Leppington Rezoning Assessment
Biodiversity and Riparian Studies

Prepared for
NSW Department of Planning and Infrastructure

June 2014
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Contents

Executive Summary ................................................................................................................................ 7

1 Introduction........................................................................................................................................ 8
  1.1 Description of project .................................................................................................................... 8
  1.2 Study Area .................................................................................................................................... 9

2 Statutory Framework ................................................................................................................ 11
  2.1 International ................................................................................................................................ 11
  2.2 Commonwealth ........................................................................................................................... 11
  2.3 State ........................................................................................................................................... 11
  2.4 Local ........................................................................................................................................... 11

3 Terrestrial Biodiversity Assessment ...................................................................................... 12
  3.1 Biodiversity certification .............................................................................................................. 12
  3.2 EPBC Act Strategic Assessment ................................................................................................ 14
  3.3 Methods ...................................................................................................................................... 14
    3.3.1 Literature Review .................................................................................................................... 14
    3.3.2 Field Survey ........................................................................................................................ 14
  3.4 Vegetation Communities & condition ......................................................................................... 15
    3.4.1 Cumberland Plain Woodland .............................................................................................. 15
    3.4.2 Alluvial Woodland ............................................................................................................... 16
    3.4.3 Vegetation Community and Condition Assessment Area Calculations ...................................... 19
  3.5 Validated Existing native vegetation area calculations .............................................................. 19
  3.6 Flora ............................................................................................................................................ 22
  3.7 Fauna .......................................................................................................................................... 23
  3.8 Ecological constraints ................................................................................................................. 26

4 Riparian & Aquatic Assessment ............................................................................................. 28
  4.1 Context ....................................................................................................................................... 28
  4.2 Study Area .................................................................................................................................. 28
  4.3 Methods ...................................................................................................................................... 30
    4.3.1 Field Investigations and Top of Bank Mapping .......................................................................... 30
  4.4 Results ........................................................................................................................................ 31
    4.4.1 Field Investigations and Top of Bank Mapping .......................................................................... 31
    4.4.2 Aquatic Habitat Condition Assessment ...................................................................................... 48
  4.5 Aquatic Assessment and Threatened Species ............................................................................... 49
4.5.1 Threatened Species ................................................................. 49
4.5.2 Groundwater Dependant Ecosystems ........................................... 49
4.6 Discussion / Recommendations ..................................................... 53
4.6.1 Stream Order Classification and Riparian Corridors ....................... 53
4.6.2 Riparian Ownership and Management Options ............................ 56
4.6.3 Water Management Act ............................................................ 56
4.7 Management of Riparian Protected Areas ....................................... 56
4.7.1 Urban Development Principles .................................................. 56

5 Conservation and Management Recommendations for Indicative Layout Plan .......... 60

6 References ......................................................................................... 62

Appendix A: Detailed Statutory Framework .......................................... 64
Appendix B: Methodology ................................................................. 68
Appendix C: Flora and Fauna Lists ..................................................... 76
Appendix D: Likelihood of Occurrence Table ........................................ 80
List of Figures

Figure 1: Leppington Precinct Study Area ................................................................. 10
Figure 2: Certified and Non-Certified Land and Conservation Plan (mapped) ENV. ........ 13
Figure 3: TSC Act Field Validated Vegetation Communities and Condition Classes and Location of Hollow Bearing Trees ......................................................................................... 17
Figure 4: EPBC Act Vegetation Communities and condition classes ........................................... 18
Figure 5: Mapped and Validated ENV plus AHCVV within the Leppington Precinct ............... 21
Figure 6: Location of threatened species records in the precinct vicinity .................................. 25
Figure 7: Ecological Constraints ...................................................................................... 27
Figure 8: Validated Watercourses within Leppington Precinct .................................................. 29
Figure 9: Strahler Stream Ordering System ............................................................................. 31
Figure 10: Watercourse Reaches and within Leppington Precinct ............................................ 33
Figure 11: Aquatic Survey Reaches and location of Alluvial Woodland GDE ......................... 52
Figure 12: Proposed riparian corridors and top of bank .......................................................... 55
Figure 13: Averaging Rule. Source NOW Controlled Activity Riparian Corridor Guidelines ........ 58
List of Tables

Table 1: A summary of area occupied by TSC listed vegetation communities and their TSC condition. 19
Table 2: A Summary of area occupied by EPBC Listed vegetation communities ................................... 19
Table 3: Amount of ENV and AHCVV in Leppington Precinct ................................................................. 20
Table 4: Noxious weeds present in Leppington Precinct. ........................................................................ 22
Table 5: NOW Riparian Categories and Buffer Specifications ................................................................. 31
Table 6: Watercourse Reach Condition and Natural Recovery Potential ................................................ 34
Table 7: Listed aquatic and amphibious species recorded in the region ................................................. 49
Table 8: NOW Riparian Corridor Matrix ................................................................................................... 59
## Abbreviations

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>DESCRIPTION</th>
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<tr>
<td>AHCVV</td>
<td>Additional High Conservation Value Vegetation – vegetation meeting the requirements for ENV that was not mapped in the (draft) Growth Centres Conservation Plan 2007</td>
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<tr>
<td>APZ</td>
<td>(Bushfire) Asset Protection Zone</td>
</tr>
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<td>AW</td>
<td>Alluvial Woodland</td>
</tr>
<tr>
<td>CEEC</td>
<td>Critically Endangered Ecological Community</td>
</tr>
<tr>
<td>CPW</td>
<td>Cumberland Plain Woodland</td>
</tr>
<tr>
<td>CLS</td>
<td>Cumberland Land Snail</td>
</tr>
<tr>
<td>DECCW</td>
<td>(Former) NSW Department of Environment, Climate Change and Water</td>
</tr>
<tr>
<td>DP &amp; I</td>
<td>Department of Planning and Infrastructure</td>
</tr>
<tr>
<td>SEWPac</td>
<td>Commonwealth Department of Sustainability, Environment, Water, Population and Communities</td>
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<td>EEC</td>
<td>Endangered Ecological Community</td>
</tr>
<tr>
<td>ELA</td>
<td>Eco Logical Australia</td>
</tr>
<tr>
<td>ENV</td>
<td>Existing Native Vegetation</td>
</tr>
<tr>
<td>EPA Act</td>
<td>Environmental Planning and Assessment Act (1979)</td>
</tr>
<tr>
<td>OEH</td>
<td>NSW Office of Environment and Heritage (formerly DECCW)</td>
</tr>
<tr>
<td>PBP / PBP 2006</td>
<td>NSW Rural Fire Service Planning for Bushfire Protection Guidelines 2006</td>
</tr>
<tr>
<td>NES</td>
<td>Matters of National Environmental Significance</td>
</tr>
<tr>
<td>RC</td>
<td>Riparian Corridor</td>
</tr>
<tr>
<td>RBM</td>
<td>Relevant Biodiversity Measure (from the Growth Centres Biodiversity Certification Order)</td>
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<td>RFS</td>
<td>NSW Rural Fire Service</td>
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<tr>
<td>SEPP</td>
<td>State Environmental Planning Policy</td>
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<tr>
<td>TSC Act</td>
<td>NSW Threatened Species Conservation Act (1995)</td>
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<td>VRC</td>
<td>Vegetated Riparian Corridor</td>
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<tr>
<td>WSUD</td>
<td>Water Sensitive Urban Design</td>
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Executive Summary

Eco Logical Australia Pty Ltd (ELA) was engaged by NSW Department of Planning and Infrastructure (DP & I) to assess the ecological, riparian and bushfire issues within the Leppington Precinct. The aim of the assessment is to identify the ecological and riparian values on the site, consider the interplay between these values, investigate the current and future constraints posed by ecological and riparian management issues and provide recommendations for the future master planning, rezoning and urban development of the site. The bushfire assessment for Leppington Precinct is contained in a separate report.

The site contains a number of ecological values that are currently listed under State and Commonwealth legislation. Biodiversity Certification of the Growth Centres Conservation Plan strategically identifies a regional offsets package, effectively enabling the strategic loss of ecological values on ‘certified lands’ without triggering further assessment under the NSW TSC Act. This strategic loss is offset through the retention and management of areas of higher ecological value across the Growth Centres and through a levy that will be used to protect and manage areas of high ecological value outside of the Growth Centres. Additionally provided development activity proceeds in accordance with the Growth Centres requirements, there is no requirement to assess the impact of development activities under the EPBC Act. This process was “turned off” by the approval of the Strategic Assessment for Western Sydney.

Within the Leppington Precinct, a mix of certified and non-certified land is present. Non-certified land exists along the north-west portion of the precinct, accounting for 23.2 ha of land. This part of the site has not been certified because of Kemps Creek, which is likely to impose some level of flood restriction on the development of land within that part of the Precinct. Stands of ENV (Existing Native Vegetation) in this non-certified area must be protected, or offset if clearing is required for the provision of essential infrastructure.

A second major watercourse (Scalabrini Creek) exists to the east of Kemps Creek, however at present there is no non-certified land associated with this watercourse. Both of the major watercourses are fed by smaller tributaries on site, the exact locations of which were verified through Top of Bank mapping for their entire reaches. In several parts of the study area the creek line has been significantly modified by previous land use practices and many of the reaches previously classed as creeks do not currently meet the criteria for watercourses. Appropriate width riparian corridors will be required and have been incorporated into the detailed design and assessment of the riparian constraints.
1 Introduction

1.1 DESCRIPTION OF PROJECT

Eco Logical Australia Pty Ltd (ELA) was engaged by the NSW Department of Planning and Infrastructure (DP & I) to undertake an assessment of the ecological, riparian and bushfire issues so as to inform the Leppington Precinct Planning Process within the South-West Growth Centre. The aim of this assessment is to identify key ecological and riparian features and constraints of the site as well as to provide recommendations with respect to terrestrial and aquatic ecosystem management. The bushfire assessment has been completed in a separate report.

DP & I have also engaged Parson Brinkerhoff (PB) to prepare a Precinct wide flooding study and Water Management Study that also includes a riparian assessment as part of that body of work. The key findings in relation to riparian corridors are common in both reports.

The aim of this integrated assessment is to identify key constraints, assess the impacts and provide input for the three stages of the Leppington rezoning process:

- Stage 1 – flora and fauna field surveys, riparian location and habitat survey, assessment of bushfire threats, provision of a consolidated constraints analysis and provision of recommendations for incorporation into the Indicative Layout Plan (ILP);
- Stage 2 – assessment of the ILP, updated reporting, agency consultation and project team liaison,
- Stage 3 – input to finalisation of the ILP and associated reporting for public exhibition.

This report fulfils Stage 1 of the integrated assessment of biodiversity and riparian issues relevant to the Leppington Precinct.

Specific objectives of this project are to:

- Undertake a strategic biodiversity assessment including a flora and fauna study, analysis of ecological values particularly in regards to identifying areas of high, moderate and low ecological value,
- Ensure the statutory requirements for the protection, restoration and enhancement of threatened species, populations, ecological communities and their habitats will be met, and that precinct rezoning processes are consistent with the terms of the biodiversity certification granted to the Growth Centres SEPP and the Commonwealth Strategic Assessment,
- Provide recommendations for achieving innovative management frameworks for ecological, riparian and bushfire issues which enable long term conservation and management while facilitating the safe urban development outcomes for the precinct.

This report demonstrates the objectives are achieved through;

- Methodology that includes a literature review of previous work, detailed terrestrial aquatic and geomorphic field assessment,
- Integrated assessment of the current and future ecological and riparian issues,
Consideration of statutory requirements, including; Growth Centres Commission Development Code, Threatened Species Conservation Act (TSC Act), Environment Protection and Biodiversity Conservation Act (EPBC Act) and approved Strategic Assessment, Growth Centres SEPP Biodiversity Certification Order, Water Management Act (WM Act), Fisheries Management Act (FM Act).

Note: NSW DP & I engaged consulting firm Parksons Brinkerhoff to prepare a precinct-wide Flood Study and Water Cycle Management Study. Part of this commission also includes a riparian assessment. The key findings from both the ELA and Parsons Brinkerhoff studies in relation to stream orders and riparian corridors are common in both reports.

1.2 STUDY AREA

The 655 ha Leppington Precinct is within the eastern portion of the South West Growth Centre. It lies entirely within the Camden Local Government Area. Following a review of the western boundary of Leppington Precinct, the planning process for Leppington has also involved assessment of 198ha of the (future) Catherine Fields North Precinct. The Leppington Precinct is bound by Camden Valley Way on the east, Ingleburn Road to the north, and follows lot boundaries and a number of roads along the west, such as Cordeaux Street, Anthony Road, Joseph Road, and Hulls Road. Fully developed, it is expected to accommodate some 9,000 dwellings for approximately 24,000 future residents.

The Precinct currently comprises small rural holdings, farming lands, market gardens and some low density residential areas. Consequently, much of the site has been cleared, with remnant vegetation limited to small regrowth remnants generally <50 years of age. Ground layer vegetation has been significantly disturbed by livestock grazing, the introduction of exotic pasture grasses and selective clearing. A number of homestead paddocks across the site include planted exotic trees and shrubs.

The watercourses present, whilst degraded, are in the main reasonably well defined and dissect the precinct into several sections. In parts the riverbanks contain good quality native vegetation, whilst other stretches have been subject to vegetation clearance and are actively eroding. However in other parts the drainage lines shown on topographic maps do not accurately reflect the on-ground situation, as landholders have re-contoured much of the site to divert drainage away from yards, homesteads and other structures (e.g. sheds, garages etc) or for irrigation of market gardens or seedling nurseries. In addition, several of the watercourses depicted on the 1: 25 000 NSW Topographic Series Maps do not meet the definition of a creek as they had no defined banks or beds.

The Leppington Precinct study area is shown in Figure 1 below.
Figure 1: Leppington Precinct Study Area
2 Statutory Framework

A substantial array of legislation, policies and guidelines apply to the assessment, planning and management of biodiversity values within the Leppington Precinct. This information was reviewed and will be used to identify priority constraints and opportunities within the study area (Refer to Appendix A). Legislation and policies reviewed include:

2.1 INTERNATIONAL
- Japan – Australia Migratory Bird Agreement (JAMBA)
- China – Australia Migratory Bird Agreement (CAMBA)
- Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)

2.2 COMMONWEALTH
- Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)
- National Biodiversity Strategy (Draft 2011)

2.3 STATE
- Environmental Planning and Assessment Act 1979 (EP&A Act)
- Threatened Species Conservation Act 1995 (TSC Act)
- Threatened Species Conservation Amendment (Special Provisions) Act 2008
- National Parks and Wildlife Act 1974
- Fisheries Management Act 1994 (FM Act)
- Native Vegetation Act 2003
- Noxious Weeds Act 1993
- Protection of the Environment Operations Act 1997
- State Environmental Planning Policy (Sydney Region Growth Centres) 2006
- State Environmental Planning Policy No.19 – Bushland In Urban Areas
- Growth Centres Development Code 2006
- (Draft) Growth Centres Conservation Plan 2007
- Sydney Regional Environment Plan No 20 – Hawkesbury Nepean River (No 2 1997)
- Local Government Act (1993)
- Local Government Amendment (Ecologically Sustainable Development Act 1997
- NSW (Draft) Biodiversity Strategy 2010 – 2015

2.4 LOCAL
- Camden Local Environmental Plan (2010) and Camden Development Control Plan (2011)
3 Terrestrial Biodiversity Assessment

3.1 BIODIVERSITY CERTIFICATION

The Sydney Region Growth Centres State Environmental Planning Policy (referred to as the ‘Growth Centres SEPP’) has been ‘biodiversity-certified’ by order of the Minister for the Environment under s.126G of the TSC Act. The mechanism for achieving this is outlined in the (Draft) Growth Centres Conservation Plan (Eco Logical Australia, 2007) and the conditions for biodiversity-certification are documented in the Ministers order for consent1.

Biodiversity certification negates the requirement for impact assessment on threatened species under s.5A of the Environmental Planning and Assessment Act, 1979 thus turning off the requirements for assessments of significance (i.e. seven part tests) or species impact statements on all certified land within the North West and South West Growth Centres.

The (Draft) Growth Centres Conservation Plan (2007) assessed native vegetation across the entire Growth Centres area and identified areas of Existing Native Vegetation (ENV). Figure 2 below shows the area of mapped ENV for the Leppington Precinct as well as the delineation of Certified and Non-Certified land in the Precinct.

By definition (TSC Act 1995, biodiversity certification conditions) ENV means areas of indigenous trees (including mature and saplings) that:

a) had 10% or greater over-storey canopy cover present,

b) were equal to or greater than 0.5 ha in area, and

c) were identified as “vegetation” on maps 4 and 5 of the (Draft) Growth Centres Conservation Plan, at the time the biodiversity certification order took effect, subject to condition 13.

Clause 13 of the biodiversity-certification details the ground-truthing requirements for ENV; namely, if new information becomes available after the biodiversity certification order took effect that demonstrates that the vegetation within an areas does not otherwise meet the definition of existing native vegetation, then for the purposes of conditions 7-8 and 11-12 only the area of validated ENV need be considered. The field validation of vegetation across the site has updated the extent of ENV within the precinct.

This has resulted in changes to the boundaries of mapped ENV and the mapping of new areas of Additional High Conservation Value Vegetation (AHCVV), that is, vegetation which meets criteria a) and b) above but was not mapped in the original conservation plan.

The area of certified and non-certified land and the originally mapped ENV is shown in Figure 2. The Precinct contains 632.2 ha of certified land and 23.2 ha of non-certified land.

Figure 2: Certified and Non-Certified Land and Conservation Plan (mapped) ENV
3.2 EPBC ACT STRATEGIC ASSESSMENT

The approval of both stages of the strategic assessment under the Commonwealth EPBC Act occurred on the 28th February, 2012. This approval essentially means that the Commonwealth is satisfied that the conservation and development outcomes that will be achieved through development of the Growth Centres Precincts will satisfy their requirements for environmental protection under the EPBC Act. So that, provided development activity proceeds in accordance with the Growth Centres requirements (such as the Biodiversity Certification Order, the Growth Centres SEPP and DCPs, Growth Centres Development Code etc) then there is no requirement to assess the impact of development activities on matters of National Environmental Significance (NES) and hence no requirement for referral of activities to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The requirement for assessment and approval of threatened species and endangered ecological communities under the EPBC Act has now been “turned off” by the approval of the Strategic Assessment.

3.3 METHODS

3.3.1 Literature Review

A desktop literature review was undertaken by ELA to determine the location and extent of previous field surveys, identify the known constraints within the study area and evaluate the presence and likelihood of threatened species, populations and ecological communities listed under both the TSC Act and EPBC Act that could potentially occur within the precinct. The following documentation and data was reviewed;

- Topographic maps, digital elevation models and aerial photography of the study area
- Database searches of NSW OEH Wildlife Atlas and EPBC online Protected Matters
- ‘(Draft) Growth Centres Conservation Plan’ prepared by Eco Logical Australia (2007) for NSW Growth Centres Commission
- Western Sydney Vegetation Mapping (NPWS 2002a) and Western Sydney Condition and Conservation Significance Mapping (NPWS 2002b)
- ngh environmental (2010) Ecological Assessment – Assessment of Significance. Camden Valley Way, Cobbitty Road to Cowpasture Road Upgrade. Prepared for the NSW RTA.

3.3.2 Field Survey

A floristic survey of the precinct was undertaken to confirm the extent, type and condition of vegetation communities present. This survey included classification of native vegetation communities in accordance with the NSW OEH profiles. Full floristic quadrats were also undertaken at certain locations (in the non-certified lands) to allow for the identification of vegetation communities to EPBC Act level where relevant.

Limitations should be noted in relation to access for surveys within existing residential areas. Numerous areas were not accessible for survey and as such existing data and desktop analysis was used where available.

Additional targeted flora and fauna surveys were also undertaken and include random meanders targeted flora searches, bird census and frog survey. Targeted searches for *Pimelea spicata* (Spiked...
Rice Flower) were undertaken at each transect / plot location across the study area. Detailed methodology can be found in Appendix B.

### 3.4 VEGETATION COMMUNITIES & CONDITION

The study area is dominated by exotic grassland. The majority of native vegetation is concentrated along Kemps Creek, which traverses the western side of the precinct, with medium to large patches of remnant vegetation concentrated in this area. The characteristics of the two native vegetation communities, Cumberland Plain Woodland and Alluvial Woodland, their conservation significance and ecological condition are summarised in Table 1 and presented in Figure 3.

#### 3.4.1 Cumberland Plain Woodland

The Cumberland Plain Woodland (CPW) Critically Endangered Ecological Community is listed under both the TSC and EPBC Acts. There are two sub-communities of CPW, being Shale Plains Woodland and Shale Hills Woodland. The species compositions of both sub-communities are generally identical on sites with some level of disturbance, and it is their position in landscape that predominantly determines whether an area is classified as Shale Plains or Shale Hills Woodland. Both sub-communities are equally protected under legislation and so have been considered together, as CPW, for this report.

CPW is the most widely distributed community on the Cumberland Plain, predominantly occurring on soils derived from Wianamatta Shale. CPW present within the study area consists of a mixture of good, moderate and poor condition vegetation due to the varying levels of disturbance to the site. The vast majority of CPW across the site is in poor condition, with the exception of a few isolated patches of good vegetation occurring along the two major waterways, where less historical disturbance has occurred. The stands of CPW along the western creekline generally have a larger patch size and condition is marginally better than other areas of the precinct. Two of the three patches of CPW on site that meet EPBC listing criteria occur in this area.

The canopy is dominated by Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Cabbage Gum (*Eucalyptus amplifolia*) and Swamp She-oak (*Casuarina glauca*).

The shrub layer over large parts of the study area has been and is currently subject to grazing. Native Blackthorn (*Bursaria spinosa*) is found sporadically throughout the study area and varies in abundance from non-existent to dominant. Other native shrubs present across the site include Climbing Saltbush (*Einadia nutans*), Coffee Bush (*Breynia oblongifolia*) and Native Cherry (*Exocarpus cupressiformis*). Parts of the site have extensive African Olive (*Olea europaea*) infestation of the shrub layer while other parts have very little to no African Olive present.

Groundcover vegetation is typically dominated by a mixture of native and exotic grasses and herbs. Native groundcover species include Kangaroo Grass (*Themeda australis*), Weeping Rye Grass (*Microlaena stipoides*), Kidney Weed (*Dichondra repens*) and Wallaby Grass (*Austrodanthonia bipartitia*). Exotic groundcovers include Spear Thistle (*Cirsium vulgare*), Paddy’s Lucerne (*Sida rhombifolia*), Fireweed (*Senecio madagascariensis*), Kikuyu Grass (*Pennisetum clandestinum*) and White Clover (*Trifolium repens*).

In 2009 both the Commonwealth and State Governments ‘up-listed’ Cumberland Plain Woodland (CPW) to the status of a Critically Endangered Ecological Community (CEEC) under the EPBC and TSC Acts respectively. The criterion that must be met for vegetation to be captured by the new CEEC listings has changed under both Acts.
Under the EPBC Act, changes to both the vegetation characteristics and the assigning of condition classes were introduced. Smaller scale changes to vegetation characteristics, such as the inclusion of derived native grassland in areas of CPW, have been made under the TSC Act. Consequently, vegetation mapping completed to illustrate areas of CPW that meet the TSC Act criteria and areas that meet the EPBC Act criteria have been included separately (refer to Figure 3 and Figure 4).

The patches of remnant CPW on site contain a number of hollow bearing trees, an important resource for native fauna such as micro-chiropteran bats and hollow-nesting woodland birds in the highly cleared and fragmented landscape of South-Western Sydney. Clearing of hollow bearing trees is listed as a Key Threatening Process under the TSC Act.

3.4.2 Alluvial Woodland

The Alluvial Woodland (AW) within the study area comprises the endangered ecological community River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (River-Flat Eucalypt Forest), which is listed on Schedule 1 of the TSC Act. AW is not listed under the EPBC Act.

AW occurs largely along the two main watercourses running through the site (refer to Figure 3).

The most common canopy species found within AW is Swamp Oak (Casuarina glauca) and Prickly-leaved Paperbark (Melaleuca styphelioides), while Grey Box (Eucalyptus moluccana) and Forest Red Gum (Eucalyptus tereticornis) occur less frequently. The shrub layer is quite variable with Native Blackthorn (Bursaria spinosa) and African Olive (Olea europaea) occurring infrequently.

Groundcover vegetation is typically dominated by a mixture of native and exotic grasses and herbs. Native groundcover species dominated by Weeping Rye Grass (Microlaena stipoides) and Couch (Cynodon dactylon). Exotic groundcovers include Panic Veldtgrass (Ehrharta erecta) and Paddy’s Lucerne (Sida rhombifolia).

The area of AW within the Precinct measures approximately 10.5 ha, of which 6.3 ha is in poor condition.
Figure 3: TSC Act Field Validated Vegetation Communities and Condition Classes and Location of Hollow Bearing Trees
Figure 4: EPBC Act Vegetation Communities and condition classes
3.4.3 Vegetation Community and Condition Assessment Area Calculations

Area calculations of each vegetation community within the study area are provided in Tables 1 and 2.

Table 1: A summary of area occupied by TSC listed vegetation communities and their TSC condition.

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<th>VEGETATION COMMUNITY</th>
<th>CONDITION*</th>
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<tr>
<td>TSC Act listed vegetation communities (Non-Certified Land Only)</td>
<td>A, B, C (Good)</td>
<td>Tx (Poor)</td>
<td>Total</td>
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<td>Cumberland Plain Woodland (including DNG)</td>
<td>1.4</td>
<td>3.6</td>
<td>5</td>
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<tr>
<td>Alluvial Woodland</td>
<td>0.5</td>
<td>1.1</td>
<td>1.6</td>
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<td>TSC Act Listed vegetation communities (Certified Land Only)</td>
<td>A, B, C (Good)</td>
<td>Tx (Poor)</td>
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<td>Alluvial Woodland</td>
<td>3.5</td>
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<td>Total (Certified and Non-Certified land)</td>
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<td>73.6</td>
<td>83</td>
<td></td>
</tr>
</tbody>
</table>

* Condition code details can be found in Appendix B

Table 2: A Summary of area occupied by EPBC Listed vegetation communities

<table>
<thead>
<tr>
<th>CUMBERLAND PLAIN WOODLAND</th>
<th>EPBC CPW</th>
<th>NON-EPBC CPW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Certified Land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumberland Plain Woodland</td>
<td>1.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Certified Land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumberland Plain Woodland</td>
<td>3.8</td>
<td>9.9</td>
</tr>
<tr>
<td>Total</td>
<td>5.2</td>
<td>13.5</td>
</tr>
</tbody>
</table>

3.5 VALIDATED EXISTING NATIVE VEGETATION AREA CALCULATIONS

The (Draft) Growth Centres Conservation Plan (2007) mapped areas of Existing Native Vegetation (ENV) as per the results of the NSW National Parks and Wildlife Service (NPWS) Cumberland Plain Vegetation Mapping Project (2002). The original mapping showed the presence of two endangered ecological communities within the Precinct, Cumberland Plain Woodland (CPW) and Alluvial Woodland (AW).

The Conservation Plan mapped 10.9 ha of ENV within the entire Leppington Precinct, 1.8 ha was located within non-certified areas and 9.1 ha within certified areas. Subsequent site inspections have validated the presence of 9.9 ha of ENV within the Precinct. The 9.9 ha is comprised of 1.4 ha in the non-certified lands and 8.5 ha in the certified lands.

In addition to the originally mapped and now validated ENV, additional areas of vegetation were found on-site that are classified as Additional High Conservation Value Vegetation (AHCVV). AHCVV is vegetation that was not mapped in the Conservation Plan but meets the specified ecological criteria (for ENV) of
a) having 10% or greater over-storey canopy cover present, and

b) patch size equal to or greater than 0.5ha.

Field inspections revealed an additional 5.7 ha of AHCVV, of which 0.6 ha is in certified lands and 5.1 ha is in non-certified lands.

Table 3: Amount of ENV and AHCVV in Leppington Precinct

<table>
<thead>
<tr>
<th>LEPPINGTON PRECINCT</th>
<th>CERTIFIED LAND (ha)</th>
<th>NON-CERTIFIED LAND (ha)</th>
<th>TOTAL (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation Plan ENV</td>
<td>9.1</td>
<td>1.8</td>
<td>10.9</td>
</tr>
<tr>
<td>Field Validated Conservation Plan ENV</td>
<td>8.5</td>
<td>1.4</td>
<td>9.9</td>
</tr>
<tr>
<td>Additional Native Vegetation (AHCVV)</td>
<td>5.1</td>
<td>0.6</td>
<td>5.7</td>
</tr>
<tr>
<td>Total Validated ENV + Validated AHCVV</td>
<td>13.6</td>
<td>2.0</td>
<td>15.6</td>
</tr>
</tbody>
</table>

The area of “Field Validated Conservation Plan ENV” is 1.0 ha less than the original Conservation Plan ENV. The ENV mapped within the Conservation Plan was based on desktop analysis of the NPWS Cumberland Plain Vegetation Mapping Project (2002). As such, discrepancy between the Conservation Plan ENV and the field validated ENV has likely occurred due to a number of factors, including:

- Changes in vegetation community boundaries due to increased accuracy of mapping from ground truthing compared to desktop analysis at a broader scale,
- Potential vegetation clearing since the previous mapping was completed,

Figure 5 is an overlay of the originally mapped ENV areas from the Centres Conservation Plan, the field validated ENV plus the AHCVV found on site. A total of 15.6 ha of ENV and AHCVV is present on site, of which 2.0 ha is located on non-certified lands and 13.6 ha is on certified lands. In order to maintain parity with the Growth Centres 2000 hectare protection target it will be necessary to protect 1.8 ha of ENV on site. As only 1.4 ha of validated ENV is located on non-certified land, the balance may need to come from certified lands.
Figure 5: Mapped and Validated ENV plus AHCVV within the Leppington Precinct
3.6 FLORA

The field survey undertaken within the study area identified 75 flora species, comprised of 43 native and 32 exotic species. A flora list for the Precinct is presented in Appendix C. This is not a comprehensive list of all flora species likely to be present within the study area.

A list of threatened flora species known to occur within a 10 km radius of the study area has been collated (Appendix D). During the field survey no species listed under either the TSC or EPBC Act were recorded. No threatened flora species have previously been recorded within the study area, but several have been recorded in proximity of the site including; *Pimelea spicata*, *Cynanchum elegans* and *Syzygium paniculatum*. Ground truthing during field survey did not record any of the above species, however as stated above, the resultant species list cannot be considered comprehensive given the access issues encountered with project (section 3.3.2).

Threatened flora species were targeted during traverses in suitable/potential habitat of the entire study area, where access was available. A nearby population of *Pimelea spicata* to the south of the precinct, south of Raby Road within the Camden Country Club was checked a week before the field survey, this population was flowering at the time. Approximately 48 person hours were utilised in completing the vegetation surveys for the site.

Noxious Weeds

Five plant species identified within the study area are listed as noxious weeds within the Camden Local Government Area. The noxious weeds present and their management class are presented in Table 4 below as well as whether the species is listed as a Weed of National Significance. It is very likely that other noxious weeds are present within the Precinct that were not detected during field survey.

Table 4: Noxious weeds present in Leppington Precinct.

<table>
<thead>
<tr>
<th>NOXIOUS WEED SPECIES</th>
<th>NOXIOUS WEED CLASS (CAMDEN LGA)</th>
<th>WONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>African Boxthorn (Lycium ferocissimum)</strong></td>
<td>4</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Blackberry (Rubus fruticosus)</strong></td>
<td>4</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Lantana (Lantana camara)</strong></td>
<td>4</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Prickly Pear (Opuntia sp)</strong></td>
<td>4</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Bridal Creeper (Asparagus asparagoides)</strong></td>
<td>4</td>
<td>Y</td>
</tr>
</tbody>
</table>
3.7 **FAUNA**

The field survey identified 26 fauna species, of which 24 were native species and 2 were introduced. Of the native species observed, 1 snake (Red Bellied Black Snake, *Pseudechis porphyriacus*), was identified, the remaining 25 species observed were birds. A fauna list for the study area is presented in Appendix C and a list of threatened fauna species known to occur within a 10 km radius of the study area has been collated (Appendix D).

The field survey identified two species listed under the TSC Act and / or EPBC Act. These species were the Cattle Egret (*Ardea ibis*) and the Little Lorrikeet (*Glossopsitta pusilla*).

Based on the Appendix D species list, the following threatened fauna species are known, likely or have the potential to occur on site;

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>TSC ACT</th>
<th>EPBC ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green and Golden Bell Frog (<em>Litoria aurea</em>)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Regent Honeyeater (<em>Anthochaera octurn</em>)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bush Stone Curlew (<em>Burhinus grallarius</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Gang Gang Cockatoo (<em>Calocephalon fimbriatum</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Varied Sittella (<em>Daphoenositta chrysoptera</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Little Lorikeet (<em>Glossopsitta pusilla</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Little Eagle (<em>Hieraeatus morphnoides</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Swift Parrot (<em>Lathamus discolor</em>)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hooded Robin (<em>Melanodryas cucullata</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Scarlet Robin (<em>Petroica boodang</em>)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Flame Robin (<em>Petroica phoenicea</em>)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Speckled Warbler (<em>Pyrrholaemus sagittatus</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Powerful Owl (<em>Ninox strenua</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Cumberland Plain Land Snail (<em>Meridolum comeovirens</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Eastern Bentwing-bat (<em>Miniopterus schreibersii oceanensis</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Large–eared Pied Bat (<em>Chalinolobus dwyeri</em>)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Eastern Freetail Bat (<em>Mormopterus norfolkensis</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Southern Myotis (<em>Myotis macropus</em>)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Grey-headed Flying-fox (<em>Pteropus poliocephalus</em>)</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
The locations of threatened flora and fauna species recorded in the immediate vicinity of the Leppington Precinct are shown in Figure 6. No previous recordings of threatened flora or fauna species have been recorded within Leppington precinct. No threatened flora species were recorded onsite, however two birds listed as migratory under the EPBC Act were recorded.

<table>
<thead>
<tr>
<th>Species</th>
<th>Listed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Broad-nosed bat (<em>Scoteanax rueppellii</em>)</td>
<td>X</td>
</tr>
<tr>
<td>Great Egret (<em>Ardea alba</em>)</td>
<td></td>
</tr>
<tr>
<td>Cattle Egret (<em>Ardea ibis</em>)</td>
<td>X</td>
</tr>
<tr>
<td>Fork-tailed Swift (<em>Apus pacificus</em>)</td>
<td></td>
</tr>
<tr>
<td>White Throated Needletail (<em>Hirundapus caudacutus</em>)</td>
<td></td>
</tr>
<tr>
<td>Eastern False Pipistrelle (<em>Falsistrellus tasmaniensis</em>)</td>
<td>X</td>
</tr>
</tbody>
</table>

*Note: X indicates that the species is listed under that Act*
Figure 6: Location of threatened species records in the precinct vicinity
3.8 **ECOLOGICAL CONSTRAINTS**

All preliminary ecological site constraints have been combined to provide 4 main ecological constraints classes for the Leppington Precinct. Figure 7 illustrates the location and extent of each of these categories, which are:

**Category 1: Non-certified ENV and Good Condition Vegetation** - All mapped and validated ENV plus the AHCVV validated on site during fieldwork within the non-certified lands. These areas are not covered by the Biodiversity Certification Order and form offsetting sites for development activities within all Growth Centre Precincts. These lands should not be developed or impacted upon unless required for essential infrastructure. Any clearing of ENV / AHCVV within these areas will require offsets pursuant to Condition 8 of the Biodiversity Certification Order. As the vegetation within the noncertified lands is CPW and AW, any impacts on these communities require assessment under both the NSW TSC Act and Commonwealth EPBC Act.

**Category 2: Riparian Corridors** - The 2 main watercourses and their tributaries running south to north through the centre of the Precinct will be subject to future revegetation and restoration requirements to achieve a fully structured riparian vegetation community in order to both protect the bed and bank stability and provide an aquatic and terrestrial habitat link within and beyond the Precinct. Land uses within the designated riparian corridors are likely to be considerably restricted and the long term ownership and management of these areas is an issue that will need to be resolved.

The Riparian Corridors have been split into two subcategories:

(a) Riparian corridor with existing vegetation,

(b) Riparian Corridor with no existing vegetation.

Riparian Corridors are likely to have revegetation and restoration requirements placed on them in accordance with NOW policies and guidelines, so that riparian corridors which are currently vegetated must remain so (restricting the location for infrastructure etc) and also so that corridors which aren’t vegetated will be required to become vegetated, placing a financial and land management responsibility on the owner of the riparian corridor.

At present, non-certified land has only been identified for the western most watercourse, and the ENV within this riparian corridor is protected through the overlay of the non-certified land. However the controls (riparian protection area overlay) over these lands may change during the precinct planning process as the flooding investigations progress. The land within the riparian corridor of the eastern watercourse display potential to become non-certified. Accordingly, ENV within this riparian corridor (if non-certified) would then fall into Category 1 above.

**Category 3: Non-certified Poor Condition Vegetation** - These areas of remnant poor condition vegetation (that do not meet the ENV definition) within non-certified lands provide important habitat and may contain tree hollows and should ideally not be developed or impacted upon unless required for essential infrastructure. Appropriate sympathetic land use zones such as open space, environmental conservation / environmental living should be attributed to these areas to protect the vegetation.

**Category 4: Other Remnant Vegetation** - While these areas are within currently certified lands, and are therefore potentially available for development because the impacts have been offset both within the non-certified areas and conservation offsetting outside the GC Precincts, they present sites of both 4(b) poorer condition vegetation and 4(a) high to moderate ecological value and which should be considered in the allocation of appropriate sympathetic land use zones such as open space, environmental conservation / environmental living, etc.
Figure 7: Ecological Constraints
4 Riparian & Aquatic Assessment

4.1 CONTEXT
The Leppington Precinct lies within the Hawkesbury-Nepean Catchment. The Hawkesbury-Nepean River system is the second-largest in NSW and has its headwaters located within largely pristine regions including the Blue Mountains World Heritage Area and Sydney Catchment Authority’s lands in the NSW Southern Highlands. These upper reaches provide over 90% of Sydney’s drinking water. Once into flatter, floodplain country, the Hawkesbury River flows eastward towards the ocean through rural and semi-rural areas of Western Sydney. These middle and lower reaches of the system are highly impacted and degraded, both directly through waterway modifications and indirectly through adjacent land use practises.

As required by statutory authorities, this riparian assessment follows the methodology outlined by the NSW Office of Water (NOW). This methodology is based on a Strahler Stream Order classification which identifies Riparian Corridor (RC) widths as measured from the Top of Bank (TOB) and minimum Vegetated Riparian Zone (VRZ) widths.

Specifically this riparian assessment includes:

- Mapping of Top of Bank using a differential GPS,
- Classification of the condition and recovery potential of stream reaches within the study area,
- Categorisation of each stream using the Strahler methodology,
- Identification of heavily degraded streams or areas of overland flow that do not meet the definition of a ‘river’ and are suitable for removal,
- Scoping of potential options for use of the non-certified lands,
- Targeted assessment and development of recommendations for the subsequent ILP.

4.2 STUDY AREA
The 655 ha of the Leppington Precinct study area contains the watercourses and floodplain of Kemps Creek and its tributaries, together with Scalabrini Creek which drain into South Creek. Kemps Creek is a significant tributary of the Hawkesbury – Nepean River Catchment. There are also several ephemeral creeks, farm dams and wetland areas on site, shown in Figure 8.
Figure 8: Validated Watercourses within Leppington Precinct
4.3 METHODS

4.3.1 Field Investigations and Top of Bank Mapping

The riparian categorisation and corridor mapping has been carried out in accordance with the Strahler-based methodology. This was based on all ‘blue lines’ appearing on the 1:25,000 topographic map series, combined with field assessment data and analysis of top of bank results.

The key outcome of this assessment is to classify watercourses that are to be retained into the stream orders identified above. All streams identified from 1:25,000 mapping were inspected and validated in the field. Drainage lines that were not classified in this assessment are deemed to be of limited riparian value or do not meet the definition of a river and are therefore suitable for engineered drainage solutions.

A survey of the Top of Bank (TOB) for all accessible watercourses in the Precinct was conducted by a geomorphologist and aquatic ecologist with a differential GPS (accuracy 50cm-70cm). The TOB mapping completed in the field was verified by cross-checking with up-to-date, high resolution satellite imagery and where necessary TOB data collected was manually amended. Any additional watercourses that could not be surveyed in the field were assessed with up-to-date, high resolution satellite imagery. Results were further verified against the data collected and presented by PB.

The TOB mapping has been used as the basis for the initial riparian buffer delineation and riparian corridor boundary determination. The watercourses present in many parts of the Precinct are highly disturbed and in some areas display no true bed and bank characteristics due to significant informal land filling in the past. For this reason and due to the lack of access to all land, the location of the watercourses in some parts of the Precinct have been inferred from contour data, high resolution aerial photography data and existing topographic map data. NOW was consulted by PB and classification of watercourses into Strahler stream orders and delineation of riparian corridors is supported.

Watercourse reach numbers have been assigned to enable clear identification and descriptions of the relevant sections of each watercourse. The condition of each reach was assessed, along with its recovery potential, using the method outlined in Geomorphic Categorisation of Streams in the Hawkesbury Nepean Catchment (DLWC 2000) document. The condition of each stream was classified into one of the following categories:

- Near intact condition
- Good condition
- Moderate condition
- Degraded condition

A detailed assessment of the hydrology of each watercourse reach enabled the allocation of a stream order value (from 1 to 3) as per the Strahler System. Using the Strahler system, numbering occurs from the top of the catchment with the smallest headwaters being assigned as 1st Order. Stream order number increases downstream through the catchment as tributaries merge and form larger streams (refer to Figure 9).
Figure 9: Strahler Stream Ordering System

Minimum riparian corridor requirements in accordance with the NOW controlled activity guidelines for Riparian Corridors are outlined in Table 5. The Vegetated Riparian Zone (VRZ) contains the areas formerly referred to as the core riparian zone (CRZ) and the vegetated buffer (VB).

Table 5: NOW Riparian Categories and Buffer Specifications

<table>
<thead>
<tr>
<th>WATERCOURSE TYPE</th>
<th>VRZ WIDTH (EACH SIDE OF WATERCOURSE)</th>
<th>TOTAL RIPARIAN CORRIDOR WIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st order</td>
<td>10 metres</td>
<td>20m + channel width</td>
</tr>
<tr>
<td>2nd order</td>
<td>20 metres</td>
<td>40m + channel width</td>
</tr>
<tr>
<td>3rd order</td>
<td>30 metres</td>
<td>60m + channel width</td>
</tr>
<tr>
<td>4th order and greater</td>
<td>40 metres</td>
<td>80m + channel width</td>
</tr>
</tbody>
</table>

4.4 RESULTS

4.4.1 Field Investigations and Top of Bank Mapping

The results of the TOB mapping and initial delineation of riparian buffers is shown in Figure 10. Each stream was broken into reaches where the amount of native vegetation and condition or recovery potential was significantly different than the area adjacent. The condition of each stream reach is summarised in Table 6.

The overall condition of the surveyed length of watercourses on the study site was generally moderate or degraded. Streamside vegetation was modified to some extent along the length of each watercourse, with the majority of vegetation subject to moderate to substantial modification. Most reaches had one or more vegetative strata dominated by exotic vegetation, with little native vegetation
remaining. Remnant vegetation was often found in isolated small patches or strips. There are large areas of dense weed infestation of the mid-storey and understorey vegetation. A significant proportion of the total length of watercourses on the site have been subject to stream bank erosion, some of which is still active, particularly in areas where cattle and other livestock have direct access to the watercourse.

The majority of watercourses are in a degraded current condition and natural recovery potential is generally moderate, but ranges from low to high in different parts of the Precinct. There are places where the natural geomorphic conditions have been highly altered through the creation of several farm dams or installation of culverts.

There are numerous farm dams existing on site, some within the proposed riparian corridors and some of which are external to the proposed riparian corridors. All existing dams within the riparian corridor are likely to be removed / reshaped as part of the drainage formalisation works. Loss of aquatic and wetland habitat from removal of these dams should be compensated through the provision of appropriately designed wet basins.

The field surveys mapped a total of 34 stream reaches: comprised of twenty two 3rd order reaches, six 2nd order and six 1st order streams (see Table 6). During field validation, numerous 1st order reaches were found to not meet the definition of a stream (Figure 8) and are therefore potentially suitable for removal if approved by NOW. Consultation between NOW and Parsons Brinkerhoff in regards to the retention of watercourses with a defined bed, banks and channels has resulted in these first order streams being approved for removal.
Figure 10: Watercourse Reaches and within Leppington Precinct
### Table 6: Watercourse Reach Condition and Natural Recovery Potential

<table>
<thead>
<tr>
<th>REACH NO.</th>
<th>HYDROLOGY</th>
<th>STREAMSIDE VEGETATION</th>
<th>PHYSICAL FORM</th>
<th>WATER QUALITY AND AQUATIC HABITAT</th>
<th>OVERALL RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3rd Order Stream (Strahler). Channel modified to include a dam and backwater pool. Inflows modified due to regionally cleared land use and upstream dams</td>
<td>Substantially Modified. Only small patches of well-separated native vegetation remain. One or more strata dominated by exotic species, ‘high threat’ species present. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class present. Very small quantities of debris present.</td>
<td>Clay banks with slope 30-70°. Approximately 5% of banks with minor gully erosion and 10% slumped. Remainder of banks well stabilised by groundcover and scattered riparian trees.</td>
<td>Moderate aquatic habitat in downstream dam, but limited in upstream channel. Wetted width of channel (0.5-5m) and mostly shallow (&lt;30cm). Macrophytes common in channel but limited large woody debris. Overall, limited fish habitat, but good quality frog habitat.</td>
<td>Moderate-degraded condition</td>
</tr>
<tr>
<td>2</td>
<td>3rd Order Stream (Strahler). Channel appears to be mechanically straightened in parts. Inflows modified due to regionally cleared land use and upstream dams. Culverts present.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Clay banks with slope 30-70° and occasionally incised. Approximately 5% of banks with minor gully erosion due to stock accessing creek. Some rock armour present on banks. Few riparian trees but banks appear stable.</td>
<td>Poor aquatic habitat due to homogenous clay substrate, regraded bank form, and no large woody debris or aquatic macrophytes. Very shallow water (&lt;10cm) at time of survey.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>REACH NO.</td>
<td>HYDROLOGY</td>
<td>STREAMSIDE VEGETATION</td>
<td>PHYSICAL FORM</td>
<td>WATER QUALITY AND AQUATIC HABITAT</td>
<td>OVERALL RATING</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
<td>------------------------</td>
<td>---------------</td>
<td>-----------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>3</td>
<td>3rd Order Stream (Strahler). Channel appears unmodified, however inflows modified due to regionally cleared land use and upstream dams. Culverts present.</td>
<td>Moderately Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species present. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and only one age class present. Quantities and/or cover 50% higher or lower than reference.</td>
<td>Clay banks with slope 30-70°. Minor erosion due to stock accessing creek. Remainder of banks well stabilised by groundcover and riparian trees.</td>
<td>Moderate aquatic habitat due to adequate riparian cover, large woody debris and some aquatic macrophytes. Occasional pools (5m width), but generally very shallow water (&lt;20cm). Limited fish habitat due to poor connectivity with other habitats (dams and culverts). Reasonable frog habitat in and around creek.</td>
<td>Moderate condition</td>
</tr>
<tr>
<td>4</td>
<td>3rd Order Stream (Strahler). Channel is narrow and straight and may have been mechanically altered. Inflows modified due to regionally cleared land use and upstream dams. Culverts present.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Clay banks with slope 30-70°. Approximately 10% of banks with minor gully erosion and 30% slumped due to stock accessing creek.</td>
<td>Poor fish habitat due to narrow channel choked with macrophytes. Swampy ground and dams adjacent to channel would provide reasonable frog habitat. However, heavy cattle disturbance to banks may restrict habitat.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>5</td>
<td>3rd Order Stream (Strahler). Channel mostly unmodified, except for an off-channel dam in the south which diverts water from the creek. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Moderately Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species present. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and only one age class present.</td>
<td>Clay banks with slope 30-70°. Approximately 10% of banks with minor gully erosion and 10% slumped due to stock accessing creek. Northern left bank highly modified by market gardens. Remainder of banks well stabilised by riparian trees.</td>
<td>Large pool (6m width) downstream provides permanent refuge for fish and frogs, but with poor connectivity to other habitats during low flows. Runoff from adjacent market gardens may alter nutrient composition of pool. Upstream sections heavily impacted by cattle trampling. Overall, limited habitat for fish, but good frog habitat where protected from cattle trampling.</td>
<td>Moderate condition</td>
</tr>
<tr>
<td>REACH NO.</td>
<td>HYDROLOGY</td>
<td>STREAMSIDE VEGETATION</td>
<td>PHYSICAL FORM</td>
<td>WATER QUALITY AND AQUATIC HABITAT</td>
<td>OVERALL RATING</td>
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<td>6</td>
<td>Culverts present.</td>
<td>Quantities and/or cover 50% higher or lower than reference.</td>
<td>Clay banks with slope &lt;30°. Minor bank erosion from scouring. Banks well stabilised by riparian trees.</td>
<td>Limited aquatic habitat due to shallow turbid water. Flows would be intermittent and influenced by upstream dams. One dead turtle observed, possible exploring away from a dam.</td>
<td>Good-moderate condition</td>
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<td></td>
<td>3rd Order Stream (Strahler). Channel appears mostly unmodified with some evidence of creek diversion or an old dam. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Slightly Modified. Width reduced by up to 1/3 and/or some breaks in continuity. Exotic species present but not dominating any strata, ‘high threat’ species rare. Cover within one stratum up to 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and/or only two age classes present. Some evidence of unnatural loss of debris (e.g. through collection of firewood, trampling of leaf litter by stock).</td>
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<td>7</td>
<td>3rd Order Stream (Strahler). Channel appears unmodified, however inflows modified due to regionally cleared land use and upstream dams. Culverts and small dams present.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Clay banks with slope 30-70°. Heavy erosion due to stock accessing creek. Few riparian trees present to stabilised banks. Channel mostly a muddy swamp due to heavy stock trampling. Riparian trees mostly cleared. Adjacent dam apparently has carp and eels.</td>
<td>Degraded condition</td>
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<td>REACH NO.</td>
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<td>8</td>
<td>3rd Order Stream (Strahler). Channel appears unmodified, however inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Moderately Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species present. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and only one age class present. Quantities and/or cover 50% higher or lower than reference.</td>
<td>Clay banks with slope 30-70° and occasionally incised. Minor bank erosion where breaks in riparian trees.</td>
<td>Limited wet habitat at time of survey, but riparian vegetation provides good habitat structure from exposed roots and woody debris. Good frog habitat in and around creek, with no cattle disturbance.</td>
<td>Moderate condition</td>
</tr>
<tr>
<td>9</td>
<td>3rd Order Stream (Strahler). Channel appears modified with culverts, straightening and one small dam. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Substantially Modified. Only small patches of well-separated native vegetation remain. One or more strata dominated by exotic species, ‘high threat’ species present. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class present.</td>
<td>Clay banks with slope 30-70° and occasionally incised. Approximately 5% of banks with minor slumping near culverts. Scattered trees stabilise remainder of banks. Several driveway crossings.</td>
<td>Heavily modified channel with many culverts, instream dams/bunds and dense macrophytes. No fish habitat, but potential frog habitat for hardy species. Limited water at time of survey.</td>
<td>Degraded condition</td>
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<td>REACH NO.</td>
<td>HYDROLOGY</td>
<td>STREAMSIDE VEGETATION</td>
<td>PHYSICAL FORM</td>
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<td>10</td>
<td>3rd Order Stream (Strahler). Channel appears mostly unmodified, except for a small dam within the channel. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Moderately Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species present. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and only one age class present. Quantities and/or cover 50% higher or lower than reference.</td>
<td>Clay banks with slope 30-70°. Approximately 5% of banks with minor slumping erosion. One instream dam. Remainder of banks well stabilised by riparian trees and groundcover.</td>
<td>Channel in reasonable condition downstream of dam but with restricted flows. Permanent water in large dam and upstream channel. Mixed habitat types most suited to frogs and turtles. Some fish may survive in dam and upstream channel which has good riparian cover.</td>
<td>Moderate condition</td>
</tr>
<tr>
<td>11</td>
<td>3rd Order Stream (Strahler). Consists of two dams within main channel. Inflows modified due to regionally cleared land use and upstream dam.</td>
<td>Substantially Modified. Only small patches of well-separated native vegetation remain. One or more strata dominated by exotic species, ‘high threat’ species present. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class present. Very small quantities of debris present.</td>
<td>Constructed banks around two instream dams. Overflow channels with limited banks. Few trees stabilising banks.</td>
<td>Consists of two medium sized dams. Overflow channels dry at the time of survey, and would have limited aquatic value when wet. Lower overflow channel redirected from original flow path, with no defined banks. May provide a permanent water source to fauna residing in adjacent woodland, and may complement upstream aquatic reach.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>12</td>
<td>3rd Order Stream (Strahler). Channel appears unmodified, however inflows modified due to regionally cleared land use and upstream dam. Retains backed-up water from dam</td>
<td>Largely Unmodified. No or little evidence of broadscale loss of native vegetation. Exotic species present but not dominating any strata, ‘high threat’ species rare. Number of strata and cover within each similar to reference. Dominant strata with reference level of cover and at least three age</td>
<td>Clay banks with slope 30-70°. Minimal erosion and good cover of riparian trees on banks.</td>
<td>Reasonable aquatic habitat, due to lack of cattle/sheep, large-scale clearing and other direct impacts. Minor clearing evident on eastern land, but with large trees retained. Western land dense native woodland. Although adjacent land reasonable, water quality is heavily influenced by upstream dams and land use. Water present at time of survey appears to be backed-up from downstream dam and may provide good habitat for dam-tolerant species that travel upstream.</td>
<td>Good condition</td>
</tr>
<tr>
<td>REACH NO.</td>
<td>HYDROLOGY</td>
<td>STREAMSIDE VEGETATION</td>
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<tr>
<td>13</td>
<td>downstream.</td>
<td>classes present (juveniles, sub-adults and adults). Quantities and cover similar to reference.</td>
<td>Two creeks make up this system as overflow from the large dam upstream. Western creek is main channel with steep clay banks &gt;70°. Channel incised with dense riparian tree cover. Eastern creek is old channel with poorly defined banks or bed. Possibly the old overflow spillway. Heavily vegetated.</td>
<td>No aquatic macrophytes present, but good riparian cover, woody debris and habitat variability.</td>
<td>Moderate condition</td>
</tr>
<tr>
<td>14</td>
<td>3rd Order Stream (Strahler). Consists of two channels overflowing from large dam. Eastern channel appears to be blocked recently, with all overflows directed to western channel.</td>
<td>Slightly Modified. No or little evidence of broad-scale loss of native vegetation. One or more strata dominated by exotic species, ‘high threat’ species present. Cover within one stratum up to 50% lower or higher than reference. Dominant strata with reference level of cover and at least three age classes present (juveniles, sub-adults and adults). Quantities and cover similar to reference.</td>
<td>Consists of two channels overflowing large upstream dam, plus one tributary from another dam. Limited aquatic habitat due to water impoundment upstream. Only small pools (&lt;0.5m wide and 0.2m deep) were present at time of survey. Western channel is main overflow path from large dam, and includes a tributary from another small dam. As the channel is deeply incised with steep banks, it would receive fast flows when the dam's overflow. Eastern channel appears to be a disused overflow path from main dam. The overflow point appears to be now blocked with fill. Overall, poor aquatic habitat, but may provide some water to fauna in the surrounding woodland.</td>
<td>Moderate condition</td>
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<td>15</td>
<td>3rd Order Stream (Strahler). Large dam with three inflow creeks and two overflow channels. Overland inflows regionally modified due to cleared land use.</td>
<td>Moderately Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species present. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and only one age class present. Quantities and/or cover 50% higher or lower than reference.</td>
<td>Constructed dam with large steep banks. Recent earthworks have reshaped the south-western edge and inflow creeks. Northern bank stabilised by dense riparian trees.</td>
<td>A large constructed dam on Kemps Creek at the confluence of two smaller creeks. This open water body (approximately 100 x 60m) would provide permanent habitat to dam-tolerant aquatic species. Some woody debris and overhanging riparian vegetation on northern bank (dam wall), but likely poor water quality from cleared catchment. Potential water source to fauna inhabiting adjacent woodland.</td>
<td>Moderate condition</td>
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<td>15</td>
<td>2nd Order Stream (Strahler) Channel modified and cleared of riparian vegetation. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Clay banks with slope 30-70°. Channel and banks heavily modified by recent removal of vegetation and regrading of banks.</td>
<td>Little aquatic value remaining as recent clearing has removed all vegetation within the channel and along banks. Mapped as the main channel of Kemps Creek, it now serves as an overflow channel from a series of dams upstream.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>16</td>
<td>2nd Order Stream (Strahler) Channel appears unmodified, however inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Moderately Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species present. One stratum missing or extra, cover within remaining strata 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and only one age class present. Quantities and/or cover 50% higher or lower than reference.</td>
<td>Clay banks with slope 30-70°. Minor erosion near culverts, but otherwise well vegetated.</td>
<td>Limited water-holding capacity as only a short reach with a densely vegetated channel. Swampy floodplain and native woodland may provide good frog habitat. Water quality influenced by upstream dams and road runoff.</td>
<td>Moderate condition</td>
</tr>
<tr>
<td>17</td>
<td>2nd Order Stream (Strahler) Channel heavily modified due to constructed dam and overflow channel. Upstream channel realigned by neighbouring landfill.</td>
<td>Substantially Modified. Only small patches of well-separated native vegetation remain. One or more strata dominated by exotic species, ‘high threat’ species present. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class present.</td>
<td>Constructed dam with gentle, stable banks. Limited erosion and generally well vegetated. Inflow and outflow channels with poorly defined banks. Upstream channel apparently shifts due to neighbouring landfill.</td>
<td>Inflow and outflow channels with poorly defined banks and no aquatic habitat. Small dam (20m diameter) in reasonable condition for the area, with numerous macrophytes, native trees and nesting waterbirds, such as swans and swamp hens. Eels present. Water quality influenced by upstream dam overflows and cleared catchment.</td>
<td>Moderate-degraded condition</td>
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<td>REACH NO.</td>
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<td>18</td>
<td>1st Order Stream (Strahler)</td>
<td>Substantially Modified. Only small patches of well-separated native vegetation remain. Few native species remaining, cover dominated by exotic species. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class present. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Modified drainage line linking two dams. Steep clay banks straightened and regraded with some riparian trees.</td>
<td>Limited aquatic value in this regraded channel. May serve as a route for frogs, turtles and eels moving between dams. Water quality influenced by upstream dam overflows and dirt tracks surrounding area.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>19</td>
<td>1st Order Stream (Strahler)</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Modified drainage line from upstream dam. Steep clay banks straightened and regraded. Resembles roadside ditch.</td>
<td>Limited aquatic value remaining in regraded channel. Mostly dense herbaceous weeds smothering shallow channel. May suit some frogs moving between dams.</td>
<td>Degraded condition</td>
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<td>REACH NO.</td>
<td>HYDROLOGY</td>
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<td>20</td>
<td>2nd Order Stream (Strahler) Channel heavily modified due to constructed dam and realignment of channel. Channel acts as an overflow path from one dam and eventually follows fenceline.</td>
<td>Substantially Modified. Only small patches of well-separated native vegetation remain. One or more strata dominated by exotic species, ‘high threat’ species present. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class present. Very small quantities of debris present.</td>
<td>Realigned channel with shallow clay banks and occasional pools. Some bank erosion from cattle access, otherwise good stabilisation from riparian trees.</td>
<td>Very limited aquatic habitat as mostly a dry narrow channel regraded to follow a fence. Two small shallow pools may provide some frog habitat. Dam upstream and Kemps Creek downstream would attract aquatic fauna.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>21</td>
<td>3rd Order Stream (Strahler). Channel a series of farm dams and marshes. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Poorly defined channel linking several farm dams and swampy areas. Little riparian vegetation to stabilise banks.</td>
<td>Local disturbance from animals and horticulture creates poor water quality. Limited aquatic habitat restricted to dams that may suit tolerant species. Swampy areas with dense sedge community provides good frog habitat away from stock.</td>
<td>Degraded condition</td>
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<td>REACH NO.</td>
<td>HYDROLOGY</td>
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<td>22</td>
<td>3rd Order Stream (Strahler). Channel mostly unmodified, however, one culvert at road crossing. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Slightly Modified. Width reduced by up to 1/3 and/or some breaks in continuity. One or more strata dominated by exotic species, ‘high threat’ species present. Cover within one stratum up to 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and/or only two age classes present. Quantities and cover similar to reference.</td>
<td>Clay banks variable between 30-70° gradient. Channel well defined and stabilised with riparian trees. Approximately 5% of reach slumped.</td>
<td>Moderate aquatic habitat with variable channel width (1-3m), deep water (30-100cm), pools and runs, large woody debris and two native aquatic macrophytes. Water clarity mostly clear. Series of pools and runs at time of surveys, with flows heavily influenced by upstream dams and road drainage. Poor fish habitat due to lack of connectivity along the creek, but good frog habitat.</td>
<td>Good-moderate condition</td>
</tr>
<tr>
<td>23</td>
<td>3rd Order Stream (Strahler). Channel heavily disturbed with most habitat removed. Appears to be mechanically straightened or dredged. Numerous pipes protruding banks that may acts as an outlet from irrigated horticulture. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Severely modified Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Straight steep banks appear to be mechanically altered and severely eroded. No riparian vegetation present to stabilise banks.</td>
<td>Very poor water quality with algal blooms and heavy weed infestation within channel. Poor fish habitat, but may suit some tolerant frogs. Large adjacent dam provides better habitat.</td>
<td>Degraded condition</td>
</tr>
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<td>24</td>
<td>3rd Order Stream (Strahler). Channel mostly unmodified, however, one culvert upstream.</td>
<td>Moderately Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species</td>
<td>Clay banks high and steep, &gt;70° gradient, with some channel incision. Minor slumping and undercutting to approximately 10% of reach. Large trees support</td>
<td>Minimal aquatic habitat due to narrow channel (&lt;1m), shallow water (&lt;20cm), homogenous clay substrate, and lack of large woody debris and aquatic macrophytes. Water very turbid. Series of pools at time of surveys, with flows heavily influenced by upstream dams.</td>
<td>Moderate-degraded condition</td>
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<td>REACH NO.</td>
<td>HYDROLOGY</td>
<td>STREAMSIDE VEGETATION</td>
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<td>25</td>
<td>Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>present. Cover within one stratum up to 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and/or only two age classes present. Quantities and/or cover 50% higher or lower than reference.</td>
<td>high banks.</td>
<td>Poor fish habitat and low quality frog habitat.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>3rd Order Stream (Strahler). Channel mostly unmodified, however, one culvert at road crossing. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Substantially modified Only small patches of well-separated native vegetation remain. One or more strata dominated by exotic species, ‘high threat’ species present. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class present. Very small quantities of debris present.</td>
<td>Steep clay banks with little variability. Confined to narrow channel 5 m wide, with heavily cleared banks, except for some scattered trees to the south. Minor erosion.</td>
<td>Poor fish habitat due to dense instream vegetation, but may suit some frogs tolerant to disturbance. Mostly shallow water with stagnant ponding. Large woody debris rare.</td>
<td>Moderate condition</td>
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<td>26</td>
<td>3rd Order Stream (Strahler). Channel mostly unmodified, however, one culvert and minor bunding upstream. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Slightly Modified. About 50% of the native vegetation remains, either in strips or patches. One or more strata dominated by exotic species, ‘high threat’ species present. Cover within one stratum up to 50% lower or higher than reference. Reduced cover (75-50%) of dominant strata, and/or only two age classes present. Some evidence of unnatural loss of debris (e.g. through collection of firewood, trampling of leaf litter by stock).</td>
<td>Clay banks variable between 30-70° gradient. Channel well defined and stabilised with riparian trees. Approximately 5% of reach slumped on outer bend.</td>
<td>Minimal aquatic habitat due to narrow channel (1-3m), shallow water (&lt;30cm), homogenous clay substrate and lack of large woody debris and aquatic macrophytes. Water very turbid with severe algae bloom in one section. Series of small pools at time of surveys, with flows heavily influenced by upstream dams. Poor fish habitat and low quality frog habitat.</td>
<td>Moderate condition</td>
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<tr>
<td>REACH NO.</td>
<td>HYDROLOGY</td>
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<td>27</td>
<td>3rd Order Stream (Strahler). Two small dams linked by short channel. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Instream dams with steep eroded banks. No riparian trees to stabilise banks.</td>
<td>Poor quality habitat due to highly turbid water, and lack of emergent macrophytes, woody debris and riparian shading. Water appears to be pumped for irrigation and then directed back into dams. Appears to have high nutrient concentration.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>28</td>
<td>3rd Order Stream (Strahler). Channel links two small dams. Some infilling near upper dam, with well-defined channel downstream. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Slightly Modified. Width reduced by up to 1/3 and/or some breaks in continuity. One or more strata dominated by exotic species, ‘high threat’ species present. Cover within one stratum up to 50% lower or higher than reference. Dominant strata with reference level of cover and at least three age classes present (juveniles, sub-adults and adults). Quantities and cover similar to reference.</td>
<td>Partially modified due to instream dams. Channel very small in upper section, with gentle banks and broad floodplain. Channel widens and deepens downstream, with steep clay banks (&lt;70°). Banks mostly stabilised by riparian trees, but with 40% slumped, especially on bends.</td>
<td>Very limited aquatic habitat as mostly shallow stagnant pools at the time of survey. Dense riparian vegetation, instream dams and woody debris may attract some frogs. No aquatic macrophytes present. Channel varies in width (0.3-1.2m) with flows controlled by a series of upstream dams. Some deep holes would retain water after dam spills.</td>
<td>Moderate condition</td>
</tr>
<tr>
<td>29</td>
<td>1st Order Stream (Strahler) in southern portion and 2nd Order Stream in northern portion. Series of dams and modified channels/swamps. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture).</td>
<td>Poorly defined channel linking several farm dams and swampy areas. Little riparian vegetation to stabilise banks.</td>
<td>Local disturbance from horticulture creates poor water quality. Limited aquatic habitat restricted to dams that may suit tolerant species. Swampy areas with dense sedge/reed community provides good frog habitat away.</td>
<td>Degraded condition</td>
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<td>REACH NO.</td>
<td>HYDROLOGY</td>
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<tr>
<td>30</td>
<td>cleared land use and upstream dams.</td>
<td>Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>One small dam upstream, with a straightened channel through downstream paddock. Poorly defined channel at lower portion leading to confluence. Gentle banks with minor erosion. Little riparian vegetation to stabilise banks.</td>
<td>Limited aquatic habitat restricted to upstream dam that may suit tolerant species. Channel may suit some frogs that prefer sedges and swampy areas.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>31</td>
<td>2nd Order Stream (Strahler). Channel mostly modified with straightening, one dam and road crossing. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>Severely Modified. Little or no remaining native vegetation. Few native species remaining, cover dominated by exotic species. Structure completely altered from reference (e.g. grassland shrubland, forest pasture). Dominant strata mostly absent. Debris mostly absent or completely dominating the sites, with little or no living vegetation.</td>
<td>Realigned channel with shallow clay banks and upstream dam. Some bank erosion from cattle access, otherwise good stabilisation from riparian trees.</td>
<td>Very limited aquatic habitat downstream of dam. Dam would attract some fauna, such as frogs and birds. Good connectivity of riparian zone to Kemps Creek downstream.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>32</td>
<td>1st Order Stream (Strahler). Channel heavily modified due to constructed dam and realignment of channel. Catchment mostly cleared of native vegetation.</td>
<td>Substantially Modified. Only small patches of well-separated native vegetation remain. One or more strata dominated by exotic species, ‘high threat’ species present. More than one stratum completely altered from reference (lost or &lt;10% remaining). Reduced cover (&lt;50%) of dominant strata, and only one age class</td>
<td></td>
<td></td>
<td>Degraded condition</td>
</tr>
<tr>
<td>REACH NO.</td>
<td>HYDROLOGY</td>
<td>STREAMSIDE VEGETATION</td>
<td>PHYSICAL FORM</td>
<td>WATER QUALITY AND AQUATIC HABITAT</td>
<td>OVERALL RATING</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
<td>-----------------------</td>
<td>--------------</td>
<td>----------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>33</td>
<td>2nd Order Stream (Strahler). This section of creek flows through small culvert. Inflows modified due to regionally cleared land use.</td>
<td>No access to site. Native riparian vegetation mostly cleared within precinct boundary.</td>
<td>No access to site. Appears to be minor creek within precinct boundary.</td>
<td>No access to site. Appears to have limited aquatic habitat within precinct boundary.</td>
<td>Degraded condition</td>
</tr>
<tr>
<td>34</td>
<td>1st Order Stream (Strahler). Channel mostly modified with straightening and one dam. Inflows modified due to regionally cleared land use and upstream dams.</td>
<td>No access to site. Reach mostly cleared of native vegetation.</td>
<td>No access to site. Minor creek with dam in cleared residential property.</td>
<td>No access to site. Appears to have limited aquatic habitat in dam only.</td>
<td>Degraded condition</td>
</tr>
</tbody>
</table>
4.4.2 Aquatic Habitat Condition Assessment

The two main 3rd order streams (Kemp’s and Scalabrini’s Creek) contain lengths which are highly modified from their original natural state due to the removal of riparian vegetation, provision of stock watering points or uncontrolled access to the creek, weed invasion, sedimentation and increased nutrient inputs. There are also small portions of the streams which are in relatively good condition with stable bank, intact stands of healthy native vegetation and relatively natural functioning.

All watercourses have existing value as part of semi-vegetated riparian corridors which provide habitat for local flora and fauna and create links to habitats beyond the precinct boundaries. In some parts aquatic habitat was limited due to shallow and turbid water. In general, there was limited habitat for fish due to poor connectivity and/or narrow channel width. However, suitable fish habitat occurred in a number of dams on site, if there was good riparian vegetation cover. Carp were identified in some areas of the precinct, which can negatively impact stream health through increasing turbidity, bank degradation and outcompeting native fingerlings. Good frog habitat existed where the watercourse is protected from livestock trampling. Some areas also provided good turtle habitat.

Parts of the creeks provide in-stream habitat for fish species, aquatic macrophytes and macro-invertebrates which all contribute to overall ecosystem health. Planning requirements involving the restoration of riparian ecosystem values will be valuable to assist with improving the condition of downstream environments.
4.5 **AQUATIC ASSESSMENT AND THREATENED SPECIES**

4.5.1 Threatened Species
The database searches undertaken for the site revealed a number of aquatic or amphibian species that are known from the region (Table 7).

A review of listed threatened species dependant on in stream habitat revealed that no threatened species are likely to occur within the aquatic habitats present in the study area. There are some areas of potential habitat for Green and Golden Bell Frog (*Litoria aurea*) such as existing large farm dams with fringing emergent vegetation, however the vast majority of the site is considered to provide marginal or unlikely habitat for this species.

Table 7: Listed aquatic and amphibious species recorded in the region

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>FM ACT STATUS / TSC ACT STATUS</th>
<th>EPBC ACT STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macquarie Perch (<em>Macquaria australica</em>)</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Australian Grayling (<em>Prototroctes maraena</em>)</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Giant Burrowing Frog (<em>Heleioporus australiacus</em>)</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Green and Golden Bell Frog (<em>Litoria aurea</em>)</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Southern Bell Frog (<em>Litoria raniformis</em>)</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Giant Barred Frog (<em>Mixophyes iterates</em>)</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Red-crowned Toadlet (<em>Pseudophryne australis</em>)</td>
<td>-</td>
<td>V</td>
</tr>
</tbody>
</table>

Whilst it is unlikely that any threatened aquatic species utilise the habitat on the site, there are a host of common aquatic species including eels, yabbies and macroinvertebrates that rely on the health of aquatic habitat for their ongoing survival. Aquatic habitat is an important component of overall ecosystem health and contributes to the diversity and viability of terrestrial habitat. It is highly recommended that future urban development considers the need to provide good quality instream habitat, longitudinal connectivity (including removal of current barriers to fish passage) and fringing riparian vegetation. In addition, erosion and sediment control should be a key requirement during construction and Water Sensitive Urban Design (WSUD) principles should be considered to improve the future quality of receiving waters and reduce potable water demand for any landscaping and water treatment features.

4.5.2 Groundwater Dependant Ecosystems
Groundwater Dependant Ecosystems (GDEs) are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater (Eamus, 2009) as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function.
Groundwater use by an ecological community or individual species does not necessarily imply groundwater dependence (Dressel et al 2010).

In Australia, the majority of ecosystems have little to no dependence on groundwater, although the full understanding of the role of groundwater in maintaining ecosystems is generally poor. The exception to this is wetland communities, for which it is thought that most have some level of dependence on groundwater resources (Hatton and Evans 1998).

GDEs are generally classified into six categories (SCCG 2006, SKM 2001):

- **Terrestrial vegetation** – forests and woodland which develop a permanent or seasonal dependence on groundwater, often by extending roots into the water table,
- **Base Flow in streams** – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow,
- **Aquifer and cave systems** – aquatic ecosystems that occupy caves or aquifers,
- **Wetlands** – aquatic communities and fringing vegetation that depend on groundwater fed lakes and wetlands,
- **Estuarine and near shore marine ecosystems** – various ecosystems including mangroves, salt marsh and seagrass, whose ecological function has some dependence on groundwater discharge
- **Terrestrial fauna** – fauna species assemblages reliant on groundwater for drinking water.

A final category is also recognised – **not apparently dependant**. This category acknowledges that some ecosystems, particularly wetland and riparian vegetation, might superficially appear to be groundwater dependent while in fact they are dependant entirely on surface flows and or rainfall.

GDEs have varying degrees of dependency on groundwater. These range from total to occasional dependence and include (SCCG 2006, SKM 2001):

- **Entirely dependent** – ecosystems for which only a slight change in the groundwater regime will have catastrophic effects,
- **Highly dependent** – ecosystems for which moderate changes in the groundwater regime will result in significant changes to ecosystem distribution, health and or diversity. These ecosystems utilise both ground and surface water resources.
- **Proportionally dependant** – ecosystems for which changes in the groundwater regime result in significant changes to the ecosystem characteristics,
- **Opportunistically or minimally dependant** – ecosystems for which the reliance on groundwater is limited to seasonal or climatic variations. These ecosystems use surface water predominantly and if access to groundwater is prolonged, declines in ecosystem distribution, health, species composition or diversity may result.

The floodplains within the study site are generally cleared and heavily grazed. Several structures to divert water (levees, channels) and drain the floodplains were observed across the precinct. Numerous farm dams, both on and off-line, are located across the precinct. These provide habitat for a number of aquatic species.

GDEs mapped in the study Area (Figure 11) are confined to the Alluvial Woodland riparian vegetation that may utilise groundwater fed base flows of Kemps Creek as freshwater wetlands located on low-
lying land close to shallow aquifers. Vegetation communities that may be recognised as GDEs within Leppington Precinct include:

- River Flat Eucalypt Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion – Alluvial Woodland.

The dependence on groundwater varies greatly with each community and its position in the landscape. There is little available information on level of groundwater dependency of the patch of Alluvial Woodland community within the precinct. However, as a safeguard for future planning, freshwater GDEs such as streams, riparian zones and wetlands can be grouped as highly dependent, particularly during base flows. GDEs are mapped by their Biometric Vegetation type in Figure 11.
Figure 11: Aquatic Survey Reaches and location of Alluvial Woodland GDE
4.6 DISCUSSION / RECOMMENDATIONS

With the likely NOW requirements for riparian corridor restoration, the aquatic and riparian habitat of the existing watercourses within the precinct will improve over time as development works progress. Given the current state of some watercourse areas, where in parts there is no discernible channel, bed or banks, realignment and restoration will eventually result in a much improved environmental outcome.

It is likely that future development will require stormwater detention areas and other WSUD features that will provide a similar type of habitat as the farm dams do within the Precinct at present. Therefore, there is potential for significant areas of new aquatic habitat to be created on site as development activity proceeds which will provide suitable habitat for aquatic species and potentially the migratory bird Cattle Egret which was recorded on site.

If and when dewatering of the existing farm dams is to occur, detailed dewatering plans should be devised prior to works to manage and minimise impacts on the existing aquatic flora and fauna. Where possible, it is recommended that the dewatering of dams be staged, so any aquatic fauna utilizing the dams have the opportunity to seek other habitat. Examples of compensatory habitat could include appropriately designed wet basins containing similar habitat features to the dams which are removed. The patches of potential GDE on site (Alluvial Woodland community) occur in close proximity to the Kemps Creek and Scalabrini Creek channels, and it is recommended that this vegetation (which is also listed under the TSC Act as an endangered ecological community and comprises areas of ENV) be retained within the riparian corridor network. If groundwater extraction is proposed as any part of future development proposals, impacts on this GDE would need to be further assessed.

4.6.1 Stream Order Classification and Riparian Corridors

Stream classification, as shown in Figure 8, identifies a range of stream orders from 1st through to 3rd order based on the Strahler stream classification system. Following the field based validation surveys a merit based assessment was undertaken to determine and clarify the functioning condition of the onsite waterways. Subsequently consultation with NOW was sought on the outcomes of the assessment and accordingly a more suitable approach to the classification of stream orders and the resulting riparian corridors has been applied. The revised approach to the watercourse classification takes into account the following points for the Leppington precinct watercourses:

- Both Kemp’s and Scalabrini’s Creek present a highly modified environment with very limited high condition riparian vegetation present.
- Numerous dams and diversions at the head of the precincts catchment have concentrated the waterflow so that there are numerous non-natural channels which have inflated the downstream classifications.
- Highly fragmented ownership throughout the site makes delivery of precinct development difficult, especially when considering future riparian corridors (and ownership) with many private land holders.
- The riparian land of both Kemp’s and Scalabrini’s Creek is of little current environmental value and mainly serves a drainage function throughout the site.
- Hydrological studies have demonstrated that 2nd order corridor widths are adequate for flood conveyance.
- The use of proposed online detention basins will allow a more efficient use of land and will provide improved opportunities for preferred public ownership of riparian lands.
- Downstream of Kemp’s and Scalabrini’s Creek have been previously classified as 2nd Order Streams. Treating the upstream sections of these two creeks within the Leppington Precinct as 2nd order streams would maintain consistency with the already approved downstream corridors.
Based on the revised approach to classifying the stream orders and riparian corridor width, it is considered appropriate to treat both Kemp’s and Scalabrini’s Creek (mapped as 3rd order under the Strahler system in Figure 8) as 2nd order streams. The key justification for this is based on the creeks overall highly modified nature. The result of this is a decrease in total riparian corridor width from 60m + channel width to 40m + channel width, and the application of the 2nd Stream Order requirements and uses (such as online detention basins) as outlined in Table 8. Figure 12 displays the final stream classification and riparian corridor network proposed for the precinct.
Figure 12: Proposed riparian corridors and top of bank
4.6.2 Riparian Ownership and Management Options

Riparian corridors may be retained in public ownership, which would increase the likelihood of achieving good and consistent environmental outcomes and provide integrated uses and access for the community. Camden Council may accept the handover of riparian areas (under Council’s *Dedication of riparian corridors ownership policy 1.18*) following appropriate rehabilitation works in accordance with a site specific vegetation management plan and a maintenance period of 5 years.

At the least, drainage and detention structures will remain in public ownership with Camden Council owning and managing these facilities. These areas will be revegetated and managed as a naturalised feature. It is understood that a vegetation management plan will be required to be prepared to the satisfaction of NOW and Camden Council for future development applications which impact on these areas.

4.6.3 Water Management Act

It is possible for NSW DP & I to seek an exemption, on a precinct-wide basis, from the requirement under the NSW Water Management Act (2000) to obtain Controlled Activity Approvals (CAAs). This would streamline the development assessment process through the removal of the need for referral to NOW under the NSW EP & A Act provisions for Integrated Development. This has been achieved for the nearby precincts of Oran Park and Turner Road through the development of a waterfront land strategy.

Further review of appropriate planning mechanisms (zoning and development controls) will need to be carried out by NOW, Camden Council and NSW DP & I in order to determine a set of controls which will be appropriate for the Leppington Precinct.

It is recommended that the Riparian Protection Area Map that will be included with the SEPP amendment is linked to the Water Management Act 2000 in a way that defines waterfront land within the precinct as being limited to the extent of the Riparian Protection Area.

4.7 MANAGEMENT OF RIPARIAN PROTECTED AREAS

The riparian areas within Growth Centres precincts were assessed according to the methodology in the NOW controlled activity guidelines for riparian corridors, which includes the use of the Strahler system for stream ordering. New guidelines regarding controlled activities within riparian corridors were introduced on 1st July 2012 which amended the minimum riparian corridor widths that apply to watercourses and make it easier for applicants to determine the requirements for NOW controlled activity approvals.

4.7.1 Urban Development Principles

The new controlled activity guidelines do not encompass specific planning controls however they do contain objectives and a guide to works and activities generally allowable on waterfront land. The overarching objective of controlled activity provisions of the WM Act is to establish and preserve the integrity of riparian corridors. Ideally, the environmental functionality of riparian corridors should be restored and maintained by applying the following principles:

- Seek to maintain or recreate a riparian corridor / vegetated riparian zone with fully structured native vegetation in accordance with the minimum riparian corridor widths,
- Seek to minimise disturbance and harm to the recommended riparian corridor / vegetated riparian zone,
- Minimise the number of creek crossings and provide a perimeter road separating development from the riparian corridor / vegetated riparian zone,
• Locate all infrastructure and services outside the riparian corridor / vegetated riparian zone,
• Where services or infrastructure are located within riparian corridors, co-locate facilities in one concentrated area to minimise overall disturbance and breaks in corridor continuity,
• Treat stormwater runoff before discharging it into the riparian corridor.

NOW does allow for a range of works and land uses within the outer (landward) edge of riparian corridors so long as they have minimal environmental harm. Activities which may be permissible are presented in Table 8 below. The following principles are contained within the NOW guidelines and are to be considered in conjunction with the matrix presented in Table 8.

• Riparian Corridor offsetting for non-riparian corridor uses: Non-riparian uses, such as Asset Protection Zones are allowed in the outer 50% of the vegetated riparian zone, so long as offsets are provided in accordance with the averaging rule (see Figure 13)
• Cycleways and Paths: Cycleways or pedestrian paths no wider than 4m (total disturbance footprint) can be built in the outer 50% of the vegetated riparian zone
• Detention Basins: detention basins can be built in the outer 50% of the vegetated riparian zones or online (where indicated in the NOW Controlled Activity Guidelines for a) Outlet structures and b) Instream work. Online basins must:
  o Be dry and vegetated,
  o Be for temporary flood detention only with no permanent water holding,
  o Have an equivalent vegetated riparian zone for the corresponding watercourse order, and
  o Not be used for water quality treatment purposes.
• Stormwater outlet structures and essential services: Stormwater outlets or essential services are allowed in the riparian corridor. Works for essential services on a 4th order or greater stream are to be undertaken by directional drilling or tied to existing crossings (refer to NOW Controlled Activity Guidelines for a) Laying pipes and cables in watercourses and b) Outlet Structures).
• Stream alignment: Indicates that a watercourse may be re-aligned (refer to NOW Controlled Activity Guidelines for Instream Works)
• Road Crossings: Indicates permitted road crossing methods (refer to NOW Controlled Activity Guidelines for Watercourse Crossings and DPW Fisheries Policy and Guidelines for Fish Friendly Waterway Crossings for Class 1 and 2 Waterways).

Works not associated with the establishment and maintenance of riparian corridors can be authorised within the outer riparian corridor provided that the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate, 50% of the outer vegetated riparian zone width may be used for non-riparian uses provided that an equivalent area is offset on site and is adequately connected to the riparian corridor vegetation. The inner 50% of the vegetated riparian zone is required to be fully protected and vegetated with native endemic riparian species, and satisfy the minimum area requirements to maintain bed and bank stability. The averaging rule (Figure 13) should generally be applied to cleared waterfront land. Development proposals involving waterfront lands that contain existing native vegetation should seek to preserve the existing vegetation in accordance with the minimum riparian corridor widths outlined in Table 5.
Figure 13: Averaging Rule. Source NOW Controlled Activity Riparian Corridor Guidelines
Table 8: NOW Riparian Corridor Matrix

<table>
<thead>
<tr>
<th>REQUIREMENTS &amp; ALLOWABLE USES</th>
<th>STREAM ORDER</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td>4th +</td>
</tr>
<tr>
<td>Vegetated Riparian Zone (VRZ) Width</td>
<td>10m each bank</td>
<td>20m each bank</td>
<td>30m each bank</td>
<td>40 m each bank</td>
</tr>
<tr>
<td>Riparian Corridor Offsetting for Non-Riparian Corridor uses</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Cycleways and Pathways</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Detention Basins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Only within outer 50% VRZ</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>- Online</td>
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<td>Stormwater Outlet Structures &amp; Essential Services</td>
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<td>Stream Re-alignment</td>
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<td></td>
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<tr>
<td>- Bridge</td>
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</tr>
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</table>
5 Conservation and Management Recommendations for Indicative Layout Plan

The site constraints listed and mapped above (Figure 7) should be used to guide the master planning processes and development of the eventual Indicative Layout Plan for Leppington Precinct.

Land uses surrounding detention basins, non-certified areas, riparian corridors and parks will need to be carefully managed so as not to adversely impact on the ecological integrity of the protected areas. Opportunities to maximise ecological values across the site will also be available through the rehabilitation and revegetation of detention basins and the potential for retention of remnant vegetation in areas zoned for public or private open space, drainage and education infrastructure, and possibly environmental conservation and environmental living.

Proposed detention basins should result in sections of land along the riparian corridor within the detention basins being revegetated and rehabilitated and retained in public ownership. These areas could provide potential habitat for fauna and strengthen habitat connectivity. Use of local provenance species for revegetation and weed management will be important in these areas to ensure ecosystem functionality is maximised and downstream impacts are minimised. Vegetation management plans for these areas will need to be prepared to the satisfaction of NOW / OEH.

It is recommended that open space areas, water quality and flood detention devices etc, are located in existing areas of low ecological constraint on certified lands, to minimise loss of existing habitat across the site.

Biodiversity Management Recommendations include:

- Maximise retention of ENV and AHCVV within non-certified lands to avoid further assessments under the TSC and or EPBC Acts,
- Maximise retention of ENV and AHCVV within certified lands and plan for the location of conservation reserves, public open space, visual buffers and other passive land uses in these areas,
- Adequate Riparian Protection Areas along each retained watercourse, with co-location of water quality and quantity treatment facilities,
- Retention of habitat trees and other native vegetation onsite through strategic location of sympathetic land use zones (such as open space, education, drainage etc). Similarly, incorporation of hollow bearing trees into streetscape areas is recommended to provide contiguous corridors that allow wildlife to migrate safely through built up areas.

There are no significant existing aquatic habitat constraints that should impact upon the master plan design, as none of the dams on site presented important habitat values and the creeks were of moderate condition.
Specific riparian and aquatic design considerations include:

- Adequate Riparian Protection Areas along Kemps Creek, with co-location of water treatment/detention facilities to maintain or increase the effective riparian corridor width,
- Embellishment of existing native riparian and aquatic vegetation and restoration of the aquatic habitat of the watercourses as part of a riparian corridor management plan
- Incorporation of open space within areas of higher aquatic habitat quality where possible, or creation of new wetland and aquatic habitat to replace areas lost for infrastructure,
- Use of local provenance wetland species for detention basin design with specific consideration of establishing suitable wetland/aquatic habitat,
- Appropriate use of large woody debris to re-introduce instream habitat,
- Management and control of exotic species, particularly mosquito fish *Gambusia holbrooki* and Carp *Cyprinus carpio*.
- Control of peak flows to reduce erosion impacts and improve water quality through water sensitive urban design.
6 References


Eco Logical Australia (2006) Western Sydney Growth Centres Conservation Plan (Final Draft), Report for Growth Centres Commission


NSW Department of Water and Energy (February 2008). *Guidelines for controlled activities: Riparian corridors*.


SEWPaC 2012a – Commonwealth Listing Advice on *Ardea ibis* (Cattle Egret)


Appendix A: Detailed Statutory Framework

Commonwealth

Environment Protection & Biodiversity Conservation Act 1999

The Commonwealth Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act) establishes a process for assessing the environmental impact of activities and developments where ‘matters of national environmental significance’ (MNES) may be affected. The EPBC Act lists endangered ecological communities, threatened and migratory species that have the potential to occur, or are known to occur on a site.

The approval of both stages of the strategic assessment occurred on the 28th February, 2012. This approval essentially means that the Commonwealth is satisfied that the conservation and development outcomes that will be achieved through development of the Growth Centres Precincts will satisfy their requirements for environmental protection under the EPBC Act. So that, provided development activity proceeds in accordance with the Growth Centres requirements (such as the Biodiversity Certification Order, the Growth Centres SEPP and DCPs, Growth Centres Development Code etc) then there is no requirement to assess the impact of development activities on matters of National Environmental Significance (NES) and hence no requirement for referral of activities to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The requirement for assessment and approval of threatened species and endangered ecological communities under the EPBC Act has now been “turned off” by the approval of the Strategic Assessment.

State

Environmental Planning and Assessment Act 1979 (EP&A Act)

The NSW Environmental Planning and Assessment Act 1979 (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development proposals. Various legislative instruments, such as the NSW Threatened Species Conservation Act 1995 (TSC Act), are integrated with EP&A Act and have been reviewed separately.

In determining a development application, the consent authority is required to take into consideration the matters listed under Section 79C of the EP&A Act that are relevant to the application. Key considerations include:

- Any environmental planning instrument, including drafts
- The likely impacts of the development
- The suitability of the site for the development
- Any submissions made in accordance with the EP&A Act or regulations
- The public interest
Threatened Species Conservation Act 1995 (TSC Act)

The Threatened Species Conservation Act 1995 (TSC Act) aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The TSC Act is integrated with the EP&A Act and requires consideration of whether a development (Part 4 of the EP&A Act 1974) or an activity (Part 5 of the EP&A Act) is likely to significantly affect threatened species, populations and ecological communities or their habitat.

The schedules of the Act list species, populations and communities as endangered or vulnerable. New species, populations and communities are continually being added to the schedules of the TSC Act. All developments, land use changes or activities need to be assessed to determine if they will have the potential to significantly impact on species, populations or communities listed under the Act.

Bio-certification was introduced under the TSC Act (s.126G) to confer certification on an environmental planning instrument if the Minister is satisfied that it will lead to the overall improvement or maintenance of biodiversity values – typically at a landscape scale. The effect of granting certification is that any development or activity requiring consent (Under Part 4 and 5 of the EP&A Act respectively) is automatically – development that is not likely to significantly affect threatened species. This certification removes the need to address threatened species considerations and the assessment of significance or seven part tests (s.5A of the EP&A Act), including the prepare species impact statements (SIS).

Where Parts 3A, 4 or 5 are not applicable, a licence under s.91 of the TSC Act from Office of Environment and Heritage must be obtained for actions (such as bush regeneration) that have the potential impact on threatened species.

The Growth Centres SEPP (see below) impacts the application of the TSC Act within Leppington Precinct, which is discussed further below.

Threatened Species Conservation Amendment (Special Provisions) Act 2008

This Act passed by NSW Parliament on 24 June 2008 confirms bio-certification of the Growth Centres SEPP by amending the TSC Act. The Act also amends the Local Government Act 1993 with respect to rates payable on land subject to conservation agreements within the Growth Centres.

State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP)

The Growth Centres State Environmental Planning Policy (SEPP) (referred to as the ‘Growth Centres SEPP’) has been ‘bio-certified’ by order of the Minister for the Environment under s.126G of the TSC Act. The mechanism for achieving this is outlined in the Growth Centres Conservation Plan (Eco Logical Australia, 2007) and the conditions for bio-certification are documented in the Ministers order for consent. Bio-certification negates the requirement for impact assessment under s.5A of the Environmental Planning and Assessment Act, 1979 thus turning off the requirements for seven part tests or species impact statements.

The areas within Leppington that are non-certified are shown in Figure 1 of the report. The site contains 2 Endangered Ecological Communities (Cumberland Plain Woodland and Alluvial Woodland) as well as a threatened flora and fauna species.
Each precinct needs to be assessed against the conditions of the Biodiversity Conservation Order to ensure that the planned rezoning and subsequent development of the precinct complies. This is undertaken through the completion of a Biodiversity Certification Consistency Report.

*Fisheries Management Act 1994 (FM Act)*

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. The FM Act defines ‘fish’ as any marine, estuarine or freshwater fish or other aquatic animal life at any stage of their life history. This includes insects, molluscs (eg. Oysters), crustaceans, echinoderms, and aquatic polychaetes (eg. Beachworms), but does not include whales, mammals, reptiles, birds, amphibians or species specifically excluded (eg. Some dragonflies are protected under the TSC Act instead of the FM Act). Under this act, if any activity occurs that will block fish passage, then a permit under this Act will be required.

*Water Management Act 2000*

The NSW *Water Management Act 2000* has replaced the provisions of the *Rivers and Foreshores Improvement Act 1948*. The *Water Management Act 2000* and *Water Act 1912* control the extraction of water, the use of water, the construction of works such as dams and weirs and the carrying out of activities in or near water sources in New South Wales. ‘Water sources’ are defined very broadly and include any river, lake, estuary, place where water occurs naturally on or below the surface of the ground and coastal waters.

If a ‘controlled activity’ is proposed on ‘waterfront land’, an approval is required under the Water Management Act (s91). ‘Controlled activities’ include:

- the construction of buildings or carrying out of works;
- the removal of material or vegetation from land by excavation or any other means;
- the deposition of material on land by landfill or otherwise; or
- any activity that affects the quantity or flow of water in a water source.

‘Waterfront land’ is defined as the bed of any river or lake, and any land lying between the river or lake and a line drawn parallel to and forty metres (40m) inland from either the highest bank or shore (in relation to non-tidal waters) or the mean high water mark (in relation to tidal waters). It is an offence to carry out a controlled activity on waterfront land except in accordance with an approval.

*Noxious Weed Act 1993*

The objectives of the NSW *Noxious Weeds Act 1993* are to identify which noxious weeds require control measures, identify control measures suitable to those species and to specify the responsibilities of both public and private landholders for noxious weed control.

*State Environmental Planning Policy No.19 – Bushland in Urban Areas*

This NSW State Environmental Planning Policy (SEPP) aims to protect and preserve bushland within selected local government areas. The policy recognises the recreational, educational and scientific significance of such bushland and aims to protect the flora, fauna, significant geological features, landforms and archaeological relics in such areas. It encourages management to protect and enhance the quality of the bushland and facilitate public enjoyment, compatible with its conservation. The policy states that a person shall not disturb bushland zoned or reserved for public open space purposes without the consent of the council.
Development Code

The Growth Centres Development Code was produced by the former Growth Centres Commission (GCC) in 2006. The Development Code was produced to guide the planning and urban design in the North West and South West Growth Centres.

The Development Code includes objectives and provisions that support the retention of as much native vegetation, habitat and riparian areas within the precinct through incorporation into land use planning outcomes such as lower density development in these areas, subdivision patterns, road design, local parks, and other areas required to be set aside for community uses without adversely affecting the development yield of areas.

As a requirement under the Development Code, the Leppington precinct will need to demonstrate how the biodiversity and other values of areas identified by the SEPP will be protected, maintained and enhanced. Key issues will include boundary management (eg. Buffers to surrounding development), bush fire and water sensitive urban design (WSUD) (GCC 2006).

Growth Centres Conservation Plan

Under the GCC Conservation Plan (January 2007), the vegetation within Leppington Precinct has been identified as ‘Lower Long Term Management Viability (LMV)’ and has already been considered for offset as part of the Improve or Maintain test (i.e. is not designated for conservation as part of the larger regional plan for Western Sydney). It should be noted however that while the Improve or Maintain test has already been considered, it can and should be supplemented by other relevant considerations as recommended by the Conservation Plan. By applying the precautionary principle, the Conservation Plan recommends that some residual areas identified as LMV should be further examined and addressed, for any potential for habitat conservation to contribute to the broader habitat values of the area at the planning stage.
Appendix B: Methodology

Literature Review

A desktop literature review was undertaken by ELA to determine the location and extent of previous surveys, identify the representative spectrum of flora and fauna within the study area and identify the presence of any threatened species, populations and ecological communities listed under the TSC Act and the Commonwealth EPBC Act that could potentially occur within the study area. To this end, the following documentation and mapping was reviewed:

- Topographic maps
- Aerial photography of the study area including historic aerials from 1947, 1961 and 1981;
- A search of the NSW OEH Bionet Atlas
- EPBC online Protected Matters Database Search
- Preliminary results from Draft Part 3A project: Water related Services for the North West and South West Growth Centres Cumberland Ecology (2010)
- ‘Growth Centres Conservation Plan’ prepared by Eco Logical Australia (2007) for NSW Growth Centres Commission;
- Western Sydney Vegetation Mapping (NPWS 2002a); and
- Western Sydney Condition and Conservation Significance Mapping (NPWS 2002b).

Likelihood of Occurrence

Appendix D identifies the threatened species returned by the NSW OEH Bionet Atlas database and EPBC online Protected Matters database searches (based on a 10km radius from the study area) together with an assessment of the likelihood of occurrence for each species. Each species likely occurrence was determined by records in the area, habitat availability and knowledge of the species’ ecology.

Five terms for the likelihood of occurrence of species are used in this report. The terms for likelihood of occurrence are defined below:

- “yes” = the species was or has been observed on the site.
- “likely” = a medium to high probability that a species uses the site.
- “potential” = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur.
- “unlikely” = a very low to low probability that a species uses the site.
- “no” = habitat on site and in the vicinity is unsuitable for the species.
Terrestrial Biodiversity Assessment

METHODS

Field survey across the study area was conducted on the 29th and 30th of August and the 6th of September 2012. Field survey consisted of validating ENV, validating vegetation community types, extent and and their condition, opportunistic fauna sightings and fauna habitat assessment. The field survey was undertaken by Jennie Powell, Belinda Failes, Rebecca Dywer, Danielle Bennet and Will Introna of Eco Logical Australia. Approximately 48 person hours were utilised in completing the survey.

Matters of National Environmental Significance (MNES) listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC) were targeted during this survey period. Some areas of the site were not accessed due to restrictions by landowners or other access limitations.

Weather conditions during field surveys

<table>
<thead>
<tr>
<th>DATE</th>
<th>MIN TEMP (°C)</th>
<th>MAX TEMP (°C)</th>
<th>RAINFALL (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29th August</td>
<td>2.1</td>
<td>21.1</td>
<td>0mm</td>
</tr>
<tr>
<td>30th August</td>
<td>5.0</td>
<td>20.6</td>
<td>0mm</td>
</tr>
<tr>
<td>6th September</td>
<td>10.0</td>
<td>26.3</td>
<td>0mm</td>
</tr>
</tbody>
</table>

Weather observations were taken from [www.bom.gov.au](http://www.bom.gov.au) Campbelltown Station 068257)

The survey involved validating the mapped vegetation communities, delineating the boundaries of mapped vegetation and assessment of community condition, and searching for threatened flora and fauna. 4 survey techniques were used during the field surveys. These techniques included:

- Floristic quadrats
- Random meander targeted flora searches
- Incidental fauna sightings
- Targeted fauna surveys

The survey techniques were based on those outlined within the Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities (Working Draft) by DEC (2004). Vegetation quadrats and transect habitat assessments followed the NSW Biobanking Methodology (DECC 2009).

Quadrats included 0.04ha (20m x 20m) surveys to record presence of all vascular flora species, along with cover and abundance for each species using a modified Braun-Blanquet scale (measures of cover and abundance taken to determine species dominating each stratum). In some locations, habitat features were determined over 0.1 ha survey (50m x 20m quadrats); measures included number of hollow bearing trees and length of fallen dead timber greater than 10 cm diameter. Within the 0.1 ha quadrats, projected foliage cover of each strata level and exotic flora was assessed along a 50m transect.

The physical characteristics (such as aspect, slope and disturbance) of each location were noted and photos were taken of the quadrats along the 50 m transect line as well at points along the random meander traverses. Species were identified to the lowest taxonomic level possible, following the Flora of NSW (Harden 1992-2002) and NSW Flora online ([www.plantnet.rbgsyd.nsw.gov.au](http://www.plantnet.rbgsyd.nsw.gov.au)). Targeted
threatened plant searches were performed during vegetation survey for species deemed as potentially or likely to occur on the basis of suitable habitat.

Incidental observations of fauna and indirect evidence of fauna, such as scats, tracks and other traces, were recorded during survey. Habitat searches were undertaken for hollow bearing trees, coarse woody debris, defoliating bark and watercourses with potential to provide aquatic habitat.

**VEGETATION COMMUNITY AND CONDITION ASSESSMENT**

Vegetation mapping was undertaken using aerial photography, ground-truthing of the ‘Native Vegetation of the Southeast of NSW (Tozer et al. 2006)’, NPWS Western Sydney Mapping Project and traversing of cleared land surrounding currently mapped vegetation remnants. Vegetation community information, canopy density and understorey condition were assigned to each vegetation polygon.

Field surveys were carried out to assess the accuracy of the mapped boundaries and attributed information and where delineation of boundaries in the field was not obvious from the aerial photography, boundaries were marked using a Global Positioning System (GPS).

Field validation of vegetation remnants was undertaken to identify correlations with ‘Existing Native Vegetation (ENV)’ (as defined in the Biocertification Order for the ‘Sydney Regions Growth Centres SEPP’), areas of ‘Additional Native Vegetation (AHCVV)’ (i.e. previously unmapped ENV), areas of Cumberland Plain Woodland that meet the criteria for the critically endangered ecological community listed under the EPBC Act, and areas of vegetation that have been cleared since aerial photos were taken.

**NSW Cumberland Plain Condition Criteria**

Table below outlines the classification rules used to determine canopy and understorey condition. This table is a modification of Table 4 in the Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney (NPWS 2002). Each area of remnant vegetation was given a condition rating according to the rule-set identified in the table below of canopy and condition codes.

<table>
<thead>
<tr>
<th>CODE</th>
<th>CANOPY DENSITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt;10%</td>
<td>Relatively intact native tree canopy</td>
</tr>
<tr>
<td>B</td>
<td>&lt;10%</td>
<td>Larger areas of remnant vegetation with a low or discontinuous canopy. Often found on the disturbed edges of larger remnants.</td>
</tr>
<tr>
<td>C</td>
<td>&lt;10%</td>
<td>Areas of native vegetation that do not have a Eucalypt canopy cover.</td>
</tr>
<tr>
<td>TX</td>
<td>&lt;10%</td>
<td>Areas of native trees with very discontinuous canopy cover.</td>
</tr>
<tr>
<td>TXr</td>
<td>&lt;10%</td>
<td>Areas of Tx (as above) located in areas where there is a combination of urban and rural activities such as rural residential development.</td>
</tr>
<tr>
<td>Txu</td>
<td>&lt;10%</td>
<td>Areas of Tx (as above) located where the dominant land use is urban (residential/industrial etc).</td>
</tr>
</tbody>
</table>

Source: Table 4 in the Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain Western Sydney (NPWS 2002).
Commonwealth Cumberland Plain Woodland and Shale Gravel Transition Forest Condition Criteria

The condition assessment criteria under the EPBC Act differs from that of the TSC Act. Condition is assigned based on patch size and perennial understorey cover. The table below outlines the EPBC Act condition criteria which were applied to vegetation within the study area to determine the condition code.

Condition Thresholds for Patches that meet the Description for the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community.

<table>
<thead>
<tr>
<th>CATEGORY AND RATIONALE</th>
<th>THRESHOLDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Core thresholds that apply under most circumstances: patches with an understorey dominated by Natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW.</td>
<td>Minimum patch size is ≥0.5ha; AND ≥50% of the perennial understorey vegetation cover is made up of native species.</td>
</tr>
</tbody>
</table>

OR

| B. Larger patches which are inherently valuable due to their rarity. | The patch size is ≥5ha; AND ≥30% of the perennial understorey vegetation cover is made up of native species. |

OR

| C. Patches with connectivity to other large native vegetation remnants in the landscape. | The patch size is ≥0.5 ha; AND ≥30% of the perennial understorey vegetation cover is made up of native species; AND The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥5ha in area. |

OR

| D. Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain. | The patch size is ≥0.5 ha in size; AND ≥30% of the perennial understorey vegetation cover is made up of native species; AND The patch has at least one tree with hollows per hectare or at least one large tree (≥80 cm dbh) per hectare from the upper tree layer species outlined in the Description and Appendix A. |

A patch is defined as a discrete and continuous area that comprises the ecological community, outlined in the Description. Patches should be assessed at a scale of 0.04 ha or equivalent (e.g. 20m x 20m plot). The number of plots (or quadrats or survey transects) per patch must take into consideration the size, shape and condition across the site. Permanent man-made structures, such as roads and buildings, are typically excluded from a patch but a patch may include small-scale disturbances, such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community, for instance the easy movement of wildlife or dispersal of spores, seeds and other plant propagules.

Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers (as outlined in the Description and Appendix A) with a life-cycle of more than two growing seasons (Australian Biological Resources Study, 2007). Measurements of perennial understorey vegetation cover exclude annuals, cryptogams, leaf litter or exposed soil (although these are included in a patch of the ecological community when they do no alter functionality as per footnote 3 and the Description and Condition Thresholds are met).

Contiguous means the woodland patch is continuous with, or in close proximity (within 100 m), of another patch of vegetation that is dominated by native species in each vegetation layer present.
Source: DEWHA (2009a) Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on an Amendment to the List of Threatened Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Vegetation community validation

During field visits random meanders were undertaken to determine the community present and full floristic lists were recorded and compared against the description of each community.

A rapid assessment was undertaken to determine if the patch was likely to meet the EPBC listing of CPSW & SGTF. Based on the results of this rapid assessment, floristic quadrats (20m x 20m) were conducted in several locations to validate and determine the floristic structure of the vegetation community. A full floristic list was compiled within each quadrat.

For each quadrat, diagnostic species for each community were identified and compared against the minimum number of diagnostic species expected to occur in a 20 x 20m quadrat for that community. Consideration was also given to those more disturbed sites where weed species were common and native species were low in abundance making the classification process more difficult as those sites containing fewer native species are less likely to contain high numbers of diagnostic species.

Threatened Flora Surveys

Random meander surveys were conducted within the vegetation communities located within the site, and other areas of potential habitat for threatened flora species. Random meander targeted surveys were conducted for the following MNES flora species were conducted at all sites where all transects / plots were completed:

- Acacia pubescens
- Dillwynia tenuifolia
- Grevillea juniperina subsp juniperina
- Grevillea parviflora subsp parviflora
- Marsdenia viridifolia var viridifolia
- Pelargonia sp striatellum
- Pimelea spicata

There is a strong correlation between the location of Pimelea spicata individuals / populations and the existence / location of CPW vegetation. Therefore, targeted survey for this species was undertaken at all locations where transects / plots were being undertaken within CPW vegetation. The Leppington Precinct study area is 655 ha in size. Within the study area, 72.98ha of CPW meeting the TSC Act criteria was validated, and 13.47ha of CPW meeting the EPBC Act criteria was validated. Therefore maximum potential habitat on site for Pimelea spicata is considered to be 72.98ha (or 11% of the study area).

Field survey was conducted during late August and early September. While Pimelea spicata can flower at any time of the year, the optimal flowering period is considered to be summer. One week prior to the Leppington field work, the large population of Pimelea spicata located at Camden Lakeside Golf Club (on the corner of Raby Road) was noted to be flowering and it is therefore considered that if Pimelea spicata was present within Leppington Precinct there was a high likelihood of detection.

Threatened Fauna Surveys
Habitat assessment for threatened fauna surveys were undertaken within the study area to determine whether any MNES species were likely to be found within the Leppington Precinct. Incidental fauna sightings were recorded. Targeted surveys were undertaken in the study area for the following and results incorporated into the assessment:

- Green and Golden Bell Frog (*Litoria aurea*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Bush Stone Curlew (*Burhinus grallarius*)
- Gang Gang Cockatoo (*Callocephalon fimbriatum*)
- Varied Sitella (*Daphoenositta chrysopserta*)
- Little Lorkeet (*Glossopsitta pusilla*)
- Little Eagle (*Hieraeatus morpohnoides*)
- Swift Parrot (*Lathamus discolor*)
- Hooded Robin (*Melanodryas cucullata*)
- Scarlet Robin (*Petroica boodang*)
- Flame Robin (*Petroica phoenicea*)
- Speckled Warbler (*Pyrrholaemus sagittus*)
- Powerful Owl (*Ninox strenua*)
- Large-eared Pied Bat (*Chalinobolus dwyeri*)
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Eastern Free Tail Bat (*Mormopterus norfolkensis*)
- Southern Myotis (*Myotis macropus*)
- Grey headed Flying Fox (*Pteropus poliocephalus*)
- Greater Broad Nosed Bat (*Scoteanax ruepelli*)
- Cumberland Land Snail (*Meridolum cornevirens*)
- White Throated Needletail (*Hirundapus caudacutus*)
- Great Egret (*Ardea alba*)
- Cattle Egret (*Ardea ibis*)
Aquatic Habitat Assessment

STUDY AREA

Kemps Creek is the dominant watercourse running approximately north-south across the western portion of the Leppington Precinct. Both tributaries of Kemps Creek present on site have been formerly designated as Category 1 watercourses by NOW.

Kemps Creek is a reasonably sized tributary of the Hawkesbury-Nepean catchment. The catchment is shale-based with no gorges or sandstone dominated landscapes. The majority of the streams are “meandering vertical” river channel types streams, which are under great threat as they are confined largely to the Cumberland Plain in the Hawkesbury Nepean catchment. Hydrological and sediment regimes have been dramatically altered due to vegetation clearance and increasing urbanisation. Increasing impervious surfaces in the catchment are causing changes to hydrology which has greatly altered the geomorphology and ecology of the watercourses.

PRELIMINARY ASSESSMENT

A preliminary assessment of all types of water features within the study area was carried out to assist with developing an appropriate methodology to highlight values and conditions of aquatic areas, defining ‘Top of Bank’ along watercourses and appraising the hydrological regime.

THREATENED SPECIES

Threatened species listed under the Fisheries Management Act 1994 and the Environmental Protection and Biodiversity Conservation Act 1999 were considered for their potential to occur within the study area by assessing habitat quality and availability as well as previous records. The following databases informed this process:

- NSW Fisheries Threatened Species Profiles
- NSW OEH Wildlife Atlas threatened species profiles
- EPBC online Protected Matters Database Search
- NSW Government Bionet Database

STREAM CATEGORISATION

Watercourses within the study area were categorised using guidelines developed by NSW Office of Water in accordance with the Strahler system for stream ordering. Stream ordering resulted in the delineation of:

- Two 3rd Order Streams (major tributaries of Kemps Creek),
- Four 2nd order tributaries and
- Four 1st order tributaries

The objectives for Core Riparian Zones under the guidelines include maintenance or development of fully structured native vegetation and the absence of infrastructure within the zone.
CONDITION ASSESSMENT

Brief field surveys were conducted along the length of the watercourse wherever access was permitted. A number of key indicators were used to assess condition along the watercourse and to designate specific reach start and end points within the overall watercourse. The chosen indicators recognise key components of watercourse health and function.

<table>
<thead>
<tr>
<th>STREAM HEALTH COMPONENT</th>
<th>INDICATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydrology</strong></td>
<td>Presence of artificial barriers.</td>
</tr>
<tr>
<td></td>
<td>Comparison to natural hydrological regime.</td>
</tr>
<tr>
<td><strong>Streamside Vegetation</strong></td>
<td>Width, condition and connectivity of riparian vegetation.</td>
</tr>
<tr>
<td></td>
<td>Recruitment of native canopy species.</td>
</tr>
<tr>
<td><strong>Physical Form</strong></td>
<td>Bank stability.</td>
</tr>
<tr>
<td></td>
<td>Fish passage.</td>
</tr>
<tr>
<td><strong>Water Quality and Aquatic Habitat</strong></td>
<td>Observed turbidity and algal growth.</td>
</tr>
<tr>
<td></td>
<td>Instream native woody debris and snags.</td>
</tr>
<tr>
<td></td>
<td>Instream macrophytes – habitat and condition of any macrophyte assemblage as based on presence of native and exotic species, diversity, and basis for occurrence.</td>
</tr>
<tr>
<td></td>
<td>Potential land management problems within adjacent riparian areas likely to be contributing to poor water quality.</td>
</tr>
</tbody>
</table>

A final overall condition class was assigned to each reach of the watercourse consistent with the guidelines used by the NSW Department of Land and Water Conservation within the Hawkesbury Nepean Catchment (NSW DLWC 2000) as specified below:

**Near Intact Condition:** Streams in a natural or near natural condition. Indicative characteristics are: intact range of native vegetation, slow rate of geomorphic change and hydrologic conditions unaltered.

**Good Condition:** Streams with self adjusting river forms and processes and relatively intact vegetation associations. Streams with character and behaviour that befit their setting with high potential for ecological diversity. Dams, reservoirs and weirs may alter hydrologic conditions.

**Moderate Condition:** Streams with localised degradation of character and behaviour, typically marked by modified patterns of geomorphic units. Vegetation associations and coverage are poor and hydrologic conditions have been altered.

Degraded Condition: These reaches generally have one or more of the following characteristics: abnormal or accelerated geomorphic instability (i.e. prone to planform change and / or bank or bed erosion), excessively high volumes of coarse bedload which blankets the bed reducing habitat diversity, low levels of bank vegetation, heavy weed infestation and artificially modified channel.
Appendix C: Flora and Fauna Lists

FIELD FLORA LIST

<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia decurrens</td>
<td>Sydney Green Wattle</td>
</tr>
<tr>
<td>Aira sp.*</td>
<td>Hairgrasses</td>
</tr>
<tr>
<td>Angophora floribunda</td>
<td>Rough-barked apple</td>
</tr>
<tr>
<td>Anredera cordifolia*</td>
<td>Madeira vine</td>
</tr>
<tr>
<td>Araucaria bidwillii</td>
<td>Bunya Pine</td>
</tr>
<tr>
<td>Araujia sericifera*</td>
<td>Moth Vine</td>
</tr>
<tr>
<td>Asparagus asparagoides*</td>
<td>Bridal Creeper</td>
</tr>
<tr>
<td>Austrodanthonia bipartita</td>
<td>Wallaby Grass</td>
</tr>
<tr>
<td>Austrostipa sp.</td>
<td></td>
</tr>
<tr>
<td>Bidens pilusa *</td>
<td>Cobblers Pegs</td>
</tr>
<tr>
<td>Breynia oblongifolia</td>
<td>Coffee Bush</td>
</tr>
<tr>
<td>Bromus cartharticus *</td>
<td>Whiskey Grass</td>
</tr>
<tr>
<td>Bursaria spinosa</td>
<td>Native Blackthorn</td>
</tr>
<tr>
<td>Callistemon sp.</td>
<td></td>
</tr>
<tr>
<td>Casuarina glauca</td>
<td>Swamp she-oak</td>
</tr>
<tr>
<td>Cerastium glomeratus*</td>
<td>Mouse-ear Chickweed</td>
</tr>
<tr>
<td>Cheilanthes siberia</td>
<td>Rock Fern</td>
</tr>
<tr>
<td>Chloris sp.</td>
<td></td>
</tr>
<tr>
<td>Cirsium vulgare *</td>
<td>Spear thistle</td>
</tr>
<tr>
<td>Conyza sp. *</td>
<td>Fleabane</td>
</tr>
<tr>
<td>Corymbia citriodora</td>
<td>Lemon scented gum</td>
</tr>
<tr>
<td>Cymbopogon refractus</td>
<td>Barbed-wire grass</td>
</tr>
<tr>
<td>Latin Name</td>
<td>Common Name</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Cynodon dactylon</td>
<td>Couch grass</td>
</tr>
<tr>
<td>Cyperus gracillis</td>
<td>Slender Flat-sedge</td>
</tr>
<tr>
<td>Daucus glochidiatus</td>
<td>Native Carrot</td>
</tr>
<tr>
<td>Dichondra repens</td>
<td>Kidney weed</td>
</tr>
<tr>
<td>Ehrharta erecta *</td>
<td>Panic veldtgrass</td>
</tr>
<tr>
<td>Einadia nutans</td>
<td>Climbing saltbush</td>
</tr>
<tr>
<td>Eucalyptus amplifolia</td>
<td>Cabbage gum</td>
</tr>
<tr>
<td>Eucalyptus crebra</td>
<td>Narrow-leaved iron bark</td>
</tr>
<tr>
<td>Eucalyptus moluccana</td>
<td>Grey box</td>
</tr>
<tr>
<td>Eucalyptus tereticornis</td>
<td>Forest Red Gum</td>
</tr>
<tr>
<td>Exocarpus cupressiformis</td>
<td>Native cherry</td>
</tr>
<tr>
<td>Foeniculum vulgare *</td>
<td>Fennel</td>
</tr>
<tr>
<td>Glycine tabacina</td>
<td>Glycine</td>
</tr>
<tr>
<td>Grevillea robusta</td>
<td>Silky Oak</td>
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<tr>
<td>Hypochaeris radicata *</td>
<td>Cats ear</td>
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<tr>
<td>Juncus acutus</td>
<td>Spiny Rush</td>
</tr>
<tr>
<td>Juncus kraussii</td>
<td>Salt Marsh Sea Rush/ Matting Rush</td>
</tr>
<tr>
<td>Juncus usitatus</td>
<td>Common Rush / Tussock Rush</td>
</tr>
<tr>
<td>Lantana camara *</td>
<td>Lantana</td>
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<tr>
<td>Lolium perene *</td>
<td>Perennial Ryegrass</td>
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<tr>
<td>Lycium ferocissimum*</td>
<td>African Box-thorn</td>
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<tr>
<td>Melaleuca decora</td>
<td>White Feather Honey Myrtle</td>
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<tr>
<td>Melaleuca sieberi</td>
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<tr>
<td>Melaleuca styphelioides</td>
<td>Prickly-leaved paperbark</td>
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<tr>
<td>Microlaena stipoides</td>
<td>Weeping Rye Grass</td>
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<tr>
<td>Olea europaea subsp. Cuspidata*</td>
<td>African olive/olive</td>
</tr>
<tr>
<td>Onopordum acanthium*</td>
<td>Scotch Thistle</td>
</tr>
<tr>
<td>Species Name</td>
<td>Common Name</td>
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<tr>
<td>Opuntia stricta*</td>
<td>Prickly Pear</td>
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<tr>
<td>Panicum effusum</td>
<td>Hairy Panic</td>
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<tr>
<td>Paspalum dilatatum</td>
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<tr>
<td>Pellaea falcata</td>
<td>Sickle Fern</td>
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<tr>
<td>Pennisetum clandestinum*</td>
<td>Kikuyu grass</td>
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<tr>
<td>Persicaria sp.</td>
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<tr>
<td>Phoenix canariensis *</td>
<td>Date Palms</td>
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<tr>
<td>Phytolacca octandra</td>
<td>Inkweed</td>
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<tr>
<td>Pinus sp.*</td>
<td>Pine</td>
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<td>Plantago sp.</td>
<td>Plantain</td>
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<tr>
<td>Pratia purpurascens</td>
<td>Whiteroot</td>
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<tr>
<td>Rubus fruticosus spp. agg. *</td>
<td>Blackberry</td>
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<tr>
<td>Rumex sp.</td>
<td>Swamp sock / Dock</td>
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<tr>
<td>Schinus areira*</td>
<td>Pepper tree</td>
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<tr>
<td>Senecio madagascariensis*</td>
<td>Fireweed</td>
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<tr>
<td>Sida rhombifolia*</td>
<td>Paddy's Lucerne</td>
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<tr>
<td>Sporobolus sp.</td>
<td>Rat's Tail Grass</td>
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<tr>
<td>Tetragonia tetragonioides</td>
<td>Warrigal Greens</td>
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<tr>
<td>Themeda australis</td>
<td>Kangaroo Grass</td>
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<tr>
<td>Trifolium repens *</td>
<td>White Clover</td>
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<tr>
<td>Typha sp.</td>
<td>Cumbungi</td>
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<tr>
<td>Urtica incisa</td>
<td>Stinging Nettle</td>
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<tr>
<td>Verbena bonariensis*</td>
<td>Purpletop</td>
</tr>
<tr>
<td>Vicia sp. *</td>
<td></td>
</tr>
<tr>
<td>Wahlenbergia sp.</td>
<td>Bluebell</td>
</tr>
</tbody>
</table>

Shading denotes Noxious weeds, * denotes exotic species
## FIELD FAUNA LIST

<table>
<thead>
<tr>
<th>CLASS</th>
<th>COMMON NAME</th>
<th>SCIENTIFIC NAME</th>
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<tbody>
<tr>
<td>Reptiles</td>
<td>Red Bellied Black Snake</td>
<td><em>Pseudechis porphyriacus</em></td>
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<tr>
<td></td>
<td>Australian Magpie</td>
<td><em>Gymnorhina tibicen</em></td>
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<tr>
<td></td>
<td>Australian Wood Duck</td>
<td><em>Chenonetta jubata</em></td>
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<td></td>
<td>Black-faced Cuckoo-shrike</td>
<td><em>Coracina novaehollandiae</em></td>
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<td></td>
<td>Butcherbird</td>
<td><em>Cracticus torquatus</em></td>
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<td>Cattle Egret</td>
<td><em>Bubulcus ibis</em></td>
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<td></td>
<td>Crested Shrike-tit</td>
<td><em>Falcunculus frontatus</em></td>
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<td></td>
<td>Double-barred Finch</td>
<td><em>Taeniopygia bichenovii</em></td>
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<td></td>
<td>Dusky Moorhen</td>
<td><em>Gallinula tenebrosa</em></td>
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<td></td>
<td>Galah</td>
<td><em>Eolophus roseicapillus</em></td>
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<td>Grey Fantail</td>
<td><em>Rhipidura albiscapa</em></td>
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<td></td>
<td>Hoary-headed Grebe</td>
<td><em>Poliocephalus poliocephalus</em></td>
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<td></td>
<td>Little Lorrikeet</td>
<td><em>Glossopsitta pusilla</em></td>
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<td></td>
<td>Magpie-lark</td>
<td><em>Grallina cyanoleuca</em></td>
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<td></td>
<td>Masked Lapwing</td>
<td><em>Vanellus miles</em></td>
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<td></td>
<td>Noisy Miner</td>
<td><em>Manorina melanocephala</em></td>
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<td></td>
<td>Pied Currawong</td>
<td><em>Strepera graculina</em></td>
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<td></td>
<td>Red Wattlebird</td>
<td><em>Anthochaera carunculata</em></td>
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<td></td>
<td>Red Whiskered Bulbul *</td>
<td><em>Pycnonotus jocosus</em></td>
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<td></td>
<td>Red-browed Finch</td>
<td><em>Neochmia temporalis</em></td>
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<td></td>
<td>Red-Rumped Parrot</td>
<td><em>Psephotus haematotus</em></td>
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<td></td>
<td>Spotted Turtledove *</td>
<td><em>Streptopelia chinensis</em></td>
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<td></td>
<td>Superb Fairy-wren</td>
<td><em>Malurus cyaneus</em></td>
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<td></td>
<td>White-plumed Honeyeater</td>
<td><em>Lichenostomus penicillatus</em></td>
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<td></td>
<td>Willy Wagtail</td>
<td><em>Rhipidura leucophrys</em></td>
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<tr>
<td></td>
<td>Yellow-rumped Thornbill</td>
<td><em>Acanthiza chrysorhoa</em></td>
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* denotes exotic species
Appendix D: Likelihood of Occurrence Table

<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>TSC ACT</th>
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<th>HABITAT ASSOCIATIONS</th>
<th>LIKELIHOOD OF OCCURRENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia pubescens</td>
<td>Downy Wattle</td>
<td>V</td>
<td>V</td>
<td>Confined to the Sydney district (DSEWPAC 2011b), associated with open woodland and forest (including Cumberland Plain Woodland, Shale/Gravel Transition Forest, Cooks River/Castlereagh Ironbark Forest) (DEC 2005). Prefers alluviums, shales and the shale-sandstone transition zone. Flowers from August to October and fruits mature from October to December (ibid.).</td>
<td>Potential</td>
</tr>
<tr>
<td>Cynanchum elegans</td>
<td>White-flowered Wax Plant</td>
<td>E</td>
<td>E</td>
<td>Clonal climber or twiner with a variable form, flowering August- May, peaking in November (DEC 2005). It occurs in dry rainforest gullies, scrub and scree slopes, and occurs mainly at the ecotone between dry subtropical rainforest and sclerophyll forest/woodland communities (NPWS 2002). The species has also been found in: littoral rainforest; Leptospermum laeavigatum – Banksia integrifolia subsp integrifolia coastal scrub; Eucalyptus tereticornis aligned open forest/ woodland; E. maculata aligned open forest/woodland; and Melaleuca armillaris scrub to open scrub (NPWS 2002).</td>
<td>No</td>
</tr>
<tr>
<td>Dillwynia tenuifolia</td>
<td></td>
<td>V</td>
<td></td>
<td>Dillwynia tenuifolia is endemic to the Sydney region and the majority of its distribution occurs on the Cumberland Plain. One population is known for the Kemps Creek area and this population is under threat. The species is found in dry sclerophyll forest and open scrubby forest or woodland (DSEWPAC 2012 a).</td>
<td>Potential</td>
</tr>
<tr>
<td>Eucalyptus scoparia</td>
<td>Wallangarra White Gum</td>
<td>E1</td>
<td>-</td>
<td>Occurs in Queensland and reaches its southern limit in NSW, where it is known from only three locations near Tenterfield. Found in open eucalypt forest and woodland on well-drained granite hilltops, slopes and rocky outcrops (OEH 2011).</td>
<td>No</td>
</tr>
<tr>
<td>Eucalyptus benthamii</td>
<td>Camden White Gum</td>
<td>V</td>
<td></td>
<td>Eucalyptus benthamii occurs in wet open forest on sandy alluvial soils along valley floors. It has a restricted but locally abundant distribution. A few scattered individuals have previously been recorded in the Nepean River System (NPWS 2000).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>SCIENTIFIC NAME</td>
<td>COMMON NAME</td>
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<tr>
<td>Grevillea juniperina subs. juniperina</td>
<td>Juniper-leaved Grevilla</td>
<td>V</td>
<td>-</td>
<td>Restricted to red sandy to clay soils – often lateritic on Wianamatta Shale and Tertiary alluvium in Cumberland Plain Woodland and Castlereagh Woodland (OEH 2011). Confined to Western Sydney and known within the area bounded approximately by St Marys, Londonderry and Prospect (ibid.).</td>
<td>Potential</td>
</tr>
<tr>
<td>Grevillea parviflora subs. parviflora</td>
<td>Small Flower Grevilla</td>
<td>V</td>
<td>V</td>
<td>Occurs on sandy clay loam soils, often with lateritic ironstone gravels (DEC 2005). Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Soil landscapes include Lucas Heights and Berkshire Park (DEC 2005). Often occurs in open, slightly disturbed sites such as along tracks. Flowering has been recorded from July to December as well as April-May (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Gyrostemon thesioides</td>
<td></td>
<td>E</td>
<td>-</td>
<td>Opportunistic post-fire and short-lived, reaching maturity within less than a year, this species is likely restricted to sandy soils on riverbanks and hillside. Only ever recorded from three locations within the Sydney Basin, at the Colo, Georges and Nepean Rivers. Not recorded at Nepean or Georges River for over 30 years (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Marsdenia viridiflora var. viridiflora</td>
<td>Marsdenia viridiflora R. Br. subs. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas</td>
<td>E2</td>
<td>-</td>
<td>A twining climber to 4 m high. Grows in vine thickets and open shale woodland. Recorded from western Sydney (Prospect, Bankstown, Smithfield, Cabramatta Creek, St Marys), and Razorback Range (DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td>Melaleuca deanei</td>
<td>Deane’s Paperbark</td>
<td>V</td>
<td>V</td>
<td>Found in heath on sandstone (DEC 2005), and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soil. Within Sydney, the species occurs in two distinct areas: Ku-ring-gai/Berowra and Holsworthy/Weddernburn. Isolated populations exist in the Blue Mountains, Wollemi NP, Hawkesbury River, and Shoalhaven regions (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Pelargonium sp. Striatellum</td>
<td>Omeo Storks’s Bill</td>
<td>-</td>
<td>E</td>
<td></td>
<td>Unlikely</td>
</tr>
<tr>
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<tr>
<td><em>Persoonia hirsuta</em></td>
<td>Hairy Geebung</td>
<td>E</td>
<td>E</td>
<td>This species occurs in dry sclerophyll eucalypt woodland/forest (Weston &amp; Johnson 1991; Weston 1995), and in shrub-woodland (Harden 1991; Blombery &amp; Maloney 1992). It grows in sandy to stony soils derived from sandstone (Weston &amp; Johnson 1991; Weston 1995) or very rarely on shale (Harden 1991), from near sea level to 600 m altitude (Weston &amp; Johnson 1991; Weston 1995), primarily flowering between November and January (Weston 1995).</td>
<td>No</td>
</tr>
<tr>
<td><em>Persoonia nutans</em></td>
<td>Nodding Geebung</td>
<td>E</td>
<td>E</td>
<td>Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000). Endemic to the Western Sydney (Benson and McDougall 2000).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Pimelea curviflora var curviflora</em></td>
<td></td>
<td>V</td>
<td>V</td>
<td>Occurs in woodlands on ridgetops and slopes, on shale/lateritic soils over sandstone or shale/sandstone transition soils. Previous records are concentrated around the Parramatta River and Illawarra coastal plains. Inconspicuous, fire-tolerant species that flowers October to May (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Pimelea spicata</em></td>
<td></td>
<td>E</td>
<td>E</td>
<td>In western Sydney, it occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale (DEC 2005). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (<em>Ibid.</em>). Has been located in disturbed areas that would have previously supported CPW (<em>Ibid.</em>). Occurs on undulating topography on substrates derived from Wianamatta Shale in areas of Cumberland Plain Woodland Vegetation Community. Recorded from open woodlands and grasslands dominated by Eucalyptus moluccana, E. crebra, E. tereticornis, Bursaria spinosa and Themeda triandra, and in the Illawarra occurs on clay soils on coastal headland in Themeda triandra grassland with low native shrubs present (DSEWPAC 2011b).</td>
<td>Potential</td>
</tr>
<tr>
<td><em>Pomaderris brunnea</em></td>
<td>Rufous Pomaderris</td>
<td>V</td>
<td>V</td>
<td>Associated with open forests (Harden 1990) in association with Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa and Kunzea ambiqua (Maryott-Brown &amp; Wilks 1993). It is found on the Colo River, the Nepean R. floodplain at Menangle, in creeklines at Wirrumbira Sanctuary (Bargo) and on the Hawkesbury R. (Harden 1990; Peacock 1996; Fairley &amp; Moore 2000). The distribution may extend into the southern section of Yengo NP along major creeklines and floodplains (Maryott-Brown &amp; Wilks 1993).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Pterostylis gibbosa</em></td>
<td>Illawarra Greenhood</td>
<td>E</td>
<td>E</td>
<td>All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. Existing populations are known from the Hunter, Illawarra and Shoalhaven regions. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter and flowers in spring (DEC 2005).</td>
<td>Unlikely</td>
</tr>
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<tr>
<td>Pterostylis saxicola</td>
<td>Sydney Plains Greenhood</td>
<td>E</td>
<td>E</td>
<td>Terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves (NPWS 1997; RBG 2011). Known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, St Marys Tower (OEH 2011).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Pultenaea parviflora</td>
<td></td>
<td>E</td>
<td>V</td>
<td>May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest, Shale Gravel Transition Forest on tertiary alluvium or laterised clays and Castlereagh Scribbly Gum Woodland (DEC 2005). Often found in association with other threatened species such as Dillwynia tenuifolia, Dodonaea falcata, Grevillea juniperina, Micromyrtus minutiflora, Persoonia nutans and Styphelia laeta (ibid.). Flowering may occur between August and November (ibid.).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Pultenaea pedunculata</td>
<td></td>
<td>E</td>
<td>-</td>
<td>Occupies a wide range of habitats, generally in woodland habitat but also on road batters and coastal cliffs (DEC 2005). On the Cumberland Plain, occupies Shale Gravel Transition Forest in the Wianamatta Shale-Tertiary alluvium intergrade areas (NPWS 1997).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Syzygium paniculatum</td>
<td>Magenta Lilypilly</td>
<td>V</td>
<td>V</td>
<td>This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW, restricted mainly to littoral rainforest on the South Coast (on grey soils over sandstone) and in riverside gallery rainforest and littoral rainforest on the Central Coast (on gravels, sands, silts and clays) (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Thelymitra sp. Kangaloone</td>
<td>Kangaloon Sun-orchid</td>
<td>-</td>
<td>CE</td>
<td>Four populations are known on the NSW Southern Tablelands near Moss Vale/Kangaloon/Fitzroy Falls, in sedgeland swamps over grey silty clay loam soils (DSEWPAC 2011b).</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
### FAUNA

<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
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</thead>
<tbody>
<tr>
<td><em>Macquarie australasica</em></td>
<td>Macquarie Perch</td>
<td>E (listed in NSW under FM Act)</td>
<td>E</td>
<td>Habitat for the Macquarie perch is bottom or mid-water in slow-flowing rivers with deep rocky holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods (DSEWPAC 2011b).</td>
<td>No</td>
</tr>
<tr>
<td><em>Prototroctes maraena</em></td>
<td>Australian Grayling</td>
<td>-</td>
<td>V</td>
<td>Historically, this species occurred in coastal streams from the Grose River southwards through NSW, Vic, and Tas. On mainland Australia, this species has been recorded from rivers flowing east and south of the main dividing ranges. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops but has also been found in muddy-bottomed, heavily silted habitat. Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous (migratory between fresh and salt waters) species (DSEWPAC 2011b).</td>
<td>No</td>
</tr>
<tr>
<td><em>Heleioporus australiacus</em></td>
<td>Giant Burrowing Frog</td>
<td>V</td>
<td>V</td>
<td>Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (DSEWPAC 2011b).</td>
<td>No</td>
</tr>
<tr>
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<tr>
<td><em>Litoria aurea</em></td>
<td>Green and Golden Bell Frog</td>
<td>E</td>
<td>V</td>
<td>This species has been observed utilising a variety of natural and man-made waterbodies (Pyke &amp; White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DEC 2005). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DEC 2005). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes—<em>Typha</em> sp. and spikerushes—<em>Eleocharis</em> sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (<em>Gambusia holbrooki</em>) (DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td><em>Litoria raniformis</em></td>
<td>Southern Bell Frog</td>
<td>E</td>
<td>V</td>
<td>Relatively still or slow-flowing sites such as billabongs, ponds, lakes or farm dams, especially where bulrushes (<em>Typha</em> sp., <em>Eleocharis</em> sp. and <em>Phragmites</em> sp.) are present (DEC 2005; Ehmann 1997). This species is common in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW (DEC 2005). This species occurs in vegetation types such as open grassland, open forest and ephemeral and permanent non-saline marshes and swamps (DEC 2005). Open grassland and ephemeral permanent non-saline marshes and swamps have also been associated with this species (Ehmann 1997).</td>
<td>No</td>
</tr>
<tr>
<td><em>Mixophyes iteratus</em></td>
<td>Giant Barred Frog</td>
<td>E</td>
<td>E</td>
<td>Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor (DEC 2005).</td>
<td>No</td>
</tr>
<tr>
<td><em>Pseudophryne australis</em></td>
<td>Red-crowned Toadlet</td>
<td>V</td>
<td>-</td>
<td>Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched sandstone outcappings in the Sydney Basin (DEC 2005). Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop (DEC 2005). Associated with open forest to coastal heath (Ehmann 1997). Utilises small ephemeral drainage lines (‘feeder creeks’) &amp; upland swamps (Ehmann 1997).</td>
<td>No</td>
</tr>
</tbody>
</table>

**REPTILES**

<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>TSC ACT</th>
<th>EPBC ACT</th>
<th>HABITAT ASSOCIATIONS</th>
<th>LIKELIHOOD OF OCCURRENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hoplocephalus bungaroides</em></td>
<td>Broad-headed Snake</td>
<td>E</td>
<td>V</td>
<td>Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer (DEC 2005).</td>
<td>No</td>
</tr>
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<tr>
<td><strong>DIURNAL BIRDS</strong></td>
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</tr>
<tr>
<td>Anthochaera phrygia (aka Xanthomyza phrygia)</td>
<td>Regent Honeyeater</td>
<td>CE</td>
<td>E &amp; M</td>
<td>Inhabits temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts (such as Red Ironbark <em>E. fibrosa</em>, White Box <em>E. albens</em> and Yellow Box <em>E. melliodora</em>) and mistletoes, and riparian forests of River Oak (<em>Casuarina cunninghamiana</em>) (Garnett 1993) and Swamp Mahogany (<em>Eucalyptus robusta</em>) in coastal areas (NPWS 1999).</td>
<td>Potential.</td>
</tr>
<tr>
<td>Botaurus poiciloptilus</td>
<td>Australasian Bittern</td>
<td>E</td>
<td></td>
<td>The species is widespread in NSW, occurring frequently along the coast and in the Murray-Darling Basin. The species inhabits floodplain wetlands (Marchant &amp; Higgins 1990).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Burhinus grallarius</td>
<td>Bush Stone-curlew</td>
<td>E</td>
<td>-</td>
<td>Associated with dry open woodland with grassy areas, dune scrub, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (DEC 2005; Marchant &amp; Higgins 1993). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Marchant &amp; Higgins 1993). Species likely requires large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed habitat.</td>
<td>No</td>
</tr>
<tr>
<td>Callocephalon fimbriatum</td>
<td>Gang-gang Cockatoo</td>
<td>V-E2</td>
<td>-</td>
<td>Inhabits dense, tall, wet forests of mountains and gullies, alpine woodlands in summer (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields &amp; Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson &amp; Day 2004).</td>
<td>Potential</td>
</tr>
<tr>
<td>Circus assimilis</td>
<td>Spotted Harrier</td>
<td>V</td>
<td>-</td>
<td>Occurs mostly commonly in native grassland, but also in grassy open woodland including acacia and mallee remnants, inland riparian woodland, and foraging at the edges of inland wetlands (DEC 2005). Can also forage over agricultural land for prey such as rabbits, but most native prey require ground cover. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn) (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Daphoenositta chrysoptera</td>
<td>Varied Sittella</td>
<td>V</td>
<td>-</td>
<td>Varied Sitellas are endemic and widespread in mainland Australia. Varied Sitellas are found in eucalypt woodlands and forests throughout their range. They prefer rough-barked trees like stringybarks and ironbarks or mature trees with hollows or dead branches (Birds in Backyards 2011).</td>
<td>Potential</td>
</tr>
<tr>
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<tr>
<td><em>Dasyornis brachypterus</em></td>
<td>Eastern Bristlebird</td>
<td>E</td>
<td></td>
<td><em>Dasyornis brachypterus</em> is endemic to Australia and occurs in three regional populations in Queensland, New South Wales and Victoria. The species inhabits low density vegetation in a broad range of habitat types and generally occurs near the coast, on tablelands or in ranges. Habitats occupied include swampland, shrubland, woodland, schleroplyll forest and rainforest (DSEWPAC 2012c).</td>
<td>No</td>
</tr>
<tr>
<td><em>Erythrotiorchis radiatus</em></td>
<td>Red Goshawk</td>
<td>V</td>
<td></td>
<td>The species is endemic to Australia and sparsely distributed across coastal and sub-coastal areas. It occurs in wooded and forested lands in tropical and warm-temperate regions. In NSW the species prefers mixed subtropical rainforest and Melaleuca forest in rugged terrain (DSEWPAC 2012d).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Glossopsitta pusilla</em></td>
<td>Little Lorikeet</td>
<td>V</td>
<td></td>
<td>In NSW, Little Lorikeets are distributed in forests and woodlands from the coast across the Divide, reaching west as far as Albury, Parkes, Dubbo and Narrabri. Occur in dry, open eucalypt forests and woodlands. Recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. Primarily feed on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands <em>Eucalyptus albens</em> (White Box) and <em>E. melliodora</em> (Yellow Box) are particularly important food sources for pollen and nectar respectively (OEH 2011).</td>
<td>Known to occur</td>
</tr>
<tr>
<td><em>Hieraaetus morphnoides</em></td>
<td>Little Eagle</td>
<td>V</td>
<td></td>
<td>Utilises open eucalypt, sheoak and acacia forest, woodland or open woodland. Builds a large stick nest in winter, in tall trees within remnant vegetation. Lays eggs in spring, and young fledge in early summer. Primarily preys on birds, reptiles and mammals, and occasionally feeds on large insects or carrion (DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td><em>Lathamus discolor</em></td>
<td>Swift Parrot</td>
<td>E</td>
<td>E</td>
<td>Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering eucalypts (Blakers et al. 1984, Schodde and Tidemann 1986). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (<em>Eucalyptus robusta</em>), Spotted Gum (<em>Corymbia maculata</em>), Red Bloodwood (<em>C. gummifera</em>), Mugga Ironbark (<em>E. sideroxylon</em>), and White Box (<em>E. albens</em>) (DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td><em>Melanodryas cucullata</em></td>
<td>Hooded Robin</td>
<td>V</td>
<td></td>
<td>Associated with a wide range of Eucalypt woodlands, Acacia shrubland and open forests (Blakers et al. 1984). In temperate woodlands, the species favours open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover (OEH 2011). Hooded Robin home ranges are relatively large, and a ground-foraging species that pounces on insect prey (ibid.).</td>
<td>Potential</td>
</tr>
<tr>
<td><em>Melanodryas cucullata cucullata</em></td>
<td>Hooded Robin (southeastern subspecies)</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>COMMON NAME</td>
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<tr>
<td>Melithreptus gularis gularis</td>
<td>Black-chinned Honeyeater (eastern subspecies)</td>
<td>V</td>
<td>-</td>
<td>Predominantly associated with box-ironbark association woodland and open forest (Birds in Backyards 2011). Widespread through NSW, though far less commonly on the eastern side of the Great Divide, with scattered records in the Hunter Valley, Central Coast and, rarely, in the Illawarra (OEH 2011).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Oxyura australis</td>
<td>Blue-billed Duck</td>
<td>V</td>
<td>-</td>
<td>The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (DEC 2005). The species is completely aquatic, swimming low in the water along the edge of dense cover (DEC 2005). It will fly if disturbed, but prefers to dive if approached (DEC 2005). Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and over-wintering lakes with some long-distance dispersal to breed during spring and early summer (DEC 2005). Young birds disperse in April-May from their breeding swamps in inland NSW to non-breeding areas on the Murray River system and coastal lakes (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Petroica boodang</td>
<td>Scarlet Robin</td>
<td>V</td>
<td>-</td>
<td>In NSW, occurs from the coast to the inland slopes, with some dispersing to open habitat of lower valleys and plains after breeding in July-January (DEC 2005). In habits dry open eucalypt forest and woodland with a sparse shrub layer. Occasionally occurs in mallee, wet forest, wetlands or tea-tree swamps (DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td>Petroica phoenicea</td>
<td>Flame Robin</td>
<td>V</td>
<td>-</td>
<td>Endemic to SE Australia, and ranges from south-east Qld to south-east SA, including Tasmania. In NSW, birds breed from spring to late summer in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, preferring clearings or areas with an open understorey dominated by native grass. Birds migrate to drier, more open forests, woodlands or grasslands in winter (DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td>Pyrrholaemus sagittatus</td>
<td>Speckled Warbler</td>
<td>V</td>
<td>-</td>
<td>Occupies a wide range of eucalypt dominated communities with a grassy understorey, often on rocky ridges or in gullies (DEC 2005). Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (DEC 2005). Large, relatively undisturbed remnants are required for the species to persist in an area (DEC 2005). Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding (DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td>SCIENTIFIC NAME</td>
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<tr>
<td><em>Rostratula australis</em> (a.k.a. <em>R. benghalensis</em>)</td>
<td>Painted Snipe (Australian subspecies)</td>
<td>E</td>
<td>V</td>
<td>Utilises wet areas with grasses, lignum, low scrub or open timber, including shallow terrestrial wetlands, lakes, swamps, claypans, waterlogged grassland or saltmarsh, dams, rice crops, sewage farms etc. (DEC 2005). Builds sparse ground nest, in shallow wetlands with areas of bare wet mud with shrubs and trees nearby. Breeding can occur year-round, and is often in response to local conditions; most often between August and February (DSEWPAC 2011b). Roosts during the day in dense vegetation (OEH 2011). Forages nocturnally on mud-flats and in shallow water on vegetation, seeds, insects, worms, molluscs, crustaceans and other invertebrates (DSEWPAC 2011b, Marchant &amp; Higgins 1993).</td>
<td>Unlikely</td>
</tr>
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</table>

**NOCTURNAL BIRDS**

<table>
<thead>
<tr>
<th>Scientific Name</th>
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<th>TSC ACT</th>
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<th>Likelihood of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ninox strenua</em></td>
<td>Powerful Owl</td>
<td>V</td>
<td>-</td>
<td>Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Debus &amp; Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding.</td>
<td>Potential</td>
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</tbody>
</table>

**MAMMALS (EXCLUDING BATS)**

<table>
<thead>
<tr>
<th>Scientific Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td><em>Dasyurus maculatus</em></td>
<td>Spotted-tailed Quoll</td>
<td>V</td>
<td>-</td>
<td>The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DEC 2005), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DEC 2005). Maternal den sites are logs with cryptic entrances, rock outcrops, burrows &amp; tree hollows (DSEWPAC 2011b).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Dasyurus maculatus</em></td>
<td>Spotted-tailed Quoll (SE Mainland Population)</td>
<td>V</td>
<td>-</td>
<td>-</td>
<td>E</td>
</tr>
<tr>
<td><em>Petaurus norfolcensis</em></td>
<td>Squirrel Glider</td>
<td>V</td>
<td>-</td>
<td>Associated with dry hardwood forest and woodlands (Menkhorst et al. 1988; Quin 1995). Habitats typically include gum barked and high nectar producing species, including winter flower species (Menkhorst et al. 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Petrogale penicillata</em></td>
<td>Brush-tailed Rock-wallaby</td>
<td>E</td>
<td>V</td>
<td>Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).</td>
<td>No</td>
</tr>
<tr>
<td><em>Phascolarctos cinereus</em></td>
<td>Koala</td>
<td>V-E2</td>
<td>-</td>
<td>Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. <em>Eucalyptus tereticornis</em> is one of the Koala’s preferred browsing species.</td>
<td>No</td>
</tr>
<tr>
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<tr>
<td><em>Potorous tridactylus</em></td>
<td>Long-nosed Potoroo</td>
<td>V</td>
<td>-</td>
<td>Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature (DEC 2005).</td>
<td>No</td>
</tr>
<tr>
<td><em>Potorous tridactylus</em></td>
<td>Long-nosed Potoroo (SE Mainland Population)</td>
<td>V</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pseudomys novaehollandiae</em></td>
<td>New Holland Mouse</td>
<td>-</td>
<td>V</td>
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<td>No</td>
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**MAMMALS (BATS)**

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td><em>Chalinolobus dwyeri</em></td>
<td>Large-eared Pied Bat</td>
<td>V</td>
<td>V</td>
<td>The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998, DEC 2005). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998, DEC 2005).</td>
<td>Potential</td>
</tr>
<tr>
<td><em>Falsistrellus tasmaniensis</em></td>
<td>Eastern False Pipistrelle</td>
<td>V</td>
<td>-</td>
<td>Prefers moist habitats with trees taller than 20m (DEC 2005). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DEC 2005).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Mormopterus norfolkensis</em></td>
<td>Eastern Fretail Bat</td>
<td>V</td>
<td>-</td>
<td>Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (DEC 2005, Allison &amp; Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (DEC 2005, Allison &amp; Hoye 1998).</td>
<td>Potential</td>
</tr>
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<tr>
<td>Myotis macropus</td>
<td>Southern Myotis, Large-footed Myotis</td>
<td>V</td>
<td>-</td>
<td>Rarely recorded more than 100 km inland, this species forages over streams and pools and utilises a range of habitats from small creeks to large lakes and mangrove lined estuaries. Generally roosts close to waterbodies in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (DEC 2006).</td>
<td></td>
</tr>
<tr>
<td>Scoteanax rueppelli</td>
<td>Greater Broad-nosed Bat</td>
<td>V</td>
<td>-</td>
<td>Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye &amp; Richards 1998). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye &amp; Richards 1998).</td>
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**INVERTEBRATES**

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<tr>
<th>Scientific Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Meridolum corneovirens</td>
<td>Cumberland (Large) Land Snail</td>
<td>E</td>
<td>-</td>
<td>Associated with open eucalypt forests, particularly Cumberland Plain Woodland described in Benson (1992). Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass (NPWS 1997; Rudman 1998). Urban waste may also form suitable habitat (NPWS 1997; Rudman 1998).</td>
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**MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT**

<table>
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<tr>
<th>Scientific Name</th>
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<tbody>
<tr>
<td>Haliaeetus leucogaster</td>
<td>White-bellied Sea-Eagle</td>
<td>-</td>
<td>M</td>
<td>Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant &amp; Higgins 1996, Simpson &amp; Day 2004). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant &amp; Higgins 1996).</td>
<td></td>
</tr>
<tr>
<td>Hirundapus caudacutus</td>
<td>White-throated Needletail</td>
<td>-</td>
<td>M</td>
<td>Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant &amp; Higgins 1999, Simpson &amp; Day 2004). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant &amp; Higgins 1999).</td>
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<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>TSC ACT</th>
<th>EPBC ACT</th>
<th>HABITAT ASSOCIATIONS</th>
<th>LIKELIHOOD OF OCCURRENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Merops ornatus</em></td>
<td>Rainbow Bee-eater</td>
<td>-</td>
<td>M</td>
<td>Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Knight 1997). Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (<em>ibid</em>). Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (<em>ibid</em>).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Monarcha melanopsis</em></td>
<td>Black-faced Monarch</td>
<td>-</td>
<td>M</td>
<td>Rainforest and eucalypt forests, feeding in tangled understorey (<em>Blakers et al. 1984</em>). May also be found in coastal scrub or damp gullies, and during migration, more open woodland habitats. Breeding migrant that arrives in coastal south-eastern Australia in September and returns north in March (<em>Birds in Backyards 2011</em>).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Myiagra cyanoleuca</em></td>
<td>Satin Flycatcher</td>
<td>-</td>
<td>M</td>
<td>Associated with eucalypt forests, often near wetlands or watercourses but absent from rainforests (<em>DSEWPAC 2011b, Blakers et al. 1984</em>); occurs in open forests, often at height (<em>Simpson &amp; Day 2004</em>). Breed above 600m asl during Nov-Jan, and migrate north for winter (<em>DSEWPAC 2011b</em>).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Rhipidura rufifrons</em></td>
<td>Rufous Fantail</td>
<td>-</td>
<td>M</td>
<td>The Rufous Fantail is a summer breeding migrant to southeastern Australia (<em>Morcombe 2004</em>). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (<em>Morcombe 2004</em>). Open country may be used by the Rufous Fantail during migration (<em>Morcombe 2004</em>).</td>
<td>Unlikely</td>
</tr>
<tr>
<td><em>Anthochaera Phrygia</em></td>
<td>Reagent Honeyeater</td>
<td>E</td>
<td>E</td>
<td>The Reagent Honeyeater has a number of fragmented breeding populations in NSW.</td>
<td>Potential</td>
</tr>
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**MIGRATORY WETLAND SPECIES LISTED UNDER EPBC ACT**

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<tbody>
<tr>
<td><em>Ardea alba</em></td>
<td>Great Egret</td>
<td>-</td>
<td>M</td>
<td>The Great Egret is common and widespread in Australia (<em>McKlligan 2005</em>). It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (<em>McKlligan 2005</em>).</td>
<td>Potential</td>
</tr>
<tr>
<td><em>Ardea ibis</em></td>
<td>Cattle Egret</td>
<td>-</td>
<td>M</td>
<td>Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (<em>McKlligan 2005</em>). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (<em>McKlligan 2005</em>).</td>
<td>Likely</td>
</tr>
<tr>
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<tr>
<td>Gallinago hardwickii</td>
<td>Latham’s Snipe</td>
<td>-</td>
<td>M</td>
<td>A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Higgins and Davies 1996). Occupies a variety of vegetation around wetlands (Higgins and Davies 1996) including wetland grasses and open wooded swamps (Simpson and Day 2004).</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Rostratula benghalensis</td>
<td>Painted Snipe</td>
<td>-</td>
<td>M</td>
<td>See: Rostratula australis</td>
<td>Unlikely</td>
</tr>
<tr>
<td>(a.k.a. R. australis)</td>
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