that are registered as Biobank Sites under the NSW Threatened Species Conservation Act. The two areas are shown on Figure 5 and are:

- Beulah (59.6 ha)
- St Marys Tower (80.1 ha)

Biobank sites have an existing legal commitment to be managed for conservation purposes in perpetuity and therefore are not available for future urban development or infrastructure.

3.6 Biodiversity Corridors

Key areas of biodiversity connectivity across the GMIA have been identified from the Hawkesbury Nepean catchment regional biodiversity corridors. The corridors within the GMIA are shown in **Figure 6**.

The biodiversity corridors were developed by OEH, through fauna assessment work conducted in the Greater Southern Sydney Region, as well as by the interpretation of relevant satellite imagery and other environmental layers; to identify connected, continuous vegetation between regional landscape features.

While not incorporated into any formal policy framework; the biodiversity corridors were mapped within and connecting to outside of the Hawkesbury Nepean Catchment area as part of a framework to identify opportunities for regional habitat connectivity. They identify the areas which are able to best consolidate the greatest overall regional biodiversity outcomes.

The biodiversity corridors within the GMIA are mainly associated with watercourses and connect to lands reserved for conservation (including the SCA special areas). A total of 2,946 ha of native vegetation has been identified within these lands.

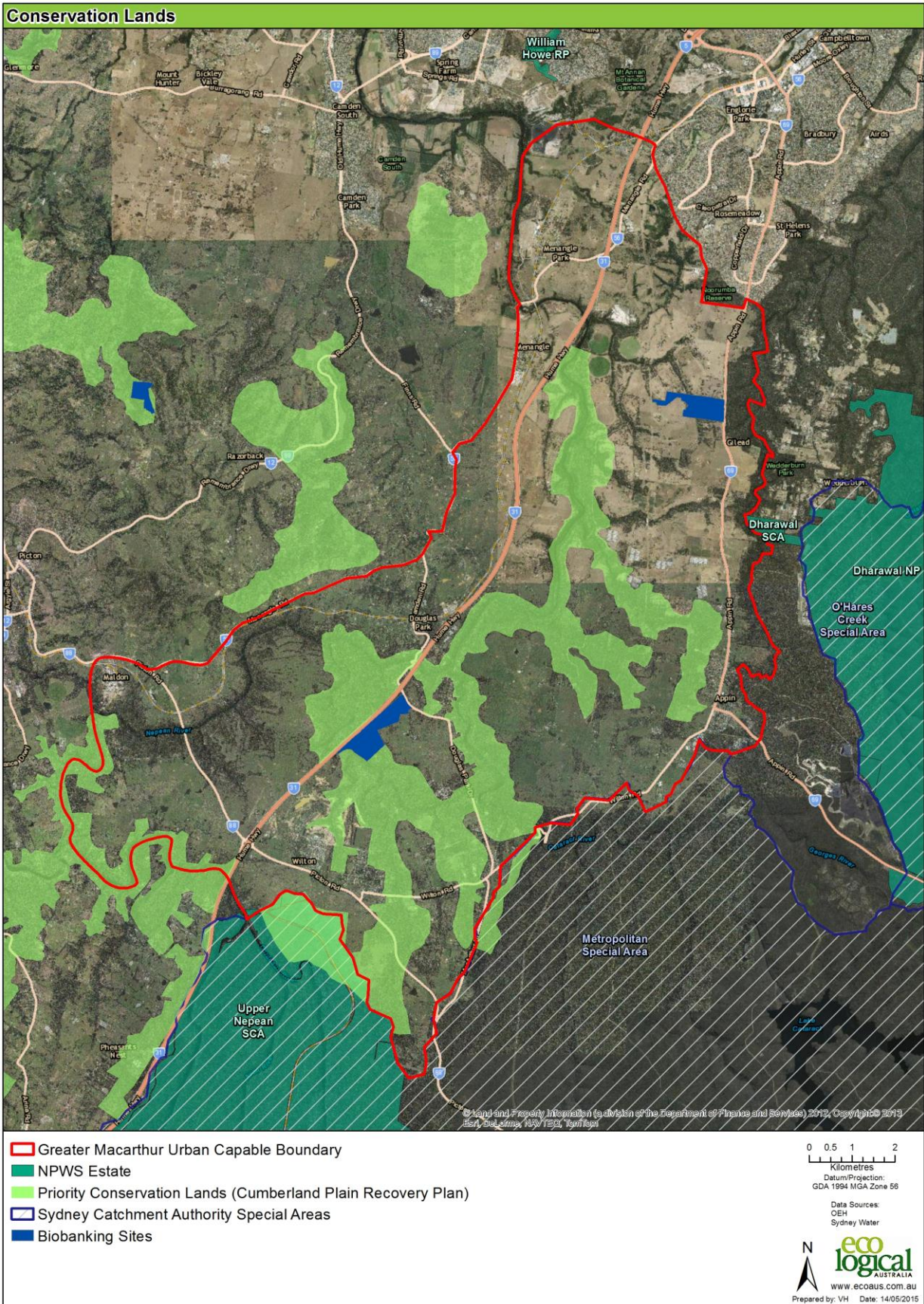


Figure 5: Priority Conservation Lands from the Cumberland Plain Recovery Plan (DECCW 2010) and Biobank Sites

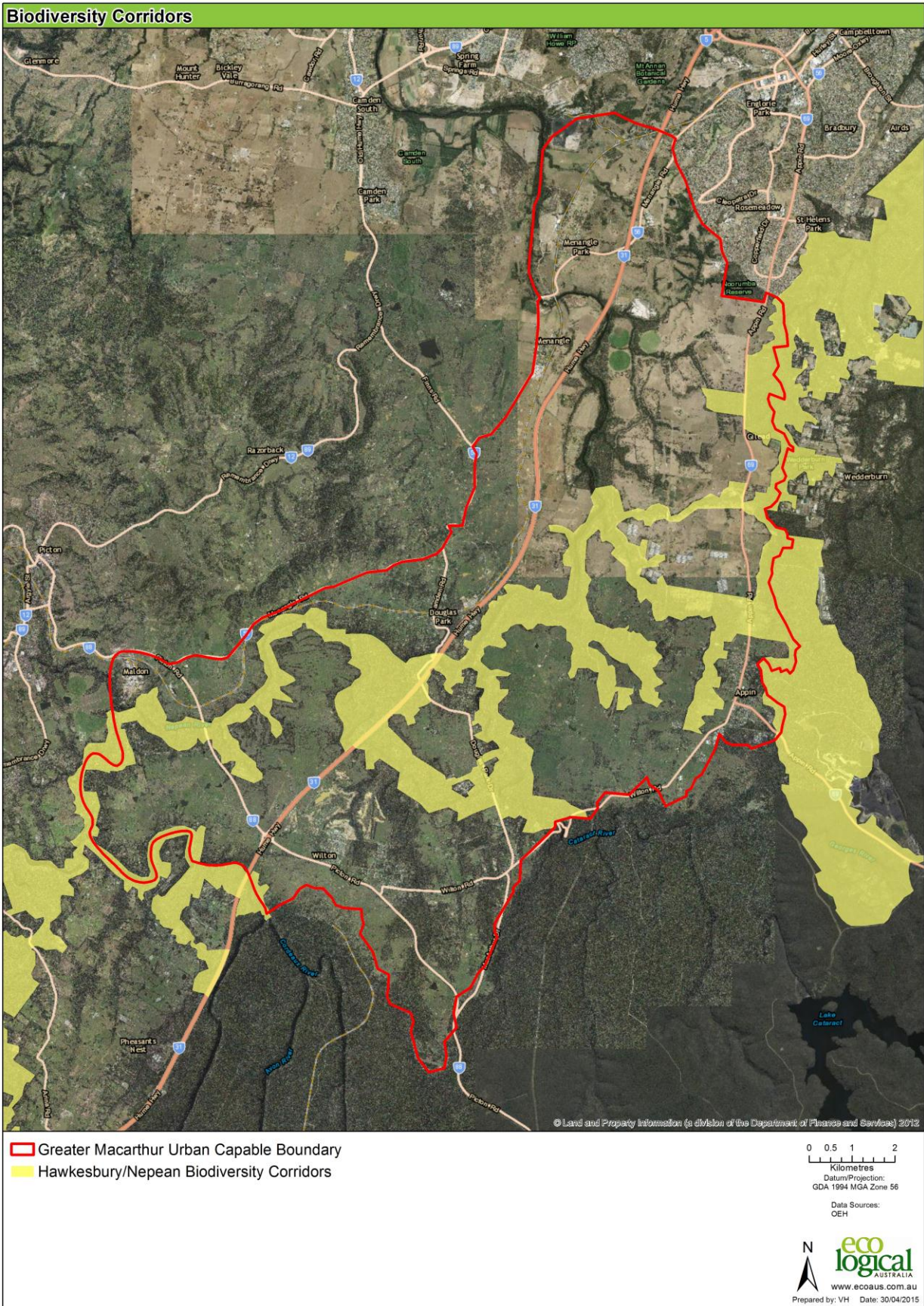


Figure 6: Hawkesbury/Nepean Biodiversity Corridors

4 Conservation Significance Assessment

The following areas have existing legal obligations for conservation management and are therefore not available for urban development:

1. Sydney Catchment Authority Special Areas
2. NPWS reserves
3. BioBanking Sites

Using the available information, an initial analysis was carried out to identify the priority conservation areas across the region outside of the above areas. The biodiversity constraint values across the region are defined in Table 6.

Table 7: Biodiversity constraint values

Biodiversity Constraint	Rationale
High	<ul style="list-style-type: none"> • All native vegetation within the Priority Conservation Lands and Hawkesbury Nepean Corridors <p>Or</p> <ul style="list-style-type: none"> • Any native vegetation that is: <ul style="list-style-type: none"> ○ EEC or CEEC outside of the PLC/HN <u>and</u> ○ is in A, B or C condition (NPWS, 2002); <u>and</u> ○ is a patch size greater than 10ha
Moderate	EECs and CEECs outside of the PCL and H/N Corridors <10ha in any condition
Low / nil	Other vegetation and cleared areas

Biodiversity constraint is shown in **Figure 7**. All areas with no mapped vegetation (cleared / developed), are considered to be of low biodiversity constraint.

This analysis has been carried out at a broad scale as a desktop process. There may be additional biodiversity values in areas which have been classified as low constraint, such as populations of threatened species or EECs.

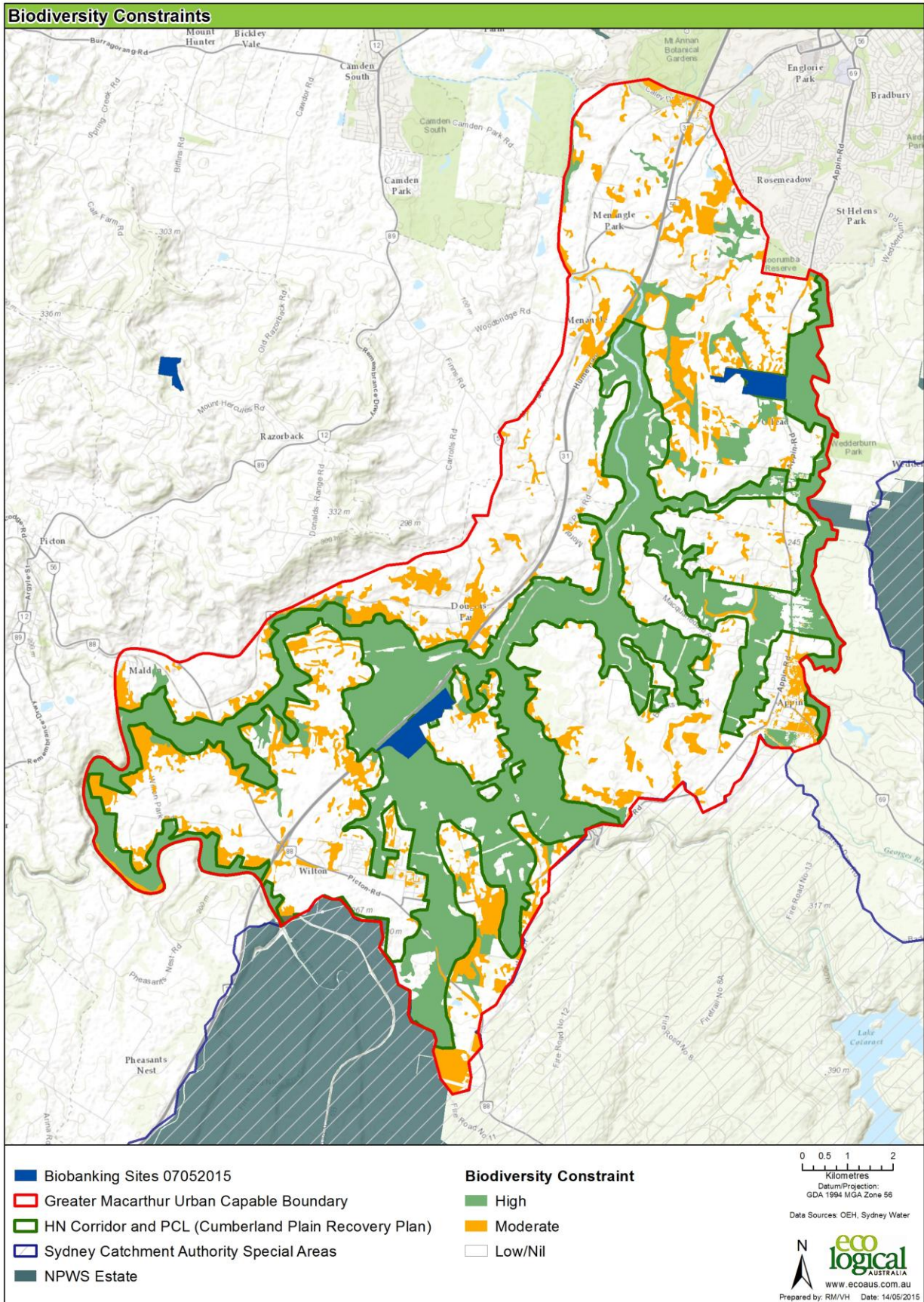


Figure 7: Biodiversity constraints

5 Biodiversity Management Frameworks

This section of the report discusses options for biodiversity planning and management for the GMIA, assuming that urban development is proposed. The preferred approach will depend on factors such as the scale of biodiversity impact, timing of expected development and whether or not the GMIA develops as a Growth Area or as developer-led projects.

Three issues are discussed:

- The use of Biodiversity Certification under the NSW TSC Act 1995
- Alternatives to Biodiversity Certification
- Strategic Assessment under the Commonwealth EPBC Act 1999

5.1 Biodiversity certification

A Plan for Growing Sydney provides broad direction for the type of framework that is desirable for new urban areas. Section 4.1.1 of A Plan for Growing Sydney identifies Biodiversity Certification under the TSC Act 1995 as a tool designed for this purpose.

A PLAN FOR GROWING SYDNEY

DIRECTION 4.1: Protect our natural environment and biodiversity

ACTION 4.1.1: Protect and deliver a network of high conservation value land by investing in green corridors and protecting native vegetation and biodiversity

A strategic approach to managing long-term biodiversity and promoting environmental resilience as housing and economic development occurs will have greater benefits than site-by-site decision making.

Applying mitigation measures can prevent or reduce the impacts of development on areas of high conservation value, native vegetation and diversity from development. Offsets can be used to address the remaining impacts and protect other areas of land with high conservation value.

The Government will invest in areas of high conservation value and protect our biodiversity through:

- the Biodiversity Banking and Offsets Scheme addresses the loss of biodiversity including threatened species by enabling biodiversity credits for landowners who commit to improve and protect biodiversity values on their land in perpetuity. These credits are sold on the open market, generating funds for the management of the site. The credits can be bought and retired by developers looking to offset biodiversity impacts on a development site. Governments, corporations and philanthropists may also purchase credits to secure conservation outcomes;
- working with private industry to manage bushland on private lands in areas of high conservation value, including biodiversity corridors. Private landholders can voluntarily enter into a joint agreement with the Minister for the Environment to permanently protect special features on their land. Such an agreement permanently conserves the land even if the land changes hands;
- and continuing to use state planning policies and local planning controls to protect high conservation value areas, native vegetation and biodiversity. Many of these areas are identified during the planning and development process. The management of these areas (and of activities taking place outside their boundaries) contributes directly to the protection of animals and plants.

A Plan for Growing Sydney contains a statement on Biodiversity Certification which it describes as a way of balancing the need to protect and manage areas that have conservation values while still providing essential housing. The Biodiversity Certification process involves a detailed assessment of biodiversity values and preparation of a Biodiversity Certification Strategy that describes the actions that will be undertaken to protect and manage vegetation to achieve an ‘improve or maintain’ outcome. The Biodiversity Certification Strategy also identifies areas proposed for development (known as ‘biodiversity certified land’). If endorsed, any development on the certified land is taken to be development not likely to have a significant impact on threatened species and endangered ecological communities under the TSC Act and therefore no further assessment or approvals would be required at the development stage. The intended result is certainty of conservation and development outcomes.

Biodiversity Certification can be undertaken at various scales. For the GMIA there would be at least two potential scales:

- Whole of GMIA; or
- Precinct scale (for example the individual Planning Proposals for Mt Gilead, Wilton Junction, Menangle Park etc)

There would be significant differences in the approach to Biodiversity Certification at these scales due to the following issues:

- Number of participants: All parties with a responsibility to deliver offsets should be signatories to the application for a Biodiversity Certification Agreement. This is relatively easy when there is a single landholder delivering the conservation outcome. It is substantially more difficult when the conservation outcomes are to be delivered by multiple parties, especially when there may be long time lags before some of those conservation outcomes are delivered. A larger number of parties will also increase the likelihood of participants having different goals, expectations, resources and timeframes.
- Data: A Biodiversity Assessment Report must be prepared in accordance with the Biodiversity Certification Assessment Methodology. Data collection and analysis for the whole GMIA (which includes around 6500 ha of vegetation) would most likely take 2 years, although there may be some time savings if adequate biometric data has been collected for existing studies. Field based data for a precinct scale assessment would most likely be carried out over a 6-9 month period.
- Knowledge of development / conservation footprint: Biodiversity Certification aims to achieve certainty of development and conservation footprint. When planning a long way ahead of having zoning or a detailed in masterplan in place there is a high likelihood that minor changes will be proposed at a later date when more detailed analysis of technical information is available. The Biodiversity certification process is not particularly flexible when dealing with changes at a later date.
- Strategic outcomes: undertaking biodiversity assessment of the GMIA as a whole is more likely to result in optimal strategic biodiversity outcomes as corridors can be planned across release areas.
- Administration of funding: The resources to undertake a Biodiversity Certification would need to be available at the start of the project. If this was undertaken for the GMIA as a whole, it would most likely require the state government to take a lead on forward funding the process and perhaps recouping costs through a Special Infrastructure Contribution – as was arranged for the Sydney Region Growth Centres. If undertaken at a precinct or land release scale it is more likely that the process would be funded by a developer.

Based on the above, whilst undertaking a GMIA-wide Biodiversity Certification would provide better opportunities for a strategic approach, the practicalities of such a large assessment make it challenging. The strategic outcomes can however still be achieved via a precinct-scale approach by identifying the broad conservation areas in a masterplan and using the following guiding principles:

1. That Biodiversity Certification is supported as the most appropriate planning tool for large scale urban development.
2. That native vegetation within the Priority Conservation Areas and H/N Corridors will be protected and urban development not supported within those areas.
3. That infrastructure and bushfire asset protection zones within the Priority Conservation Areas and H/N corridors be avoided wherever possible.
4. That degraded areas within the Priority Conservation Lands and H/N Corridors would be a priority for rehabilitation.
5. That the Priority Conservation Lands and H/N Corridors should be targeted for Biobank Agreements to ensure conservation outcomes have in perpetuity funding.

In undertaking Biodiversity Certification processes, issues associated with long term ownership, public access and funding of management for conservation areas is likely to arise as a key issue. As developers will generally wish to divest themselves of their landholdings, there will be several options for long term management and ownership including dedication to a public authority, retaining in private ownership or establishing Trust ownership. Options for securing management costs associated with long term management will include mechanisms such as Biobanking and Planning Agreements. Should the GMIA proceed as a priority release area, discussion of these options early in the planning process is recommended.

5.2 Alternative to Biodiversity Certification

If Biodiversity Certification is not used, there are two scenarios for how biodiversity issues would affect future developments. If the development has nil or insignificant impacts on threatened species or endangered ecological communities, the issue of conservation requirements or offsets should not arise.

If however future developments do have a significant impact (as defined by s5A of the EP&A Act 1979) on threatened species or endangered ecological communities, a Species Impact Statement would need to be prepared. The detailed studies and offset strategies that are typically required for a Species Impact Statement are similar to the studies and offset strategies required under Biodiversity Certification. This being the case, it would be more efficient to have dealt with the issue at the Planning Proposal stage. The scenario of requiring a Species Impact Statement is not an unlikely one given the presence of Critically Endangered Ecological Communities across the GMIA.

5.3 Commonwealth Framework

The Shale Sandstone Transition Forest and Cumberland Plain Woodland are both listed under the NSW Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999 as Matters of National Environmental Significance (MNES). Significant impacts to MNES require approval from the Commonwealth Minister for the Environment and are known as Controlled Actions. Where there are likely to be numerous Controlled Actions, the EPBC Act allows for a Strategic Assessment which assesses all potential actions and approves certain classes of action so that approval from the Commonwealth is not required on a project by project basis.

This approach is similar in concept to Biodiversity Certification under the NSW TSC Act 1995. If biodiversity certification is pursued, it is logical to ensure that the conservation outcomes provide for

Commonwealth listed Matters of National Environmental Significance. Discussions with the Commonwealth are recommended to determine whether a separate Strategic Assessment would be required, or whether the Commonwealth could endorse the Biodiversity Certification process and therefore not require separate assessment.

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