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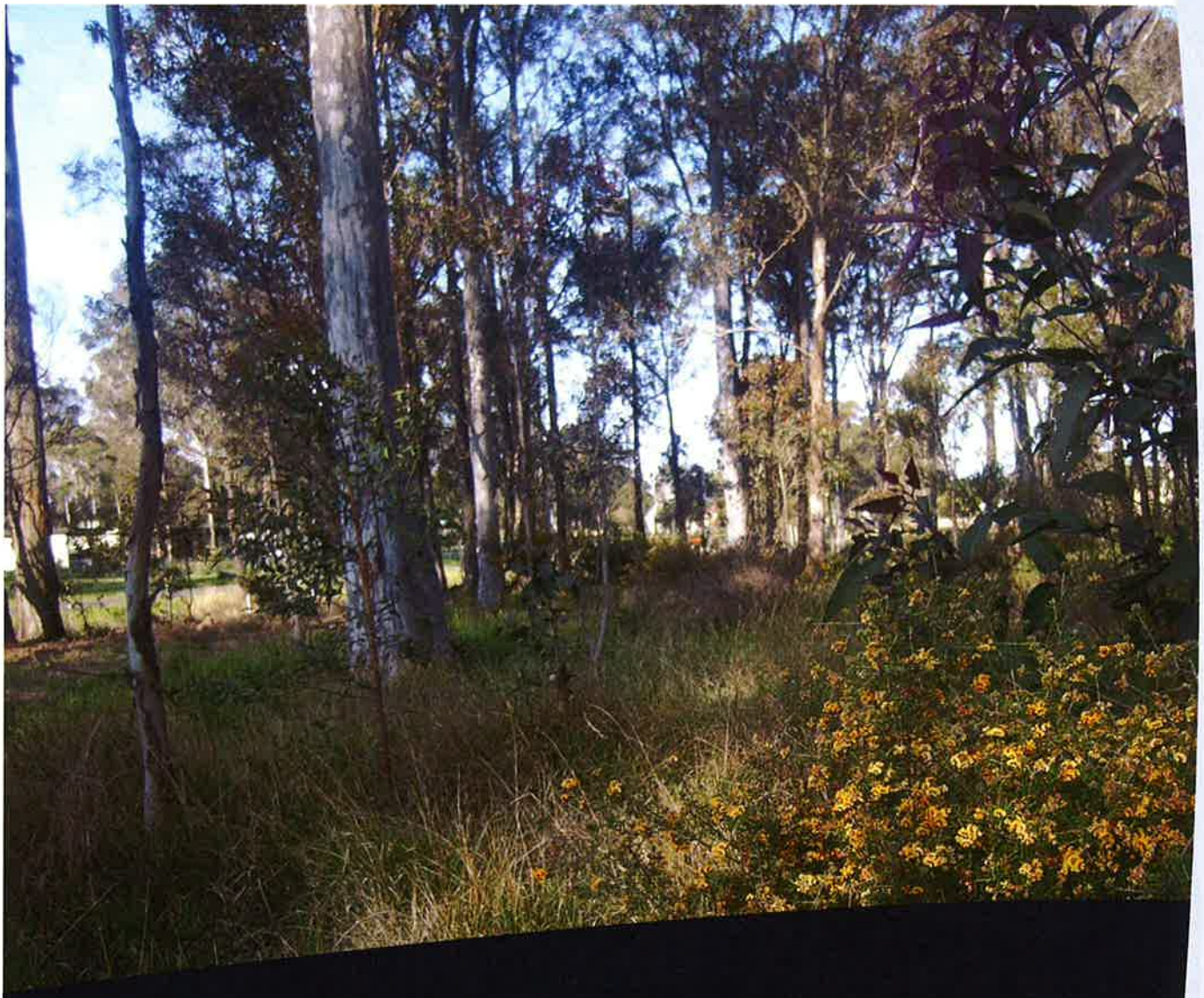

Austral-Leppington North Precinct

Biodiversity Conservation Assessment

600288/R2678v7

Prepared by Cardno for the Department of Planning

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Cover Photograph – Open eucalypt woodland within Austral Precinct (November 2010)

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Executive Summary

The precincts of Austral and Leppington North are currently subject to a planning process to inform the orderly development of the South West Growth Centre. As part of the establishment of the Sydney Growth Centres, Biodiversity Certification was conferred on lands within the Centres. This certification applies to a large proportion of the land within the Austral and Leppington North Precincts. The Biodiversity Certification provides a regional offset scheme to allow for the loss of native vegetation (in particular threatened species and communities) within "certified" land, without triggering further assessment requirements under the *Threatened Species Conservation* Act 1995.

The Ministerial order conferring the Biodiversity Certification included the provision of a series of requisite conditions ("Relevant Biodiversity Measures", RBMs (**Appendix A**)). The Biodiversity Certification can be suspended or revoked should the RBMs fail to be met. A key RBM relevant to the Austral and Leppington North Precincts is the permanent protection of 2000 hectares of existing native vegetation within the entire Growth Centres area (either within certified or non-certified areas).

The purpose of this Biodiversity Conservation Assessment is primarily to assess the existing condition and value of terrestrial and aquatic habitat within the Precincts, and to determine associated conservation values in order to provide planning and management recommendations for the Precinct Planning Process. In particular, to ensure that the Precinct Planning Process is consistent with the requirements issued under the Growth Centres State Environment Planning Policy (SEPP) Biodiversity Certification, and the Strategic Assessment undertaken for the Growth Centres under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The long history of anthropological disturbances in the area (primarily small scale agriculture), has resulted in the degradation of nearly all vegetative communities and riparian systems. The presence of weeds, isolation of vegetation patches and lack of significant diversity within the majority of sites has led to a generally low ecological value across the site. In support of this assessment, extensive fieldwork was undertaken in 2010 to allow comparison of vegetation present with existing National Parks and Wildlife Service mapping. During this fieldwork, all terrestrial vegetation on site was characterised in comparison to reference locations of known high quality vegetation.

In terms of terrestrial ecology, the current vegetation communities within the Precincts are composed of three Threatened Ecological Communities associated with the Cumberland Plain:

- Shale-Gravel Transitional Forest;
- Sydney Coastal River Flat Forest – Alluvial Woodland; and
- Cumberland Plain Woodland – Shale Plains Woodland (including both Shale hills and Shale Plains Woodland).

Only one threatened flora species (*Acacia pubescens*) and no threatened fauna species were observed during field surveys of these vegetation communities. The field surveys undertaken within the study site identified 96 flora species, including 57 native species and 39 exotic species. Opportunistic sightings identified 19 fauna species.

Two Hundred and Sixty individual vegetation communities within the Austral and Leppington North precincts were classified as being of High, Medium or Low Total Ecological Value. This assessment found 51% of vegetation (by area) to be high quality, 48% to be medium quality and 1% to be low quality. The majority of the High Quality and Medium Quality vegetation was found to lie within non-certified land. It is recommended that all vegetation having a high total ecological value and any vegetation within non-certified land should be zoned for environmental protection.

A comparison of the native vegetation on non-certified land mapped by Cardno in 2010 and 2012 (during the ground truthing survey) and the Existing Native Vegetation (ENV) mapping (DoPI, 2011) found that the ground truthing survey recorded 43.58ha more native vegetation, 19.13ha of which is currently on non-certified land, than is mapped under the conservation plan.

ENV is defined as areas of indigenous trees (including any sapling) that:

(a) Have 10% or greater over-storey canopy cover present;

(b) Are equal to or greater than 0.5 ha in area; and

(c) Are identified as "vegetation" on maps 4 and 5 of the draft Growth Centres Conservation Plan.

Although the additional 43.58ha of native vegetation mapped by Cardno meets criteria (a) and (b) above, the vegetation cannot be classed as ENV, since it does not also meet criteria (c). The additional 43.58ha of native vegetation identified by the Cardno survey has been termed "Additional High Conservation Value Vegetation (AHCVV)", and is not eligible to be counted toward the 2000 ha of ENV that is to be protected. However, it is recommended that these areas of vegetation be retained where possible.

Some vegetation which Cardno had previously reported as present in 2010 has since been cleared. Cardno undertook further ground truthing at a number of sites in May 2012 in response to submissions made during the exhibition period. This report has been updated to account for the vegetation that was found to be cleared.

The report has also been updated to consider approved vegetation clearance of 2.24ha of ENV (of which 0.52ha is in currently non-certified areas) for the construction of the South West Rail Link (SWRL). Although present at the time of the ground truthing work undertaken by Cardno, this vegetation has not been included in calculations of the amount of ENV in the precincts due to the expectation that it will be cleared in the near future.

The conditions of Biodiversity Certification Order require that a total of 107.14ha of ENV be protected. This comprises:

- 48ha of ENV be protected in Austral;
- 52ha in Leppington North; and
- 7.14ha in investigation areas (details of investigations areas can be found in **Section 1.1**).

The SWRL development would offset the amount of non-certified ENV that would be impacted, and therefore, the amount of ENV within the Precincts that requires protection under the Biodiversity Certification Order has been reduced by 0.52ha. This results in a revised total of 106.62ha of ENV requiring protection under the Biodiversity Certification Order.

Ground truthing indicates that the actual area of ENV in non-certified lands is approximately 101.58ha, of which, 0.52ha of ENV on non-certified land is known to be impacted by the approved South West Rail Link (SWRL).

Any development of land within the area of the non-certified ENV communities would be required to comply with the relevant provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Threatened Species Conservation Act 1995* (TSC Act).

The 2012 Indicative Layout Plan for the Austral and Leppington North Precinct (herein referred to as the ILP and shown in Annex B of **Appendix M**), proposes the protection of approximately 116.62ha of ENV within both Precincts. This is 10.00ha more than is required to be protected by the Biodiversity Certification Order (Annex C in **Appendix M**). To achieve this it is proposed that the boundaries of the non-certified areas are changed (refer to Annex E in **Appendix M**), mostly based on the 1:100 year floodline, and to ensure that vegetation to be protected outside floodprone land is also on non-certified land.

Table 1.1 presents the results of the Biodiversity Conservation Assessment.

Table 1.1: Key statistics of the Biodiversity Conservation Assessment.

	Key Statistics	Data source / comment	Area of ENV (ha)
A	ENV required by the Biodiversity Certification Order to be protected within Austral and Leppington North Precincts and investigation areas prior to the impact from the SWRL	48ha in Austral, 52ha in Leppington North, and 7.14ha in Investigation Areas	107.14ha
B	Approved Impacts on ENV by SWRL in non-certified areas	Calculated from Cardno's ground truthed ENV as per Figure 4.4 and maps provided	0.52ha
C	ENV required by the Biodiversity Certification to be protected within Austral and Leppington North Precincts and investigation areas	Requirement of Biodiversity Conservation Order =A-B	106.62ha
D	Total ENV protected within Austral and Leppington North precincts under the Proposed Non-Certified land boundaries	Calculated from Cardno's ground truthed ENV as per Figure 4.4 and Proposed Non-certified Area in (Appendix M Annex E)	116.62ha
E	**Total ENV to be protected beyond the Biodiversity Certification Order requirement**	**=D-C**	**10.00ha**

Consideration should be given to the potential to utilise the quantity of ENV identified on site as offset areas for removal of ENV elsewhere within the Sydney Growth Centres area in accordance with the issued Biodiversity Certification and RBMs.

In terms of aquatic habitat, the creek systems present on site were seen to be typically highly disturbed and in poor condition. Only eight native fish species (three of which are pest species) were observed within the creek systems, reflecting the observed poor water quality and the presence of minor algal blooms at some locations. The riparian banks were typically observed to be degraded and eroding, while the in-stream habitat was found to typically lack complex structure or habitat.

While largely degraded, both the terrestrial and aquatic habitats are considered to represent a significant opportunity for rehabilitation. In particular the importance of riparian corridors and associated vegetation is recognised. The riparian corridors contain much of the higher quality vegetation and act as the primary wildlife corridors within the Precincts.

It is recommended that a management plan be established for all areas of vegetation to be retained. In particular, land uses surrounding non-certified areas will need to be carefully managed in order to avoid negatively affecting the ecological integrity of the protected areas.

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Glossary

AHCVV	Additional High Value Conservation Value Vegetation
Aesthetic Quality	A perception of the beauty of a natural or cultural landscape.
Air Quality	Measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.
AHD	Australian Height Datum
Amenity	Those features of an area that foster its use for various purposes.
Best Management Practice	A practice or combination of practices determined by an agency to be the most effective and practical means (technological, economic, and institutional) of controlling point and non point source pollutants at levels compatible with environmental quality.
Biodiversity	The range of organisms present in a given ecological community or system, which can be measured by the numbers and types of different species, or the genetic variations within and among species.
Biodiversity Corridor	A river corridor or wildlife corridor identified in the Spatial Plan, Territory Plan or in a nature conservation strategy, or action plan under the *Nature Conservation Act 1980*.
Buffer	A vegetation strip or management zone of varying size, shape, and character maintained along a stream, lake, road, recreation site, or different vegetation zone to mitigate the impacts of actions on adjacent lands, to enhance aesthetic values, or as best practice management.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Certified Area/Land	An area marked as certified on a biodiversity certification map. If land is identified as 'Certified' in the Biodiversity Certification Order, it will not need to go through any further threatened species assessments for development proposals.
Critical Habitat	Habitats of threatened or endangered species as designated by the EPBC Act.

Critically Endangered Ecological Community	An ecological community facing an extremely high risk (50%) of extinction in the wild in the immediate future (EPBC Act) An ecological community facing an extremely high risk of extinction in New South Wales in the immediate future as determined by the Scientific Committee (TSC Act)
DA	Development Application
DCP	Development Control Plan
Development	The erection of a building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land.
DSEWPAC	Department of Sustainability, Environment, Water Population and Communities
Domestic Water Supply Catchment	A domestic water supply catchment identified in the Territory Plan.
EA	Environmental Assessment
EIA	Environmental Impact Assessment
Ecosystem	The complex of a community of organisms and its environment functioning as an ecological unit.
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
Endangered ecological community	An ecological community facing a very high risk (20%) of extinction in the wild in the near future (EPBC Act) An ecological community that is facing a very high risk of extinction in New South Wales in the near future as determined by the Scientific Committee (TSC Act)
Endangered species	A species facing likely extinction unless the circumstances and factors threatening its abundance, survival or evolution cease, or where the reduction of its numbers of habitats to such a level that the species is in immediate danger of extinction.
Environmental Management Plan	A document setting out the management, control and monitoring measures to be implemented during construction and/or operation of a development, to avoid or minimise the potential environmental impacts identified during an environmental impact

	assessment process.
ENV	"Existing Native Vegetation" means areas of indigenous trees (including any sapling) 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*
EPA	Environment Protection Authority (ACT)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESCP	Erosion and Sediment Control Plan
Exotic	An ecological term that describes the introduction of a species from another place or region.
Fauna	The wildlife or animals of a specified region or time.
Flora	Plant life, especially all the plants found in a particular country, region, or time regarded as a group. Also, a systematic set of descriptions of all the plants of a particular place or time.
GIS	Geographical Information Systems
FM Act	Fisheries Management Act 1994
Growth Centres SEPP	A State Environmental Planning Policy certified by the NSW State Government defining the legislative requirements in regards to planning and development of areas within the Sydney Growth Centres defined boundaries.
Habitat	The places in which an organism lives and grows.
Impact	A modification in the status of the environment brought about by a proposed action.
Investigation Areas	Investigation areas adjoin the Austral and Leppington North Precincts. Approximately 100 hectares of land (bordered by Bringelly Road, Camden Valley Way and Cowpasture Road, and land between Camden Valley Way and Edmondson Park) was formerly part of the Western Sydney Parklands but has since been excised from the Parklands. This land retains a rural zoning

	under Liverpool LEP. A second area comprises 4.5 hectares of residual land north of Ninth Avenue, Austral.
LEP	Local Environmental Plan
LGA	Local Government Plan
Mitigate	To alleviate, reduce, or render less intense or severe. Mitigation Action taken to avoid, reduce the severity of, or eliminate and adverse impact.
NES	Matters of National Environmental Significance
Non-Certified Area/Land	An area marked as a non-certified area on a biodiversity certification map.
NPWS	National Parks and Wildlife Service
NSW	New South Wales
Protected	A species is protected if the species is a protected fish, protected invertebrate, protected native animal or protected native plant under the *Nature Conservation Act 1980*.
RBM	Relevant Biodiversity Measure
Region	A large tract of land generally recognised as having similar character types and physiographic types.
SEPP	State Environmental Planning Policy
Threatened Ecological Community	Endangered, critically endangered or vulnerable ecological community listed in the TSC Act and/or EPBC Act
Threatened species	Rare, vulnerable or endangered species.
Threatening process	In relation to a species or ecological community, means a process that threatens, or may threaten the survival, abundance or evolution of the species or community and includes the spreading of a pest animal or pest plant.
Topography	A surface which defines the ground level of a chosen area.
Tributary	Catchment, stream or river which flows into a larger river, lake or water body.

Vegetation community	Species of plants that commonly live together in the same region or ecotone.
Vulnerable Ecological Community	An ecological community facing a high risk (10%) of extinction in the wild in the medium-term future (EPBC Act) An ecological community facing a high risk of extinction in New South Wales in the medium-term future as determined in accordance with criteria prescribed by the regulations (TSC Act)
Vulnerable	In relation to a species, means a species that within the next 25 years is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolution cease.
Vulnerable species	Species likely to become endangered within the foreseeable future throughout all or a significant part of its range.

1 Introduction

Cardno was engaged by the NSW Department of Planning (DoP) to undertake a Biodiversity Conservation Assessment within the Austral and Leppington North Precincts (ALNP) which form part of Sydney's South West Growth Centre. The assessment was conducted for both Terrestrial and Aquatic habitat within the area and with reference to the Growth Centres SEPP and issued Biodiversity Certification conditions.

1.1 Background – Growth Centres and Precinct Planning

In 2005 the NSW Government identified two regions, one in Sydney's northwest and one in Sydney's southwest, of largely undeveloped land as the potential location for development of new communities. Combined these two growth areas are capable of accommodating 500,000 people and have been named the North West Growth Centre and the South West Growth Centre respectively. Each growth centre is divided up into a number of Precincts that will drive the staged development of each Growth Centre.

In order to prioritise and facilitate the development of the Precincts within the Growth Centres the NSW Government passed *State Environmental Planning Policy (Sydney Region Growth Centres)* 2006 (referred to as 'Growth Centres SEPP'). The Growth Centres SEPP primarily expedites the Precinct planning and rezoning processes that most developments are required to undergo in accordance with the *Environmental Planning and Assessment Act 1979 (EP&A Act)*. The Growth Centres SEPP establishes the planning rules and objectives for the Growth Centres.

In November 2010 the Commonwealth Environment Minister endorsed the NSW Government's Sydney Growth Centres Strategic Assessment Program. Through the Strategic Assessment, the Commonwealth Government has worked with partners such as the NSW and local governments to ensure that nationally protected matters are adequately safeguard for the long term through the implementation of a policy, plan or program.

Nationally protected matters which are protected through this process include:

- World heritage properties;
- National heritage places;
- Wetlands of international importance;
- Listed threatened species and ecological communities;
- Migratory species protected under international agreements;
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park;
- Nuclear actions (including uranium mines).

The completion of the strategic assessment and issuing of approvals means that individual proponents will not have to seek approval under the EPBC Act from the Commonwealth

Government, as long as they undertake their projects in accordance with the endorsed policy, plan or program.

Each Precinct is required to undergo a Precinct Planning Process, which brings together State government agencies and local councils to coordinate the provision of infrastructure and social services within each of the Precincts. Integral to this stage is the assessment of appropriate land use options within each of the Precincts (e.g. key transport routes, residential housing, commercial areas, and biodiversity conservation). As such, the Precinct Planning Process involves detailed investigations into environmental constraints which will help determine the development potential within any area. The need to conserve and enhance biodiversity and existing environmental values is a stated aim of the Growth Centres SEPP. The Precinct Planning Process is integral to the control and management of development to ensure these aims are met. This Biodiversity Conservation Assessment assesses the terrestrial and aquatic ecological constraints within the Austral and Leppington North Precincts.

By identifying and planning around constraints at a Precinct level, the need for further assessments at the Development Application (DA) stage is significantly reduced It should be noted, that in terms of ecological studies, the Precinct Planning Process removes the requirement for assessment of potential threatened species impacts at the DA stage in certified lands.

Ultimately the environmental constraints identified within a Precinct are combined to prepare an Indicative Layout Plan, which is placed on public exhibition along with supporting documents (the Precinct Planning Package). Following receipt of submissions, the Minister for Planning may approve the Precinct Planning Package, rezoning the land within the Precinct. Following rezoning, Development Applications may then be lodged.

This Biodiversity Conservation Assessment has been undertaken as part of the Precinct Planning Process for the Austral and Leppington North Precincts, within the South West Growth Centre. The Austral Precinct has an area of approximately 930 hectares and is expected to accommodate around 8,000 dwellings and 22,000 residents. The Leppington North Precinct (located immediately south of Austral Precinct) has an area of approximately 1100 ha and is expected to accommodate around 12,000 dwellings and 30,000 residents. The location of these two Precincts is illustrated in **Figure 1.1**.[1]

[1] In August 2010, the NSW Department of Planning updated the boundary of Leppington North to include a small northern section of the Leppington Precinct. See **Figure 1.2** for new boundary lines.

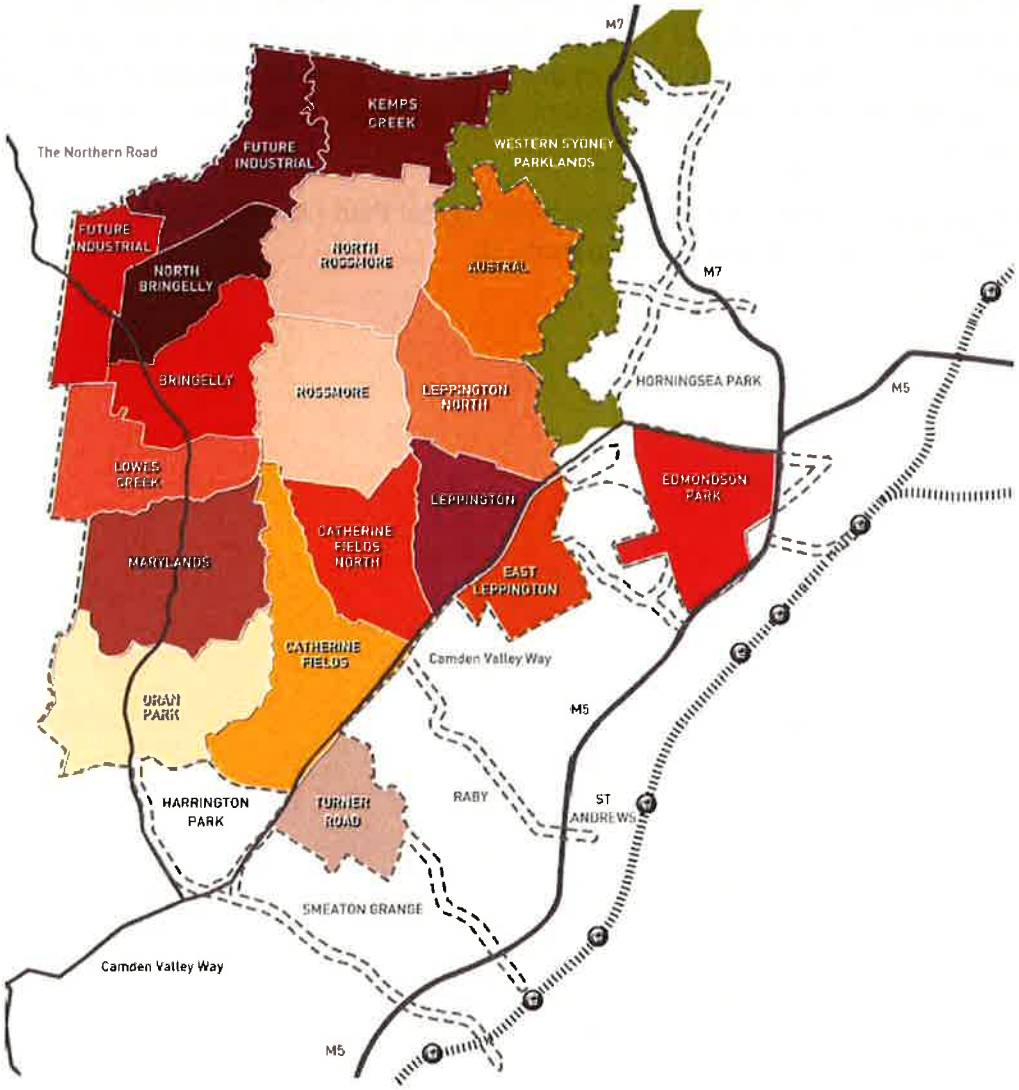

Figure 1.1 Location of Southwest Growth Centre (NSW DoP, 2010)

The Precinct Boundary Review Process (PBRP) is a publicly transparent process to consider changes to Precinct boundaries in the North West and South West Growth Centres. The review process concluded that the boundary of the Leppington North Precinct should be extended south to Ingleburn Road. Based on this finding, the Minister for Planning, in August 2010, approved a partial release of land in the Leppington Precinct north of Ingleburn Road. The Precinct Plan will apply to this land in addition to land within the Austral and Leppington North Precincts as originally defined.

The Boundary Review process also identified two investigation areas, located within the South West Growth Centre but not in a Precinct. These two investigation areas adjoin the Austral and Leppington North Precincts. Approximately 100 hectares of land (bordered by Bringelly Road, Camden Valley Way and Cowpasture Road, and land between Camden Valley Way and Edmondson Park) was formerly part of the Western Sydney Parklands but has since been excised from the Parklands. This land retains a rural zoning under Liverpool

LEP. The second area comprises 4.5 hectares of residual land north of Ninth Avenue, Austral. Both have been investigated as part of the Precinct Planning process and the draft Precinct Plans include proposed planning controls for these investigation areas. When Precinct Planning is finalised the Precinct boundaries are to be formally amended to include these investigation areas in the Precincts, and therefore, have been included in this assessment.

This assessment is based on the final Indicative Layout Plan (June 2012) (herein referred to as the ILP and shown in Annex B of **Appendix M**).

1.2 Background – Biodiversity Certification and Strategic Assessment

The NSW Government amended the *Threatened Species Conservation Act 1995* (TSC Act) to incorporate 'Biodiversity Certification'. Biodiversity Certification allows for the Minister for Environment to certify that the application of an Environmental Planning Instrument (EPI) (e.g. a Local Environmental Plan or State Environmental Planning Policy) will lead to an overall maintenance or improvement in biodiversity values on land to which that EPI applies. By certifying that the Minister is satisfied that biodiversity values will be maintained or improved, Biodiversity Certification consequently dictates that any development of certified land will not significantly impact threatened species or communities. As such, certification removes the need for any development applications under the relevant EPI to address threatened species considerations (e.g. assessment of significance or species impacts statements under the EP&A or TSC Act).

Following submission of a Growth Centres Conservation Plan detailing how development of the Growth Centres could improve or maintain biodiversity values (Eco Logical, 2007), Biodiversity Certification was conferred upon the Growth Centres SEPP under Section 126G of the TSC Act in December 2007.

It should be noted that the Growth Centres Conservation Plan (upon which certification was granted) did not apply for certification across all growth centre lands, but only those considered potentially developable. As such the Biodiversity Certification does not apply to a range of lands within the Growth Centres, including:

- Lands identified in the SEPP as environment conservation (including flood-prone lands and transitional lands) or public recreation zonings;
- Lands identified as offsets to the Western Sydney Orbital (Colebee, Kemps Creek and Rouse Hill);
- Lands zoned for regional park or environmentally significant land overlay at Edmondson Park; or
- Lands within the Western Sydney Parklands.

Any development within these lands within the Growth Centres would be required to comply with the TSC Act and the relevant provisions of the EP&A Act. The areas within the Austral and Leppington North Precincts to which the Biodiversity Certification does not apply are shown in **Figure 1.2**. The majority of non-certified lands within the Austral and Leppington North Precincts are associated with flood-prone lands or land that was formerly intended to be within the Western Sydney Parklands. The Growth Centres SEPP requires Council approval for the removal of any native vegetation from properties within the flood-prone lands.

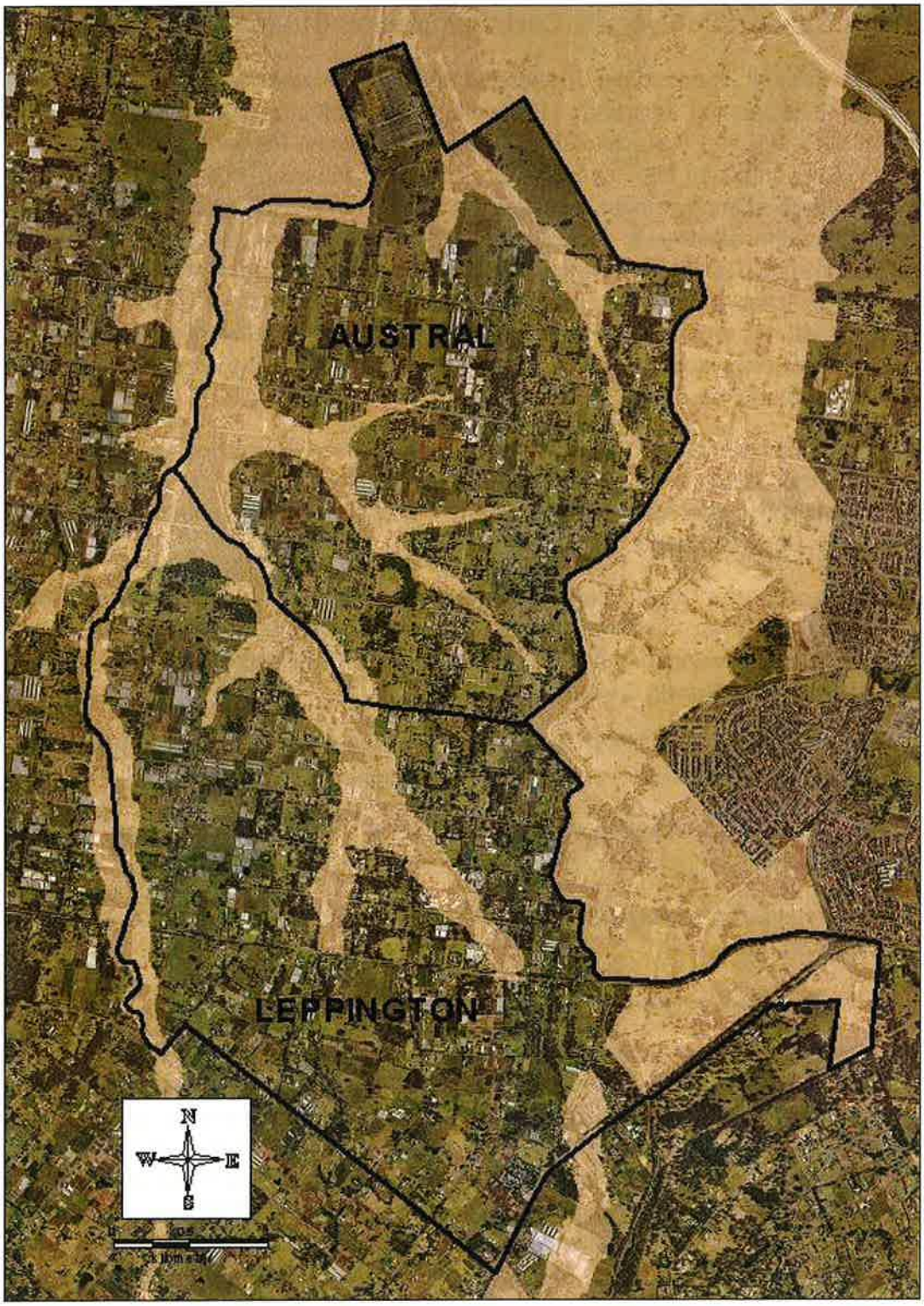

Figure 1.2 Non-Certified areas of Austral and Leppington North Precincts

The Ministerial order conferring the Biodiversity Certification included the provision of a series of requisite conditions ("Relevant Biodiversity Measures", RBMs (**Appendix A**)). The Biodiversity Certification can be suspended or revoked should the RBMs fail to be met. Key RBMs relevant to the Austral and Leppington North Precincts include:

- The permanent protection of 2000 hectares of existing native vegetation within the Growth Centres (either within certified or non-certified areas).
- The establishment by the NSW Government of a $530 million conservation fund to protect areas of biodiversity value (derived in part from infrastructure contributions) generated within the Growth Centres. Part of these funds is to go towards purchase of areas of high conservation value within and outside the Growth Centres to offset any negative impacts.
- Clearing of existing native vegetation in non-certified areas during Precinct Planning or Development may be permissible (subject to other approvals), however any such clearance must also demonstrate how the loss of vegetation will be offset either by protection of an equal or greater area of existing native vegetation, or rehabilitation/restoration of an approved area.
- Ground-truthing during the Precinct Planning Process can verify the occurrence of existing native vegetation within the precinct. The RBMs relating to existing native vegetation will relate only to the area of confirmed existing native vegetation.
- A survey for the presence of *Acacia pubescens* in the area adjacent to Thirty-Second Avenue, Austral (outside the precincts).
- If *Acacia pubescens* is present, the Precinct Planning Process shall incorporate suitable habitat protection of this species.

The final two points above were addressed in a separate report prepared by Cardno in 2011.

1.3 Aims and Objectives

This Biodiversity Conservation Assessment has two broad aims:

- To assess the existing condition and value of terrestrial and aquatic habitat on site and to determine associated conservation values in order to provide planning and management recommendations to assist DoP during its Precinct Planning Process and formation of the Indicative Layout Plan; and
- To ensure Precinct Planning and formation of the Indicative Layout Plan is consistent with statutory requirements, in particular the RBMs issued under the Growth Centres SEPP Biodiversity Certification, and the Growth Centres Conservation Plan.

1.4 Document Structure

This report is structured to demonstrate the achievement of these aims, and to provide practical recommendations which can be incorporated into the Precinct Planning Process. As such the report is comprised of the following sections:

- **Section 1**: Introduction – a brief overview of the context to the Biodiversity Conservation Assessment and its purpose.

- **Section 2**: Study site – a description of the key environmental factors within the Austral and Leppington North Precincts including a summary of known ecological issues within the area.
- **Section 3**: Legislative Context – a summary of the relevant statutory requirements for ecological planning within the Precincts.
- **Section 4 and 5**: Methodology - the methodology adopted to assess ecological and conservation values for both terrestrial and aquatic ecosystems.
- **Sections 6 and 7**: Results – a description of the results of the assessment for both terrestrial and aquatic ecosystems.
- **Section 8**: Discussion – a discussion of the results and provision of recommendations in terms of ecological constraints and values which can be incorporated within the Indicative Layout Plan, whilst ensuring consistency with all statutory requirements.
- **Section 9**: References – a list of reference documents used in preparing this report.
- **Appendices A – Q**: these appendices provide information supporting this assessment.

For the purpose of this Biodiversity Conservation Assessment, the Austral and Leppington North Precincts have been considered as one unit of assessment. Recommendations are provided assuming that the rezoning of these precincts is undertaken collectively.

2 Study Site

2.1 Location and Site Descriptions

The precincts of Austral and Leppington North (**Figure 1.1**) (the "site") are located in the south west of Sydney within the Cumberland Plain. Both precincts are typified by rural residential housing with small scale agriculture (predominantly vegetable crops and poultry farms). A small number of light industrial and commercial areas occur within each precinct. Aerial imagery indicates that approximately 85% of the land area encompassed by Austral and Leppington North has been cleared of native vegetation to permit development.

Kemps Creek flows north along the western boundary of both Austral and North Leppington (**Figure 2.1**). Kemps Creek is a fourth order stream and is fed by a number of tributaries including Bonds Creek and Scalabrini Creek. The precincts are bordered to the east by the Sydney Water Supply Canal and to the north by the Kemps Creek Nature Reserve (**Figure 2.1**) and Western Sydney Parklands. The precincts are bordered by a Transgrid Electricity Substation to the north and the southern border runs along Ingleburn Road.

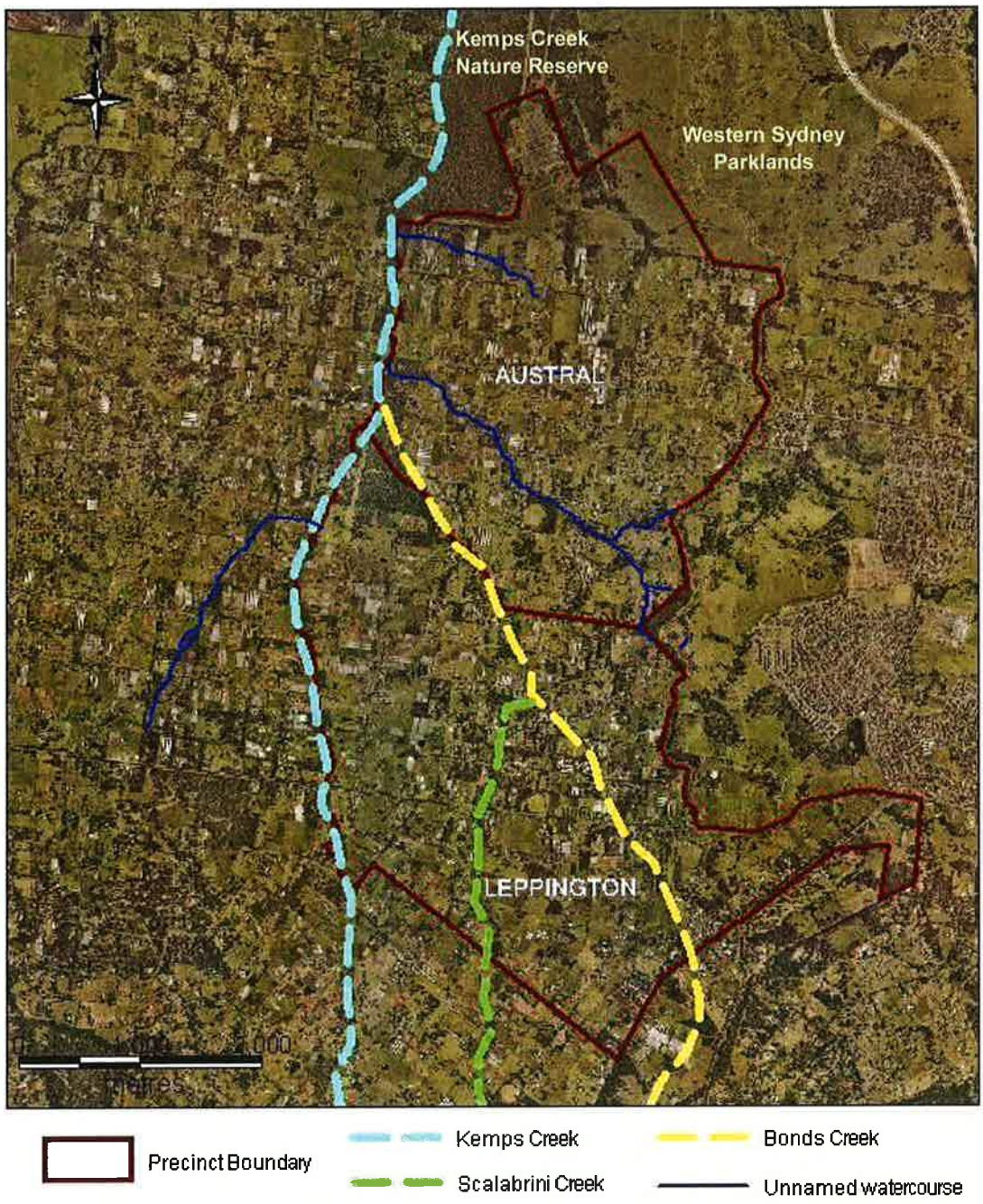

Figure 2.1 Study Area showing Kemps Creek and major adjoining tributaries

The Austral Precinct covers an area of 932.5 ha while the Leppington North Precinct covers an area of 1096 ha. The topography of the site is typically quite flat, composed of rolling plains, with an overall decline to the north east. The site has a maximum and minimum height of 100 m and 50 m AHD respectively. No significant hills or ridge terrain are located within the study site. Inspection of the Penrith Soil Landscape Series Sheet (1:100,000) (Hazelton *et al.* 1989) indicates the site to be primarily underlain by the Blacktown Soil Landscape Group; shallow to moderately deep red and brown podzolic soils over Wianamatta Group shales. Such soils are typically of low fertility, poor drainage, and are frequently vegetated with tall open-forest dry sclerophyll eucalypt woodland. The soils surrounding the creek lines within the site are composed of soils from the South Creek Soil

Landscape Group; typically deep layered sediments over bedrock. Such soils have a significant erosion hazard.

On the eastern boundary of the study site, the soils landscape shifts to the Luddenham Soil Landscape Group, reflecting the increase in elevation and number of hills and ridges. Luddenham Soils are typically associated with wet sclerophyll forest.

2.2 Existing Ecological Surveys

A number of ecological studies have been conducted within and in close proximity to Austral and Leppington North. Most significantly these include:

- Parsons Brinckerhoff (2010) South West Rail Link Environmental Assessment Biodiversity Technical Paper. Prepared for TIDC.
- Cumberland Ecology (2010) Ecological Assessment – Part 3A Project: Water Related Service for the Northwest and Southwest Growth Centres. Currently being prepared for Sydney Water Corporation.

Both these studies undertook extensive field survey within and around the Austral and Leppington North Precincts and were utilised as points of comparison within this assessment.

In addition to these studies a number of related biodiversity studies and biodiversity plans exist and relate to the Precincts including:

- Growth Centres Conservation Plan, Exhibition Draft (Eco Logical Australia, 2007).
- Western Sydney Growth Centres: An assessment of the proposal to confer biodiversity certification on State Environmental Planning Policy (Sydney Region Growth Centres) 2006 under section 126G of the Threatened Species Conservation Act 1995 (Department of Environment and Climate Change 2007).
- Order to confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Minister for Climate Change Environment and Water 2007).
- Liverpool City Council Biodiversity Strategy (Eco Logical, 2003).
- NPWS (2002) Native Vegetation of the Cumberland Plain.

2.2.1 Bioregion

Bioregions and associated subregions are the reporting units utilised in assessing the status of native ecosystems and their protection under the National Reserve System (the network of protected native ecosystems across Australia). The Austral and Leppington North Precincts fall with the Sydney Basin bioregion (Cumberland subregion). The Sydney Basin bioregion has one of the highest levels of protected areas (comprising nearly 40% of the region area (Parsons Brinckerhoff, 2010)) across Australia.

No areas managed by the Department of Environment, Climate Change and Water (i.e. protected areas within the Sydney Basin bioregion) occur within the Precincts of Austral and Leppington North. However, immediately to the north west of the site is the Kemps Creek

Nature Reserve while to the northeast and east are the lands maintained by the Western Sydney Parklands Trust.

2.2.2 Mitchell Landscape

The Mitchell Landscape mapping is a system of ecosystem classification based on variation in geology, geomorphology, topography, soils and geodiversity across NSW. According to DECCW, Mitchell Landscape mapping (DECC, 2003), both the Austral and Leppington North Precincts are classified as Cumberland Plain (**Section 2.2.3**). This landscape occurs solely within the bounds of the Hawkesbury Nepean Catchment Management Authority.

2.2.3 Cumberland Plain

Cumberland Plain is characterised by the presence of low rolling hills and valleys within the rain shadow area between the Blue Mountains and the east coast of Australia. The geology of this area consists primarily of horizontal Triassic shales and lithic sandstones, with the occasional occurrence of volcanic vents, and partly covered by Tertiary river gravels and sands of the Hawkesbury-Nepean Terrace Gravels landscape. The watercourses within this landscape are typically bounded by Quaternary alluvium (DECCW, 2009).

Typical flora communities and species occurring within the Cumberland Plain include woodlands and open forest characterised by:

- Grey box (*Eucalyptus moluccana*);
- Forest red gum (*Eucalyptus tereticornis*);
- Narrow-leaved ironbark (*Eucalyptus crebra*);
- Thin-leaved stringybark (*Eucalyptus eugenioides*);
- Cabbage gum (*Eucalyptus amplifolia*);
- Broad-leaved apple (*Angophora subvelutina*);
- Australian boxthorn (*Bursaria spinosa*);
- Swamp oak (*Casuarina glauca*); and
- Paperbarks (*Melaleuca spp.*).

The DECCW (2008) Vegetation Types Database estimates that 89% of the native Cumberland Plain landscape has been cleared. This is a significant level of clearance and highlights the need for conservation management of the remaining vegetation communities in the landscape. It should be noted that typically under the *NSW Native Vegetation Act 2003*, landscapes that are more than 70% cleared are considered to be "overcleared" and further clearance is not allowed except when the vegetation is assessed as being in low condition.

The Cumberland Plain landscape is considered to be composed of 18 distinct community types (**Table 2.1**). As a result of historic clearing and associated land management practices, a number of these communities have been listed as threatened under either the *NSW Threatened Species Conservation Act 1995 (TSC Act)* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

It should be noted that the *TSC Act* and *EPBC Act* maintain differing definitions in regards to the qualification of a vegetation community as threatened (i.e. a community may be considered to represent a threatened EEC under the *TSC Act* but not under the *EPBC Act* due to the condition and composition of the vegetation patch).

Table 2.1 Cumberland Plain landscape community types and their current conservation status (NPWS, 2002)

Vegetation Community	Conservation Status
Agnes Banks Woodland	Endangered Ecological Community (TSC Act)
Blue Gum High Forest	Critically Endangered Ecological Community (TSC Act, EPBC Act)
Castlereagh Swamp Woodland	Endangered Ecological Community (TSC Act)
Castlereagh Scribbly Gum Woodland	Vulnerable Ecological Community (TSC Act)
Cooks River / Castlereagh Ironbark Forest	Endangered Ecological Community (TSC Act)
Cumberland Plain Woodland – Shale Hills Woodland	Critically Endangered Ecological Community (EPBC Act, TSC Act)
Cumberland Plain Woodland – Shale Plains Woodland	Critically Endangered Ecological Community (EPBC Act, TSC Act))
Elderslie Banksia Scrub Forest	Endangered Ecological Community (TSC Act)
Freshwater Wetlands	Endangered Ecological Community (TSC Act)
Moist Shale Woodland	Endangered Ecological Community (TSC Act)
Shale-Gravel Transition Forest	Critically Endangered Ecological Community (EPBC Act) Endangered Ecological Community (TSC Act)
Shale-Sandstone Transition Forest – Low Sandstone Influence	Endangered Ecological Community (TSC Act and EPBC Act)
Shale-Sandstone Transition Forest – High Sandstone Influence	Endangered Ecological Community (TSC Act and EPBC Act)
Sydney Coastal River Flat Forest – Riparian Forest	Endangered Ecological Community (TSC Act)
Sydney Coastal River Flat Forest – Alluvial Woodland	Endangered Ecological Community (TSC Act)
Sydney Turpentine Ironbark Forest	Endangered Ecological Community (TSC Act) Critically Endangered Ecological Community (EPBC Act)
Sydney Turpentine Ironbark Forest – Margin Forest	Endangered Ecological Community (TSC Act) Critically Endangered Ecological Community (EPBC Act)
Western Sydney Dry Rainforest	Endangered Ecological Community (TSC Act)

Clearing within the Austral and Leppington North Precincts has been primarily driven through agricultural development (since the 1800s) and more recently industrial and residential development. The Cumberland Plain vegetation communities that have been identified within Austral – Leppington North are discussed in **Section 2.2.5**.

2.2.4 Local Connectivity

Connectivity reflects the degree to which an area (or areas) of native vegetation is linked to other areas of vegetation (DECCW, 2009). Typically, within urban areas, connectivity is established/maintained through the presence of wildlife corridors; linear habitat areas of sufficient width and condition to facilitate migration of species and individuals. The Austral – Leppington North Precincts are not known to contain any formalised regional habitat corridors. However, at a local level the riparian habitats and associated alluvial woodlands along Kemps Creek are considered to play an important role in local connectivity, particularly for more mobile species. In particular, the riparian corridors connect up with the Kemps Creek Nature Reserve to the north of the Austral Precinct (**Figure 2.1**). This reserve and its surrounds have been marked within the Growth Centres Conservation Plan (Eco Logical, 2007) as Higher Long Term Management Viability and as such are areas to be retained and protected.

Parsons Brinckerhoff (2010) note that within the Cumberland Plain, the presence of remnant trees in agricultural paddocks can also be important in terms of fauna conservation by providing stepping-stone habitats for highly mobile fauna species. However, within the Austral – Leppington North Precincts there are few clearly defined non-riparian wildlife corridors between larger areas of wildlife habitat.

2.2.5 Local Vegetation Communities

The NPWS (2002) mapping survey identified the potential presence of four vegetation community types within the Austral – Leppington North Precincts (**Figure 2.2**). These include:

Cumberland Plain Woodland - Shale Plains Woodland: Shale Plains Woodland is the more common form of Cumberland Plain Woodland. Occurring on the gently undulating Wianamatta Shale plains of the Cumberland Plain, Shale Plain Woodlands are typified by the presence of Grey box (*E.moluccana*), Forest red gum (*E.tereticornis*), Spotted gum (*Corymbia maculata*) and Thin-leaved stringybark (*E.eugenioides*) in the overstorey. The shrub layer is typically dominated by *Bursaria spinosa* and the understorey is generally associated with grasses (e.g. *Themeda australis*, *Microlaena stipoides* var *stipoides*) and herbs (e.g. *Dichondra repens*, *Brunonniella australis*, *Desmodium varians*).

Cumberland Plain Woodland - Shale Hills Woodland: The Shale Hills Woodland is similar to the Shale Plains Woodland, particularly in terms of its understorey layer. The key difference between the two lies in the tendency for Shale Hills Woodland to be located upon elevated and sloping terrain, as opposed to the flat undulating terrain occupied by Shale Plains Woodland. The canopy layer also differs between the two with Shale Hills Woodland being typified by additional presence of the Narrow-leaved ironbark (*E. crebra*).

Sydney Coastal River Flat Forest – Alluvial Woodland: This community is typically located along minor watercourses and terraces adjacent to riparian forests. While comprised of many species found within Cumberland Plain Woodland, Alluvial Woodland is

characterised by the presence of Cabbage gum (*E. amplifolia*), Forest red gum (*E. tereticornis*) and Swamp oak (*Casuarina glauca*).

Shale-Gravel Transitional Forest: This transitional forest typically grades into Cumberland Plain woodland communities as gravel content decreases. The canopy of Shale-Gravel Transitional Forest is dominated by the Broad-leaved ironbark (*E.fibrosa*) and associated with the presence of Grey box (*E.moluccana*) and Forest red gum (*E.tereticornis*). Below the canopy layer paperbarks (*Melaleuca decora*) are common.

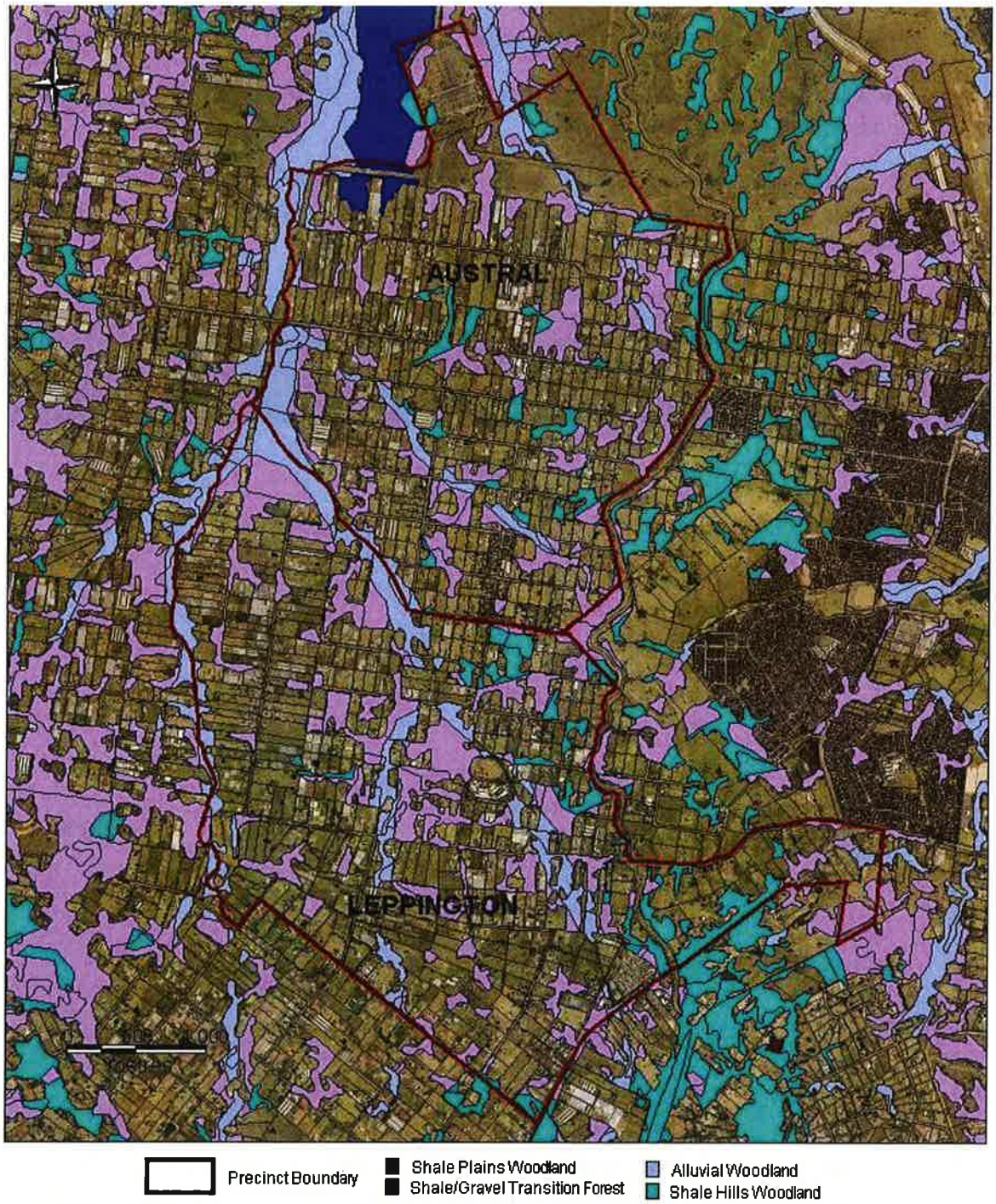

Figure 2.2 NPWS Vegetation community types within the Austral – Leppington North Precincts.

2.2.5.1 General Vegetative Condition

The Existing Native Vegetation (ENV) mapping survey (in the draft Growth *Centres Conservation Plan*) also provides preliminary vegetation community information, canopy cover and understorey condition for all vegetation patches within the study site. Mapping of ENV has been updated by DoPI in 2011 through analysis of aerial imagery.

ENV as defined in the RBMs are areas of indigenous trees (including any sapling) that:

- Has 10% or greater over-storey canopy cover present;
- Are equal to or greater than 0.5 ha in area; and
- Are identified as "vegetation" on maps 4 and 5 of the draft *Growth Centres Conservation Plan.*

Table 2.2 outlines the various vegetation categories and classification rules adopted by NPWS (2002b) mapping as well as indicating the relative proportion of each category present within the Austral – Leppington North Precincts.

Table 2.2 Polygon classification codes and canopy cover*

Vegetation Quality	Condition Code	Description	Patch Area (ha)	Canopy Cover (%)	Proportion of Vegetation within the Site
Higher Quality ↕	A	Dominant canopy species, understorey characteristics, disturbance and reliability all coded.	>0.5	>10	39%
	B	Tree cover species only with some overstorey and/or understorey integrity. Dominant canopy species and reliability coded. May have understorey code.	>5	<10	9%
	C	As for "A" or "B" except the dominant canopy species are non-eucalypts species.		<10	0.2%
	Tx	Tree cover only with agriculture but no major urban or suburban development. Most have dominant canopy species coded.	>0.5	<10	33.8%
	Txr	Tree cover only with rural residential development. Most have dominant canopy species coded.	>0.5	<10	18%
	Txu	Tree cover only with urban development. Most have	>0.5	<10	0%

Vegetation Quality	Condition Code	Description	Patch Area (ha)	Canopy Cover (%)	Proportion of Vegetation within the Site
Lower Quality		dominant canopy species coded.			
	X	No Tree Cover	>0.5	<10	0%

*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).

2.2.6 Key Species – Flora

The previous studies and database searches have identified the potential for key threatened flora species (both Commonwealth and State listed) to occur within the Austral – Leppington North Precincts. The key threatened flora species with potential to be present are:

- *Acacia pubescens*;
- *Pimelea spicata*; and
- *Pultenaea pendunculata*.

2.2.7 Key Species - Fauna

The previous studies and database searches have identified the potential for key threatened (both Commonwealth and State listed) fauna species to occur within the Austral – Leppington North Precincts. The key threatened fauna species with potential to be present are:

- Common (Eastern) Bentwing Bat (*Miniopterus schreibersii oceanensis)*;
- Large-footed Myotis (*Myotis macropus*);
- Eastern Freetail Bat (*Mormopterus norfolkensis*);
- Greater Broad-nosed bat (*Scoteanax rueppellii*);
- Grey-headed Flying Fox (*Pteropus poliocephalus*);
- Barking Owl (*Ninox connivens*);
- Masked Owl (*Tyto novaehollandiae*);
- Yellow-bellied Sheathtail bat (*Saccolaimus flaviventris*);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Cumberland Land Snail (*Meridolum corneovirens*); and
- Green and Golden Bell Frog (*Litoria aurea*).

3 Legislative Context

A range of international, national, state and local legislation and policy is applicable to the Austral – Leppington North area. This statutory context requires consideration in the planning and management of ecological values within the study site. For the purposes of this Biodiversity Conservation Assessment, the relevant applicable statutory documents were reviewed to assist in the identification of key constraints to be considered within the Precinct Planning Process.

The relevant legislation and policies identified are listed below and summarised in **Appendix L**. The legislation identified is relevant when considering both this Biodiversity Conservation Assessment (as the legislative requirements in regards to species, communities and habitat will inform conservation values), and the Precinct Planning Process as a whole.

- International
  - Japan – Australia Migratory Bird Agreement (JAMBA)
  - China – Australia Migratory Bird Agreement (CAMBA)
  - Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)
- Commonwealth
  - *Environment Protection & Biodiversity Conservation Act 1999* (*EPBC Act*), and Strategic Assessment which falls under the EPBC Act.
- State
  - *Environmental Planning and Assessment Act 1979 (EP&A Act)*
  - *Threatened Species Conservation Act 1995 (TSC Act)*
  - State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP)
  - Environmental Planning and Assessment Amendment (Sydney Region Growth Centres) Regulation 2006
  - *Threatened Species Conservation Amendment (Special Provisions) Act 2008*
  - *Fisheries Management Act 1994 (FM Act)*
  - *Water Management Act 2000 (WM Act)*
  - *Noxious Weeds Act 1993*
  - Planning for Bushfire Protection 2006
  - *Protection of the Environment Operations Act 1997*
  - *Catchment Management Authorities Act 2003*
  - Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2 - 1997)
  - State Environmental Planning Policy No.19 – Bushland in Urban Areas
  - Growth Centres Development Code 2006
  - Growth Centres Conservation Plan 2007
- Local
  - Liverpool Local Environment Plan 2008
  - Camden Local Environment Plan 2010.

4 Methodology – Terrestrial Habitat Assessment

In order to demonstrably fulfil the project aims (**Section 1.3**), a staged methodology was adopted. This methodology involved the following:

- Literature and Database Searches (**Section 4.1**).
- Field Survey – Identification and Evaluation of Vegetation Reference Sites (**Section 4.2**).
- Field Survey – Rapid Condition Assessment of Existing Vegetation and Habitat (**Section 4.3**).
- Field Survey – Threatened Flora Survey (**Section 4.4**).
- Evaluation of Total Ecological Value (**Section 4.5**).
- Vegetative Mapping (**Section 4.6**).
- Recommendation of Conservation and Management Measures (**Section 4.7**).
- Consistency Assessment against Relevant Biodiversity Measures (**Section 4.8**).

4.1 Literature and Database Searches

A desktop literature and database study was undertaken to identify flora, fauna, and ecological communities known to occur or have previously occurred within the study site and to identify the quantity and quality of ecological information previously gathered for the Austral – Leppington North Precincts and surrounding locality. In particular the desktop study focussed on the potential presence of threatened species, populations and ecological communities as listed under both State and Commonwealth legislation.

In addition to the studies and documents listed in **Section 2.2**, the following databases were assessed as part of the desktop study:

- Australian Faunal Directory;
- Australian Weeds Database;
- BioBanking Threatened Species Profile Database;
- Birds Australia Atlas (August, 2010);
- DSEWPC's EPBC online Protected Matters Database Search (August, 2010);
- NSW DECCW Wildlife Atlas database (August, 2010);
- NSW DECCW Register of Critical Habitat;
- NSW DECCW Threatened Species Profiles; and
- PlantNet Flora Online Database (August, 2010).

The EPBC online Protected Species Profile Database identifies Commonwealth protected species that are considered as potentially occurring within the area based on estimated

geographic ranges and known habitat. In contrast, the NSW DECCW Wildlife Atlas reports the location of known threatened species (under the *TSC Act*) sightings over a significant time period. As such, neither of these databases necessarily declares threatened species to currently be present within the search area. To determine the likelihood of these listed threatened species occurring within the Austral – Leppington North Precincts, a Likelihood of Occurrence rating was determined for each species identified within these database searches.

For the purposes of this assessment, species were classified as follows:

- Present: Recent surveys (within the last 5 year) have identified the species as occurring on site.
- Highly likely: Has been previously observed on site.
- Likely: The habitat is such that based on species ecology it is reasonable to expect the species is present.
- Possible: The habitat is such that, based on species ecology, the species may occur on site.
- Unlikely: The habitat is such that based on species ecology, the species is not expected to occur on site.
- Absent: The habitat is such that, based on species ecology, the species should not occur on site.

The results of these database searches and the determined Likelihood of Occurrence were utilised during the field inspections in terms of preparation and site selection. Species identified as having "Likely" or greater probability of occurring, but not observed during field inspections, were also considered in the provision of management and conservation recommendations (**Section 8**).

4.2 Identification and Evaluation of Vegetation Reference Sites

To compare and contrast the quality of existing habitat and provide meaningful management and conservation recommendation measures, a field survey was undertaken to identify and characterise the vegetation communities on site. This process involved:

- The identification of Reference Sites representing high quality ecological communities;
- Detailed evaluation of the Reference Sites;
- Rapid evaluation of the condition of existing vegetation and habitat through comparison to the Reference Sites (**Section 4.3**); and
- A targeted survey for *Acacia pubescens* (**Section 4.4**).

A field survey across the study site was completed on 20 – 23 September (spring) 2010 for the establishment of Reference Sites. Rapid evaluation of the existing vegetation on site was completed on 24 and 25 of September 2010 as well as 16 – 18 November 2010. All field work was undertaken by ecologists Dr Monica Campbell, Leonard Drynan and Dr Caroline

Bathje from Cardno. In total, approximately 200 person field hours were spent in undertaking the survey. Weather conditions during field days were predominantly fine with temperatures averaging around 22°C. The only precipitation during field inspection was a light rain shower on the afternoon of 22 September.

High quality Reference Sites for all vegetation communities expected to occur within the Austral-Leppington North Precincts were established where possible, as detailed below and shown in **Figure 6.3**:

- Shale-Gravel Transitional Forest – one Reference Site established;
- Sydney Coastal River Flat Forest – Alluvial Woodland – three Reference Sites established;
- Cumberland Plain Woodland - Shale Hills Woodland – no communities observed on site (**Section 6.3.2**); and
- Cumberland Plain Woodland - Shale Plains Woodland - three Reference Sites established.

Within each Reference Site, the structural and floristic elements were quantified using:

- A full floristic survey;
- Assessment of community structure; and
- Assessment of fauna habitat values.

4.2.1 Full Floristic Survey

Sampling was undertaken within quadrats (20m x 20m) randomly placed within each Reference Site. Within each quadrat all vascular flora species present within the quadrat were recorded. The relative abundance and cover of each identified species within each quadrat was estimated using a modified Braun-Blanquet scoring system (**Table 4.1**).

Table 4.1 Modified Braun-Blanquet scoring system

Score	Projected Foliage Cover
1	Species comprises 0 – 5% of cover with few individual plants present
2	Species comprises 0 – 5% of cover with many individual plants present
3	Species comprises 5 – 25% of cover
4	Species comprises 25 – 50% of cover
5	Species comprises 50 – 75% of cover
6	Species comprises 75-100% of cover

All quadrats were geo-referenced using a hand-held GPS and a photographic log created to allow visual comparison.

The floristic data and relative abundances were compared against the diagnostic species and abundances described for the relevant vegetation communities provided under Commonwealth and State legislation.

While every attempt was made to identify all vascular flora species present within the quadrats it should be noted that species occurring with low frequency and cryptic species may have not been recorded. Further, species occurring outside the quadrats were not recorded, however data collected is considered to be representative of the broader vegetation types present.

4.2.2 Community Structure Assessment

The structural elements of vegetation within each Reference Site were assessed within a 50 x 20 metre quadrat. Within each quadrat the presence/absence of the following strata were determined:

- Emergents;
- T1 (canopy trees);
- T2 (sub canopy understory trees);
- S1 (shrub strata 2-4m);
- S2 (shrub strata 0.5-1.5m); and
- Ground (0-0.5m).

An example of the delineation of community strata is provided in **Figure 4.1**.

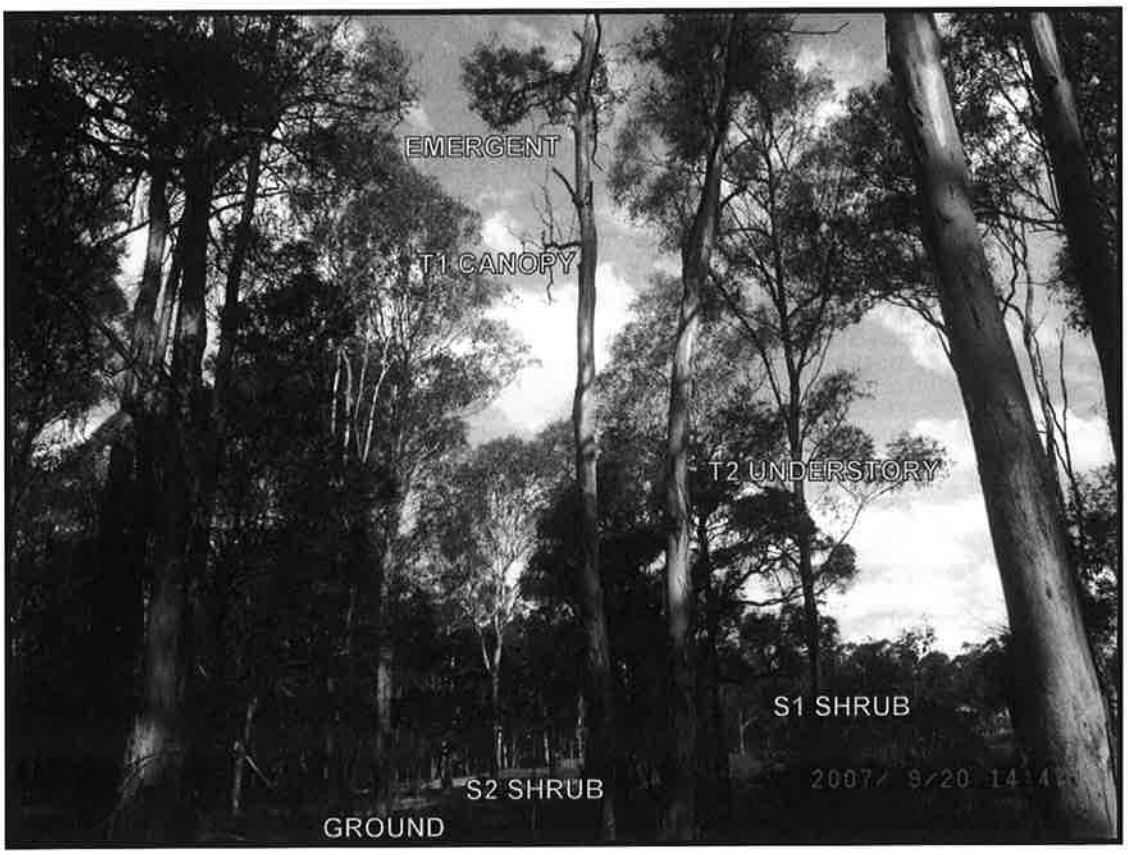

Figure 4.1 Vegetation community structure

For each stratum, the following data was collected:

- Key species;
- Dominance of key species (Dominant, Co-Dominant, Associated, Suppressed);
- Density of each stratum (Sparse – Dense);
- Vegetative cover (%); and
- Weed species dominance, density and cover.

4.2.3 Fauna Habitat Values

To assess the fauna habitat values of each Reference Site vegetation community, evidence of fauna activity in the area and key habitat characteristics of value to fauna species were assessed within 50 x 20m quadrats. Fauna habitat features recorded included:

- Hollow bearing trees;
- Fallen logs/hollow stumps;
- Diggings;
- Scratch marks on tree trunks;
- Scats; and
- Nests.

No targeted field surveys for fauna species were undertaken. Opportunistic sightings of fauna species were recorded throughout all field work. The potential for threatened fauna species to occur on site following vegetation and habitat characterisation was determined through utilisation of the Likelihood of Occurrence assessment (**Appendix E**).

4.3 Rapid Condition Assessment of Existing Vegetation and Habitat

Given the extent of vegetated area within the combined Austral-Leppington North Precincts (approximately 1,930 ha of vegetation) a Rapid Condition Assessment methodology was developed to allow for comparison of the smaller vegetative communities present against the Reference Sites. Given the size of the Austral-Leppington North Precincts and property access issues, implementation of a Rapid Condition Assessment that could be employed remotely was considered to be the most effective means of evaluating the vegetation within the Precincts. It is noted that using this method does not enable boundaries of vegetation patches to be recorded as accurately as if access to the vegetation patch was possible, to enable recording of the position with a GPS device (**Section 6.6.1).**

Where possible, all stands were assessed in-situ. Vegetation communities requiring assessment from greater than 20m distance, have been noted and taken into consideration in the results. For the purposes of this report, vegetation communities assessed under this methodology are termed "Remote Sites" (*c.f.* Reference Sites).

The methodology consisted of an assessment of community structure. For each community stratum the following elements were assessed:

- Presence/absence of strata (i.e. Emergent, T1, T2, S1, S2, G);
- Percentage cover of each stratum;
- Estimated species richness (ground species were estimated within ranges);
- Key species present within each layer;
- Estimated non-native cover; and
- The proportion of cover within each layer represented by native tree saplings.

4.3.1 Scoring of Sites

Using the information collected in the Rapid Condition Assessment and the Reference Site data, a comparative scoring system was developed to calculate an overall score for the condition of each of the vegetative layers present within the Remote Sites. Taken cumulatively these vegetative layer scores provided an overall habitat condition score for each Remote Site as a whole.

The Reference Site data was utilised to develop a benchmark score for each of the EECs present within the Precincts. For each vegetative layer (**Figure 4.1**) an EEC benchmark was established based on the following elements:

- Community strata present;
- Percentage cover of each stratum;
- Observable species richness (Ground species were estimated within ranges);
- Key species present within each layer; and
- Estimated non-native cover.

A series of rules were then developed to contrast the vegetation layers within the Remote Sites (**Section 4.3**) to the relevant identified EEC benchmarks. For example, a remote site classified as Shale Plains Woodland under NPWS (2002) mapping was compared to the benchmark data generated for the Shale Plains Woodland community (**Section 4.2**). The vegetative layer elements and the scoring rules adopted are provided in **Table 4.2**.

Table 4.2 Remote Site vegetative layer elements and scoring system

Present/ Absent	Difference Between Observed % Cover and Benchmark	Species Richness	Dominant Species	Non-Native Cover
Present = 1 point Absent = 0 points	Plus/Minus 10% = 3 points Plus/Minus 20% = 2 points Plus/Minus 30% = 1 point >30% = 0 points	Difference between observed species number and Reference Site species number.	One point for every similar species observed that is part of the EEC species listing.	< Benchmark = 3 points +10% = 2 points +20% = 1 point >20% = 0 points

The assigned scores for each vegetative layer were summed to provide a total site score for each of the five elements assessed. These cumulative scores were then scaled to provide an equal weighting for each of the five elements (i.e. a score out of 10) and then summed to provide a final score out of 50 for each remote site.

4.4 Threatened Flora Survey

A targeted survey for *Acacia pubescens* (Downy Wattle or Hairy Stemmed Wattle) was completed in accordance with Condition 17 of the Relevant Biodiversity Measures for the *Biodiversity Certification for the South West Growth Centres*. The targeted surveys were conducted using meandering transects within remaining bushland habitat along and adjoining the Thirty-Second Avenue road reserve located near (but not within) the Austral Precinct (**Figure 6.4**). The location of individuals identified in the field as *Acacia pubescens* were marked in the field using a hand-held GPS and a sample was taken for confirmation by the NSW Herbarium. These findings have been reported separately as they are not within the Austral – Leppington North Precincts.

4.5 Evaluation of Total Ecological Value

The ecological value of any one vegetative community is a function of both its existing vegetative structure and characteristics and its current and potential future contribution to the habitat of the locality/region as a whole. Based on common methodologies adopted within Western Sydney (e.g. Eco Logical (2003), Eco Logical (2009), a total ecological value was predominantly determined based on the following three elements.

1. **Functional Conservation Value** (**Section 4.5.1**) – this captures the conservation value of the individual patch in terms of its:
    - Site condition (the species composition, complexity, and condition of the communities);
    - Geospatial characteristics (the patch area and perimeter/area ratios); and
    - Connectivity (the quantity of adjacent habitat area).
2. **Threatened Status** (**Section 4.5.2**) – the likelihood of threatened species or communities to occur within the individual patch.
3. **Recovery Potential** (**Section 4.5.3**) – the perceived potential for the patch to improve in value over time as indicated by:
    - The extent of juvenile / regrowth;
    - Land use and disturbance history;
    - Connectivity to surrounding patch areas; and
    - The extent of non-native weed present.

This is graphically depicted in **Figure 4.2**.

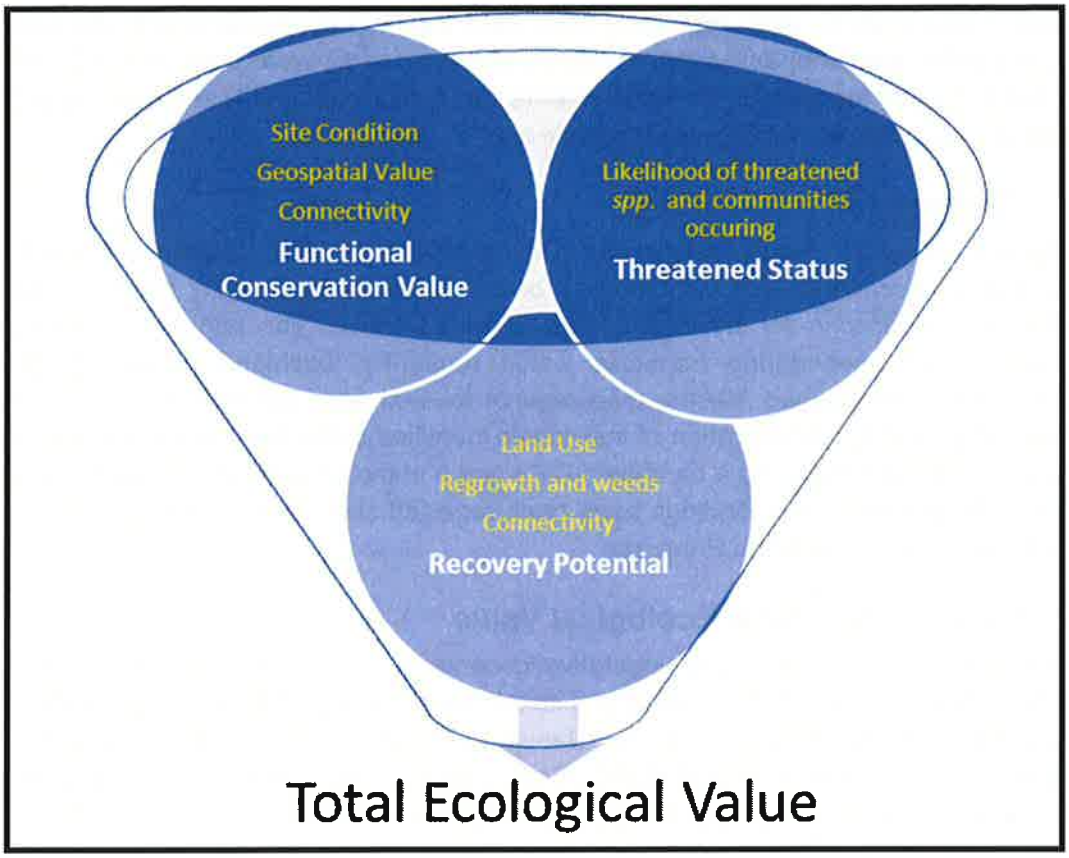

Figure 4.2 Composition of Total Ecological Value

4.5.1 Functional Conservation Value

The Site Condition value of all the vegetation patches (both Remote and Reference Sites) within the Precincts was estimated through the Rapid Condition Assessment and scoring process outlined in **Section 4.3**. All sites were assigned a relative habitat value score out of 50.

The geospatial characteristics were established through GIS analysis of the NPWS (2002) mapping, combined with approximate ground-truthing undertaking during the field inspections (**Section 4.2**). For each vegetation community assessed, community area and the community perimeter to area ratio were determined. For both these elements a relative community ranking was determined, and a proportionate score assigned out of 25, to provide an overall relative geospatial score out of 50.

The connectivity values associated with each individual community was determined through GIS analysis of community distribution. In accordance with DECCW (2008) (for woody ecosystems), adjoining vegetation was considered to be all communities separated by a distance of 100m or less. Based on the observed area of adjoining vegetation, communities were assigned a ranking and a proportionate score out of 50.

Combining these three aspects (equally weighted), provided an overall estimate of the Functional Conservation Value for each site (i.e. a score out of 150).

4.5.2 Threatened Status

All vegetation communities (i.e. Remote and Reference Sites) within the Precincts were seen to represent either:

- Shale-Gravel Transitional Forest;
- Sydney Coastal River Flat Forest – Alluvial Woodland; or
- Cumberland Plain Woodland – Shale Plains Woodland (including both Shale hills and Shale Plains Woodland).

All of these are listed as Threatened Ecological Communities under the TSC Act and are protected under existing legislation. Further, it is noted that due to the extent of historic clearing of the community across the state, Cumberland Plain Woodland – Shale Plains Woodland is formally listed under Schedule 1A of the TSC Act (1995) as a Critically Endangered Ecological Community and is considered to be more vulnerable to extinction if not appropriately managed. Consequently, while all the vegetation communities present on site are of conservation value, vegetation patches corresponding to Cumberland Plain are particularly recognised as being of conservation importance.

In order to incorporate the relative threatened status value of the vegetation communities into the Total Ecological Value an estimate of conservation significance was developed based on the significance categories provided in NPWS (2002c), including:

- Core Habitat: Areas that constitute the backbone of a viable conservation network across the landscape; or areas where the threatened ecological communities are at imminent risk of extinction.
- Support for Core Habitat: Areas that provide a range of support value to the Core Habitat, including increasing remnant size, buffering from edge effects and providing corridor connections.
- Other Remnant Vegetation: All native vegetation that does not fall within the above significance categories.

Consistent with other ecological assessments undertaken within south-western Sydney, all vegetation communities identified within the precinct were assigned a conservation significance based on the methodology outlined in NPWS (2002b). This methodology combines the community type, condition, patch size, and connectivity of the vegetation patches. The condition assessment utilised the NPWS (2002a) mapping classifications which were adjusted accordingly following ground truthing. The associated decision matrix adopted is shown in **Table 4.3**. Based on the assigned conservation significance a score out of 75 was attributed to each vegetation patch assessed (the greater the conservation significance the higher the score) (**Table 4.3**).

Table 4.3 Conservation significance decision matrix

Community Type	Condition Code*	Patch Size	Connectivity	Code	Conservation Significance	Score
Critically Endangered Ecological Community	ABC, TX, or Txr	Any	Any	C3	Core	75
	Txu	Any	Any	URT	URT	25
Endangered	ABC (with understory in	>10 ha	Any	C1	Core	65

Community Type	Condition Code*	Patch Size	Connectivity	Code	Conservation Significance	Score
Ecological Community	good or moderate condition)	<10 ha	Adjacent to C1 or CEEC	C2	Core	55
			Adjacent S1	S2	Support for Core	50
			None	O	Other Remnant Vegetation	37.5
	Tx or Txr, ABC (with poor understory condition)	Any	Adjacent to any Core	S1	Support for Core	50
			None	O	Other Remnant Vegetation	37.5
	Txu	Any	Any	O	Other Remnant Vegetation	37.5
Non – Endangered Community	-	Any	Any	NE	Low Conservation Significance	12.5

*Condition Codes were adopted consistent with NPWS (2002c) where:

- **A** = canopy density > 10% with relatively intact native tree canopy;
- **B** = canopy density < 10% with larger areas of remnant vegetation with a low or discontinuous canopy;
- **C** = canopy density < 10% with areas of native vegetation that do not have a Eucalypt canopy cover.
- **TX** = canopy density < 10% Areas of native trees with very discontinuous canopy cover.
- **TXR** = canopy density < 10% Areas of TX located in areas where there is a combination of urban and rural activities.
- **TXU** = canopy density < 10% with areas of TX located where the dominant land use is urban.

Just as the conservation significance of the vegetation communities varied across the Precincts, it was also considered that the potential for threatened individual flora and fauna species to occur was likely to vary between the communities present. The threatened species likelihood of occurrence assessment (**Appendices E** and **G**) identified a large number of species which may occur and utilise the Precincts for either breeding or foraging. In particular, a significant number of potentially occurring threatened species typically associated with the presence of riparian and wetland areas were identified. Consistent with similar studies undertaken within Western Sydney (e.g. Eco Logical 2009), the potential for threatened species to occur on site was determined based on:

- Field observations of flora and fauna;
- Historic sightings of flora and fauna;
- The threatened species likelihood of occurrence assessment (**Section 6.1**, **Appendix E**);
- The determined Functional Conservation Value; and
- Specific community characteristics (e.g. wetland or riparian vegetation).

Table 4.4 describes the decision matrix adopted to categorise the potential for threatened flora or fauna species within each identified community and the subsequent score assigned.

Table 4.4 Threatened flora and fauna decision matrix

Threatened Spp. last recorded within the community	Functional Conservation Value	Habitat Type	Potential for threatened species	Assigned Score
≤5 years	Any	Any	High	75
>5 years	High (>100)	Any	High	75
	Medium (50 – 100)	Any	High	75
	Low (<5)	Any	Medium	50
No Species Recorded	High (>100)	Wetland	Medium	50
		Riparian	Medium	50
		Terrestrial	Medium	50
	Medium (50 -100)	Wetland	Medium	50
		Riparian	Medium	50
		Terrestrial	Low	25
	Low (<50)	Wetland	Medium	50
		Riparian	Low	25
		Terrestrial	Low	25

Combining the conservation significance score (**Table 4.3**) and threatened flora and fauna score (**Table 4.4**), provided an overall estimate of the Threatened Status Value for each site (i.e. a score out of 150).

4.5.3 Recovery Potential

For the purposes of this report, recovery potential is defined to be the perceived capacity for a disturbed area to improve its condition to a state representative of its condition prior to disturbance (assuming no further disturbance or active management). Estimation of recovery potential is difficult, due to the variety of site specific factors which influence vegetative growth (e.g. soil quality, light infiltration, hydrology etc.). In general, it can be seen that recovery potential is influenced by the extent of prior/on-going disturbance, the existing and potential supplementation to the seed bank, connectivity, and the competition due to non-native species. For the vegetation of the Cumberland Plain, the restoration of characteristic canopy species is a significant factor in condition improvement. As such the presence of saplings within the communities is considered a key indicator of recovery potential.

Table 4.5 outlines the decision rules adopted in determining the recovery potential for each vegetation patch observed within the precincts, resulting in a ranking of 1 – 6 where 1 has the least recovery potential and 6 has the best chance for native vegetation recovery.

Table 4.5 Recovery potential decision matrix

Current Condition and Land Use	Connectivity*	Saplings cover**	Non-Native Cover**	Recovery Potential
Highly Disturbed (e.g. no continuous canopy, intensive grazing, planted gardens)	High	<10%	High	1
			Low	3
		10-30%	High	2
			Low	4
		>30%	High	3
			Low	4
	Medium	<10%	High	1
			Low	2
		10-30%	High	1
			Low	3
		>30%	High	2
			Low	3
	Low	<10%	High	1
			Low	1
		10-30%	High	1
			Low	2
		>30%	High	1
			Low	2
Wooded, native canopy present or regenerating	High	<10%	High	3
			Low	4
		10-30%	High	4
			Low	5
		>30%	High	4
			Low	6
	Medium	<10%	High	2
			Low	3
		10-30%	High	3
			Low	4
		>30%	High	4
			Low	5
	Low	<10%	High	2
			Low	3
		10-30%	High	3
			Low	4
		>30%	High	4
			Low	5

*As determined by the connectivity rankings determined in Section 0 ("High" – the top third ranked sites, "Medium" – the middle third ranked sites, "Low" – the bottom third ranked sites).
**Data obtained during the rapid characterisation field inspections (Section 4.3).

4.5.4 Total Ecological Value

Based on the rankings determined (**Sections 4.5.3**), the Recovery Potential scores for each vegetation patch were scaled to provide scores out of 150. As described in **Sections 4.5.1** and **4.5.2** the Functional Conservation Value and Threatened Statue Value for each vegetation community was also evaluated out of possible score of 150. All three of these ecological value elements (**Figure 4.2**) were then combined to provide an equally weighted score out of 450 for each of the discrete vegetation patches identified (i.e. the community Total Ecological Value).

To aid in Precinct Planning, based on the observations made during the field survey and Cardno's professional experience it was considered appropriate to further categorise the Total Ecological Values into "High" (Total Ecological Values greater than 300), "Medium" (Total Ecological Values from 150 to 300) or "Low" (Total Ecological Values less the 150) value classes.

4.6 Vegetative Mapping

Utilising the existing ENV mapping (DoPI, 2011) and field survey ground-truthing, the vegetative communities on site (i.e. Remote and Reference Sites) were mapped with GIS, and assigned the relevant determined ecological value score and classification. The maps and values assigned were revised following:

- The public exhibition period, and
- Additional fieldwork carried out in direct response to the comments received during public exhibition.

The resulting maps were compared and contrasted against the ENV mapping and certified/non-certified area mapping to aid in the formation of an Indicative Layout Plan that accurately incorporates biodiversity values.

Figure 4.3 shows the distribution of existing ENV as provided by DoPI in 2011. In total, (and including 3.45ha of ENV within the area of Kemps Creek Nature Reserve which is within the precincts), this figure shows approximately 212.15ha of ENV comprised of 102.73ha of ENV on certified land, and 109.42ha on non-certified land.

Some areas of ENV shown by the DoPI mapping in **Figure 4.3** were found by the Cardno Ground Truthing not to be ENV as they did not meet one of the three criteria for ENV shown in **Section 2.2.5.1. Figure 4.4** shows the distribution of ENV corrected by Cardno in light of the ground truthing exercises and the approved vegetation clearance to accommodate the SWRL. The area of ENV in the revised mapping is reduced by 16.45ha to 195.70ha, with the areas of difference being identified by orange shading in **Figure 6.9.** This corresponds to 94.12ha of ENV on certified land, and 101.58ha on non-certified land. The corrected ENV data as ground truthed by Cardno has been used for all further calculations and mapping within this report.

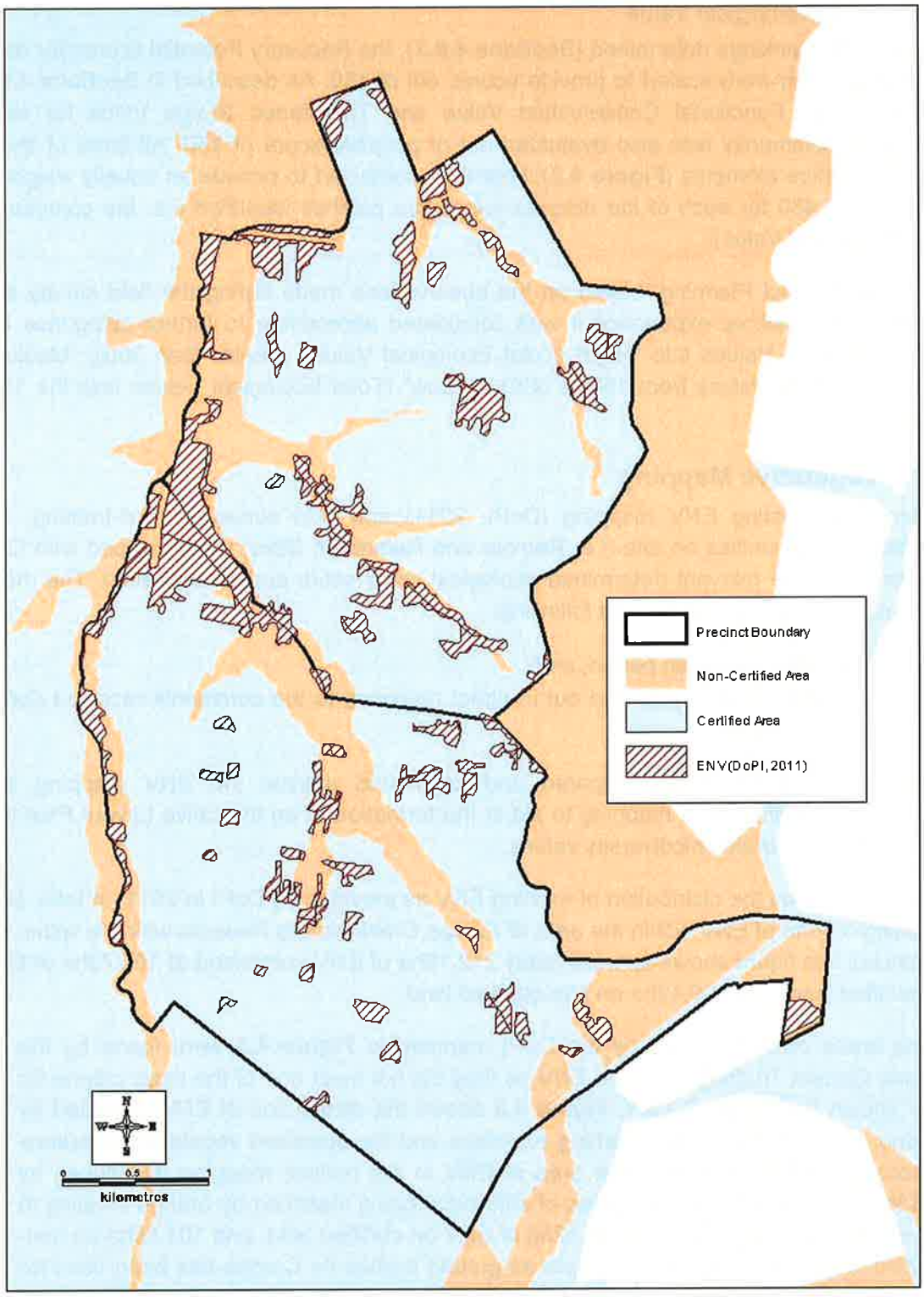

Figure 4.3 Existing Native Vegetation (DoPI, 2011) 102.73ha on Certified and 109.42ha on Non-Certified land.

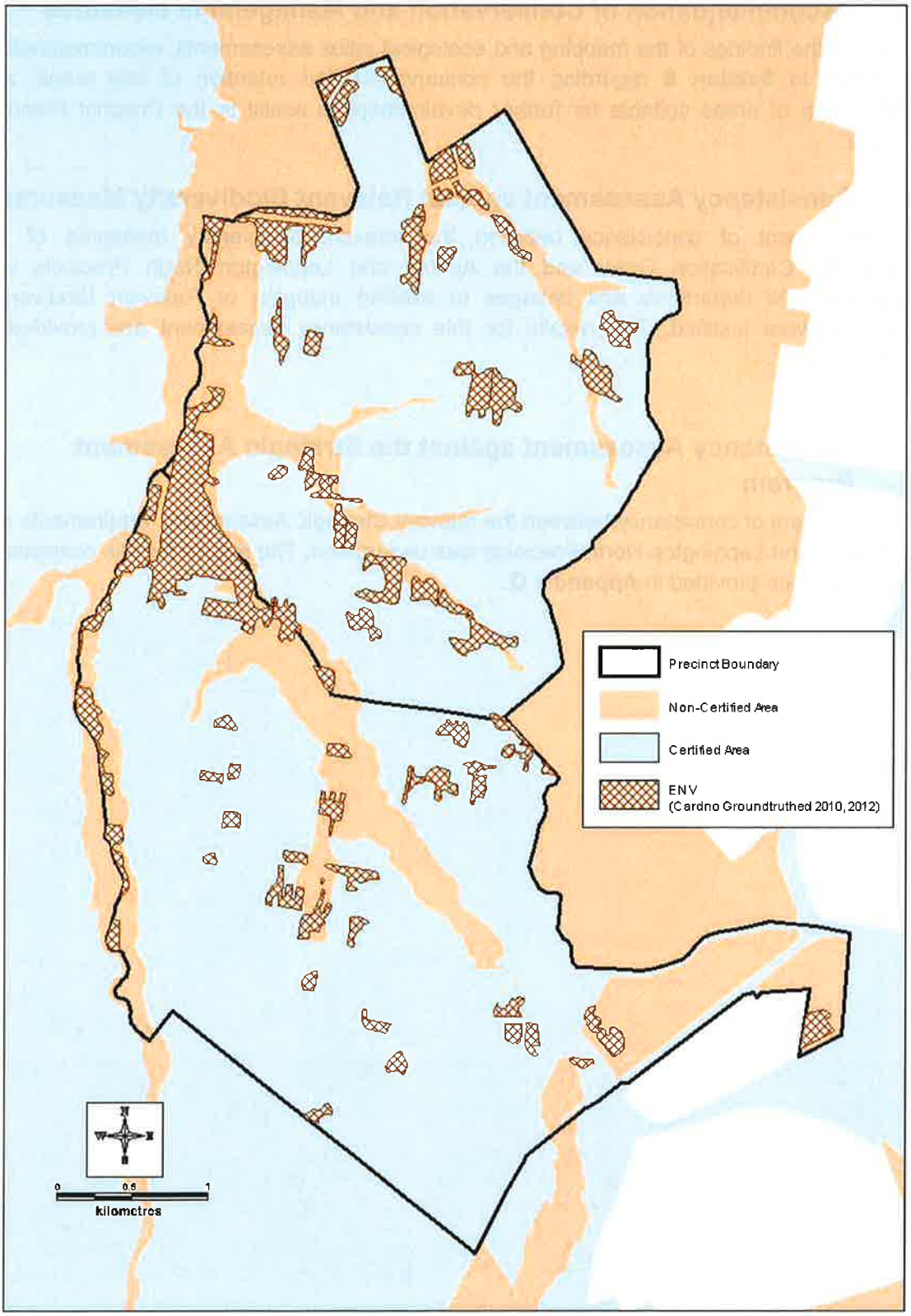

Figure 4.4 Existing Native Vegetation (DoPI, 2011, amended to show results of 2010 and 2012 ground truthing and SWRL impacts) 94.12ha on Certified and 101.58ha on Non-Certified land.

4.7 Recommendation of Conservation and Management Measures

Based on the findings of the mapping and ecological value assessments, recommendations are made in **Section 8** regarding the conservation and retention of key areas, and identification of areas suitable for further development to assist in the Precinct Planning process.

4.8 Consistency Assessment against Relevant Biodiversity Measures

An assessment of consistency between the relevant biodiversity measures of the Biodiversity Certification Order and the Austral and Leppington North Precincts was undertaken. All departures and changes to existing mapping or Relevant Biodiversity Measures were justified. The results for this consistency assessment are provided in **Appendix M**.

4.9 Consistency Assessment against the Strategic Assessment Program

An assessment of consistency between the relevant Strategic Assessment requirements and the Austral and Leppington North Precincts was undertaken. The results for this consistency assessment are provided in **Appendix Q**.

5 Methodology – Aquatic Ecology Assessment

The specific objectives of this study relating to aquatic ecology were to:

- Identify aquatic species, populations or ecological communities that occur or for which potential habitat occurs within Austral and Leppington North Precincts;
- Describe existing aquatic habitats and determine the occurrence of aquatic plants, aquatic macroinvertebrates and fish, including those regarded as threatened or noxious species;
- Identify the location of any threatened species found on site, areas of habitat value for threatened and regionally significant species, the biodiversity and habitat values of the site and areas of high conservation value.

In order to achieve these objectives, the following methodology was implemented:

- Literature and database searches (**Section 5.1**);
- Aquatic habitat field surveys (**Section 5.2**),
- Water quality sampling and assessment (**Section 5.3**);
- Aquatic flora surveys (**Section 5.4**);
- Aquatic fauna surveys (**Section 5.5**);
- Recommendation of conservation and management measures (**Section 5.6**).

All field investigations undertaken as part of the aquatic biodiversity assessment for the site (i.e. aquatic habitat surveys, water quality sampling, aquatic flora surveys, and aquatic fauna surveys) were undertaken on 19 August 2010. The survey commenced in the morning after approximately 2.2mm of rain had fallen. As the survey was restricted to one day, it provides a "snapshot" of the state of the waterways and their biota.

Thirteen sites distributed across the waterways present on site were surveyed. Aquatic habitat, water quality, and the occurrence of macrophytes (aquatic plants) were assessed at all sites. However, aquatic fauna (macroinvertebrates and fish) were sampled only where there was suitable aquatic habitat (**Section 5.5**). The position of the thirteen study sites surveyed is shown in **Figure 5.1** and their geographic coordinates are listed in **Table 5.1**

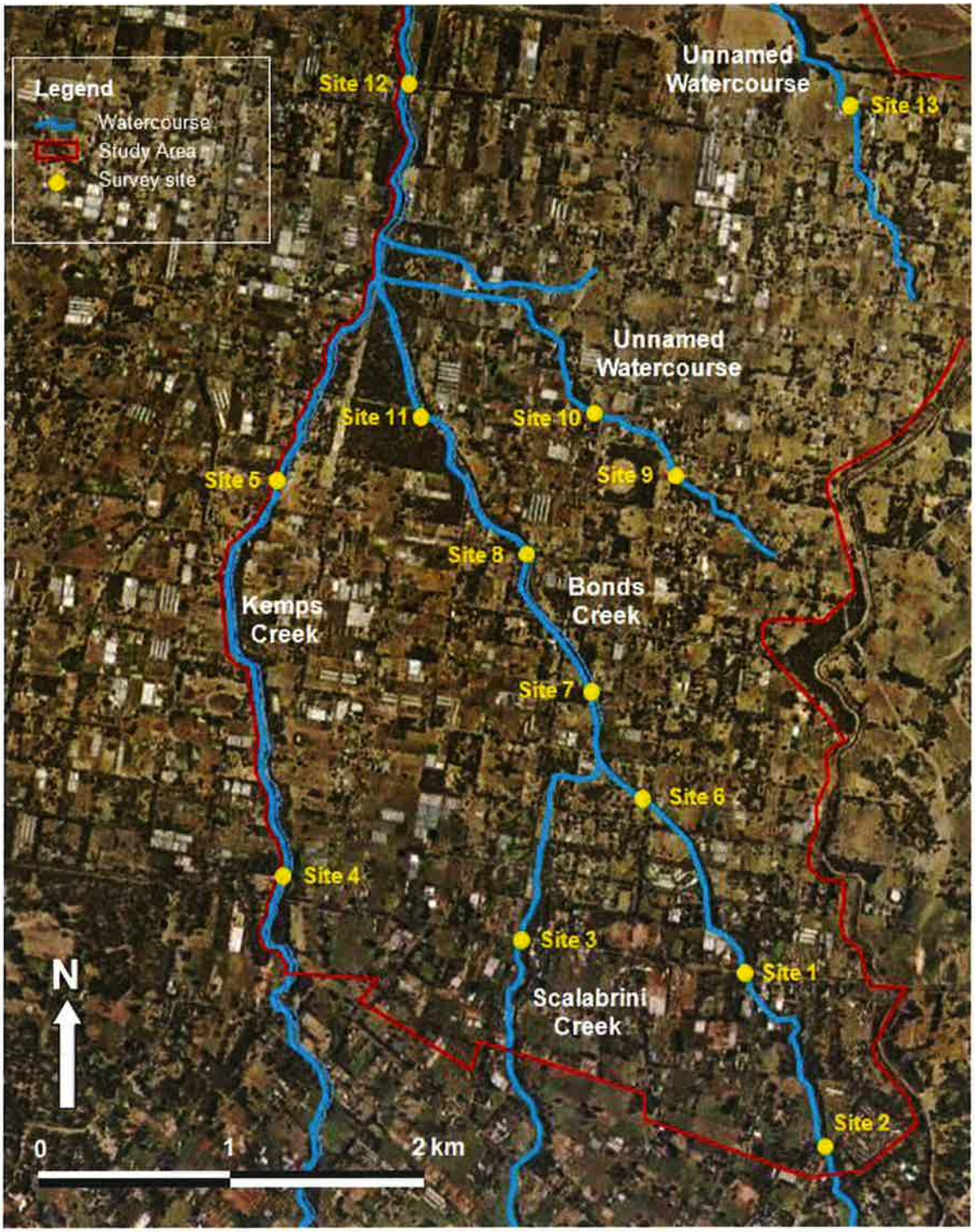

Figure 5.1 Location of the aquatic ecology survey sites within the Study site. Image source: Google Earth.

Table 5.1 GPS coordinates for each of the 13 sites surveyed within the Study site. Datum: UTM WGS 84 Zone: 56H.

Site	Easting	Northing	Waterway
1	0298132	6241075	Bonds Creek
2	0298573	6240189	Bonds Creek
3	0296968	6241237	Scalabrini Creek
4	0295719	6241505	Kemps Creek
5	0295662	6243569	Kemps Creek
6	0297594	6241941	Bonds Creek
7	0297296	6242516	Bonds Creek
8	0296937	6243217	Bonds Creek
9	0297825	6243549	Unnamed
10	0297280	6243961	Unnamed
11	0296402	6243943	Bonds Creek
12	0296262	6245662	Kemps Creek
13	0298552	6245602	Unnamed

5.1 Literature and database searches

Existing information on aquatic habitats and associated biota within the region of the Study Area was obtained by searching for relevant literature using the internet. Threatened species, populations and ecological communities that occur or for which potential habitat occurs within the study site were identified by reviewing the current listings on databases maintained by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), Industry and Investment NSW (I&I NSW) and NSW Department of Environment, Climate Change and Water (DECCW). Database searches were made on 17 August 2010.

The DSEWPC Environmental Reporting Tool was used to determine whether any matters of National Environmental Significance (NES) listed under the schedules of the *EPBC Act* are likely to occur in the Study site. The search for matters of NES was limited to frogs, ray-finned fish and aquatic plants (macrophytes) and encompassed the entire Kemps Creek catchment.

The I&I NSW Threatened and Protected Species Record Viewer was used to search for records of threatened and protected species listed by Schedules 4, 4A and 5 of the *FM Act* occurring in the Penrith Local Government Area and the broader Hawkesbury – Nepean Catchment.

The DECCW Geographic Region Search was used to determine whether any aquatic threatened plant and frog species listed under the *TSC Act* were present in the Cumberland CMA sub-region of the Hawkesbury - Nepean Catchment Management Authority (HNCMA) Area, which encompasses the Study site.

Searches were also done for the presence of significant or critical aquatic habitat present within the region of the study site, such as RAMSAR wetlands.

The following reports relating to the aquatic ecology of the region were also reviewed:

- Managing Sydney's Urban Growth: Aquatic Biodiversity Values (Bioanalysis, 2003);
- South West Rail Link: Environmental Assessment Biodiversity Technical Paper (Parsons Brinckerhoff, 2010);
- Freshwater Fishes of South-Eastern Australia (McDowall, 1996);
- Carp in NSW: Assessment of distribution, fishery and fishing methods (Graham et al., 2005); and
- I&I NSW survey of Penrith Lakes for the Penrith Lakes Development Corporation (I&I NSW 2009).

5.2 Aquatic Habitat Field Survey

At each survey site, a standardised description of adjacent land and condition of riverbanks, channel and bed was recorded using the 'Riparian, Channel and Environmental Inventory' (RCE), developed by DECCW (previously the NSW Environment Protection Authority). RCE is used to scale and quantify the environmental state of particular locations for use in management decisions. The RCE score for each site is calculated by summing the scores for each descriptor noted (**Appendix B**). The highest score (52) would be assigned to a stream with no obvious physical disruption. The lowest score (13) would be assigned to a heavily disturbed stream without any riparian vegetation. Habitat descriptors included:

- Geomorphological characteristics of the waterways;
- Land use along the waterway (e.g. industries associated with the river, recreational uses);
- Riparian vegetation and instream vegetation (e.g. presence/absence, native or exotic, condition); and
- Channel substratum type (e.g. rock, sand, gravel, alluvial substrata).

The fish habitat potential at each site was assessed in accordance with *NSW Policy and Guidelines: Aquatic Habitat Management and Fish Conservation* (Smith and Pollard 1999) and *Guidelines and Policies for Fish Friendly Road Crossings* (Fairfull and Witheridge 2003). The criteria for the fish habitat classifications are given in **Appendix C**. The assessment of impacts assumed that any waterway crossing required in the proposed works would be designed and built to comply with these guidelines and policies.

General observations, including water characteristics such as flow rates and colour, the presence of spawning areas (e.g. gravel beds, aquatic vegetation), refuge (e.g. deep pools,

snags) and natural or artificial barriers to fish passage (e.g. weirs, dams, culverts etc) and the type of existing waterway crossing if present, were also recorded.

5.3 Water Quality Sampling and Assessment

Water quality was measured at each site using a Yeo-Kal 611 probe. Physical-chemical properties measured included: electrical conductivity (µs/cm); salinity (ppt); temperature (°C); turbidity (NTU); dissolved oxygen (mg/L and % saturation); pH; and ORP (Oxidation Reduction Potential: mV). Two replicate measures of each variable were taken from just below the water surface at each site.

The in situ water quality readings were used to assess water quality within the study site by comparison with the Australia, New Zealand Environment Conservation Council (ANZECC/ARMCANZ 2000) guidelines for lowland rivers in south-eastern Australia.

5.4 Aquatic Flora (Macrophytes)

The instream macrophyte (aquatic plants) taxa occurring at all sites were recorded. The presence of threatened species, the condition and contribution to the overall habitat of the species present was also noted. Results are shown in **Section 7.4**.

5.5 Aquatic Fauna

5.5.1 Aquatic Macroinvertebrates

Based on the observed availability of suitable habitat, macroinvertebrates associated with edge habitat were sampled at Sites 1, 3, 4, 5, 7, 11 and 12 (**Figure 5.1,** and **Table 5.2**). Edge habitat is defined as areas along creek banks with little or no flow, including alcoves and backwaters, with abundant leaf litter, fine sediment deposits, macrophyte beds, overhanging banks and areas with trailing bank vegetation (Turak *et al.* 2004). Samples were collected over a total length of 10 m of edge habitat usually in 1-2m sections, ensuring that all significant sub-habitats within each site were sampled (Turak *et al.* 2004).

Table 5.2 Sampling undertaken at each aquatic site surveyed within the study site

Site	Waterway	Aquatic Habitat Assessment	Water Quality	Macrophyte	Macroinvertebrate	Fish
1	Bonds Creek	✓	✓	✓	✓	✓
2	Bonds Creek	✓	✓	✓		✓
3	Scalabrini Creek	✓	✓	✓	✓	✓
4	Kemps Creek	✓	✓	✓	✓	✓
5	Kemps Creek	✓	✓	✓	✓	✓
6	Bonds Creek	✓	✓	✓		
7	Bonds Creek	✓	✓	✓	✓	✓
8	Bonds Creek	✓	✓	✓		✓

Site	Waterway	Aquatic Habitat Assessment	Water Quality	Macrophyte	Macroinvertebrate	Fish
9	Unnamed	✓	✓	✓		
10	Unnamed	✓	✓	✓		
11	Bonds Creek	✓	✓	✓	✓	✓
12	Kemps Creek	✓	✓	✓	✓	✓
13	Unnamed	✓	✓	✓		✓

Dip nets with a mesh size of 250µm were used to collect the macroinvertebrates. The dip net was first used to disturb animals by agitating bottom sediments and suspending invertebrates into the water column. The net was then swept through this cloud of material to collect suspended and surface dwelling animals. Each macroinvertebrate sample was rinsed in the net with local water to minimise fine particles and placed into a white sorting tray. Animals were removed from the tray using forceps and pipettes. Trained staff removed animals for a minimum period of forty minutes. Thereafter, removals were performed in ten minute periods to a total of one hour, at which time removals would cease if no new taxa were found in a ten minute period. The animals collected were placed inside a labelled jar containing 70% ethanol for laboratory identification.

Animals in the macroinvertebrate samples were removed, identified using a binocular microscope, and up to a maximum of ten animals from each taxon were counted. Taxa were identified to family level except for Aranaea, Cladocera, Copepoda, Hydracarina, Nematoda, Nemertea, Oligochaeta and Ostracoda which were identified to species level where possible. Chironomidae were identified to sub-family level. Identification of animals was validated by a second experienced scientist performing QA checks on each sample.

Macroinvertebrates are useful indicators of the ecological health of freshwater systems. Some macroinvertebrates are more tolerant to pollution and disturbance than others therefore if a waterway is polluted and/or disturbed its macroinvertebrate assemblages should generally be characterised by pollution-tolerant taxa. Conversely, a healthy or pristine habitat should have a greater proportion of pollution-sensitive taxa than an unhealthy habitat. The SIGNAL (Stream Invertebrate Grade Number – Average Level) score provides a measure of environmental health based on the composition of the macroinvertebrate assemblages and the sensitivity of individual taxa to pollution and disturbance. SIGNAL grades for each taxon range from 1 (most tolerant) to 10 (most sensitive). Subsequently, the average SIGNAL score for the taxa found at each site was also used to assess the habitat value (**Section 5.2**) environmental health, with

- SIGNAL higher than 6 = healthy habitat;
- SIGNAL between 5 and 6 = mild pollution and/or disturbance;
- SIGNAL between 4 and 5 = moderate pollution and/or disturbance;
- SIGNAL less than 4 = severe pollution and/or disturbance.

5.5.2 Fish

Fish and large mobile macroinvertebrates occurring at ten sites were sampled by back-pack electrofishing. This is a commonly used, effective non-destructive technique for sampling fish in freshwater habitats such as creeks, drainage ditches and streams. The technique involves discharging an electric pulse into the water which stuns fish, allowing them to be easily netted, counted, identified and released. Electrofishing was done in appropriate habitat such as shallow pools and beneath overhanging banks and vegetation. One staff member used the electrofisher, whilst a second equipped with a dip net was responsible for capture of stunned fish. Captured fish were placed into a fish box filled with stream water for identification and subsequent release. All native species were returned to the water unharmed, but introduced pest species, such as mosquito fish (*Gambusia holbrooki*) and goldfish (*Carassius auratus*), were euthanized humanely with benzocaine.

The entire length of each site was electrofished and the duration of fishing was recorded. The amount of fishable habitat varied among sites and therefore the time fished also varied. Fishing power (amps) was standardised across sites by adjusting voltage output according to the electrical conductivity of the water.

It should be noted that frog species were not sampled, as the survey was undertaken outside their peak activity period.

Results are shown in **Section 7.5**.

5.6 Recommendation of Conservation and Management Measures

Based on the habitat, water quality, aquatic flora and fauna results each of the sites assessed (**Figure 5.1**) and their respective creeks were evaluated in terms of its ecological value and significance. Recommendations in regards to aquatic ecology are made in **Section 8** regarding the conservation and retention of key areas, and identification of areas suitable for further development to assist in the Precinct Planning process.

6 Results – Terrestrial Ecology

6.1 Literature and Database Searches Results for Fauna

A search of the relevant online databases identified 466 fauna species occurring in Liverpool and Camden LGAs. These species included 28 amphibians, 312 birds, 4 Gastropods, 79 mammals, and 43 reptiles. A holistic fauna list and threatened species fauna list for the Liverpool and Camden LGAs is presented in **Appendix D**. 55 species are listed under either the *TSC Act* or the *EPBC Act.*

Appendix E contains the results of the fauna Likelihood of Occurrence assessment (**Section 4.1**). Based on the outcomes of this assessment the 44 threatened fauna species known, likely or having the potential to occur on site are shown in **Table 6.1**.

Figure 6.1 shows the location of threatened fauna species known to have occurred in the vicinity of the site.

Table 6.1 Threatened fauna species that are known, likely or have the potential to occur on site.

Species Name	*Common Name*	*EPBC Act 2000*	*TSC Act 1995 Classification*
Amphibia			
Litoria aurea	Green and Golden Bell Frog	Vulnerable	Endangered
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Vulnerable
Pseudophryne australis	Red-crowned Toadlet	-	Vulnerable
Aves			
Stictonetta naevosa	Freckled Duck	-	Vulnerable
Anthochaera phrygia	Regent Honeyeater	Endangered	Endangered
Pyrrholaemus saggitatus	Speckled Warbler	-	Vulnerable
Circus assimilis	Spotted Harrier	-	Vulnerable
Stagonopleura guttata	Diamond Firetail	-	Vulnerable
Haliaeetus leucogaster	White-bellied Sea-Eagle	Marine, Migratory	-
Hieraaetus morphnoides	Little Eagle	-	Vulnerable
Lophoictinia isura	Square-tailed Kite	-	Vulnerable
Burhinus grallarius	Bush Stone-curlew	-	Endangered
Callocephalon fimbriatum	Gang-gang Cockatoo	-	Vulnerable
Calyptorhynchus lathami	Glossy Black-Cockatoo	Endangered (SA)	Vulnerable
Merops ornatus	Rainbow Bee-eater	Marine, Migratory	-
Monarcha melanopsis	Black-faced Monarch	Marine, Migratory	-

Species Name	Common Name	EPBC Act 2000	TSC Act 1995 Classification
Myiagra cyanoleuca	Satin Flycatcher	Marine, Migratory	-
Rhipidura rufifrons	Rufous Fantail	Marine, Migratory	-
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	-	Vulnerable
Daphoenositta chrysoptera	Varied Sittella	-	Vulnerable
Apus pacificus	Fork-tailed Swift	Marine, Migratory	-
Melanodryas cucullata	Hooded Robin	-	Vulnerable
Petroica boodang	Scarlet Robin	-	Vulnerable
Petroica phoenicea	Flame Robin	Marine	Vulnerable
Glossopsitta pusilla	Little Lorikeet	-	Vulnerable
Lathamus discolor	Swift Parrot	Endangered	Endangered
Ardea alba (or Ardea modesta)	Eastern Great Egret, White Egret	Marine, Migratory	-
Ardea ibis	Cattle Egret	Marine, Migratory	-
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	Marine, Migratory	-
Rostratula benghalensis australis (or Rostratula australis)	Australian Painted Snipe	Vulnerable, Marine, Migratory	Endangered
Ninox connivens	Barking Owl	-	Vulnerable
Tyto novaehollandiae	Masked Owl	-	Vulnerable
Ninox strenua	Powerful Owl	-	Vulnerable
Gastropoda			
Meridolum corneovirens	Cumberland Plain Land Snail	-	Endangered
Mammalia			
Cercartetus nanus	Eastern Pygmy-possum	-	Vulnerable
Dasyurus maculatus	Spotted-tailed Quoll	Endangered	Vulnerable
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	Vulnerable
Mormopterus norfolkensis	Eastern Freetail-bat	-	Vulnerable
Petaurus norfolcensis	Squirrel Glider	-	Vulnerable
Phascolarctos cinereus	Koala	-	Vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable

Species Name	*Common Name*	*EPBC Act 2000*	*TSC Act 1995 Classification*
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	Vulnerable
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	-	Vulnerable
Myotis macropus	Southern Myotis or Large-footed Myotis	-	Vulnerable
Scoteanax rueppellii	Greater Broad-nosed Bat	-	Vulnerable

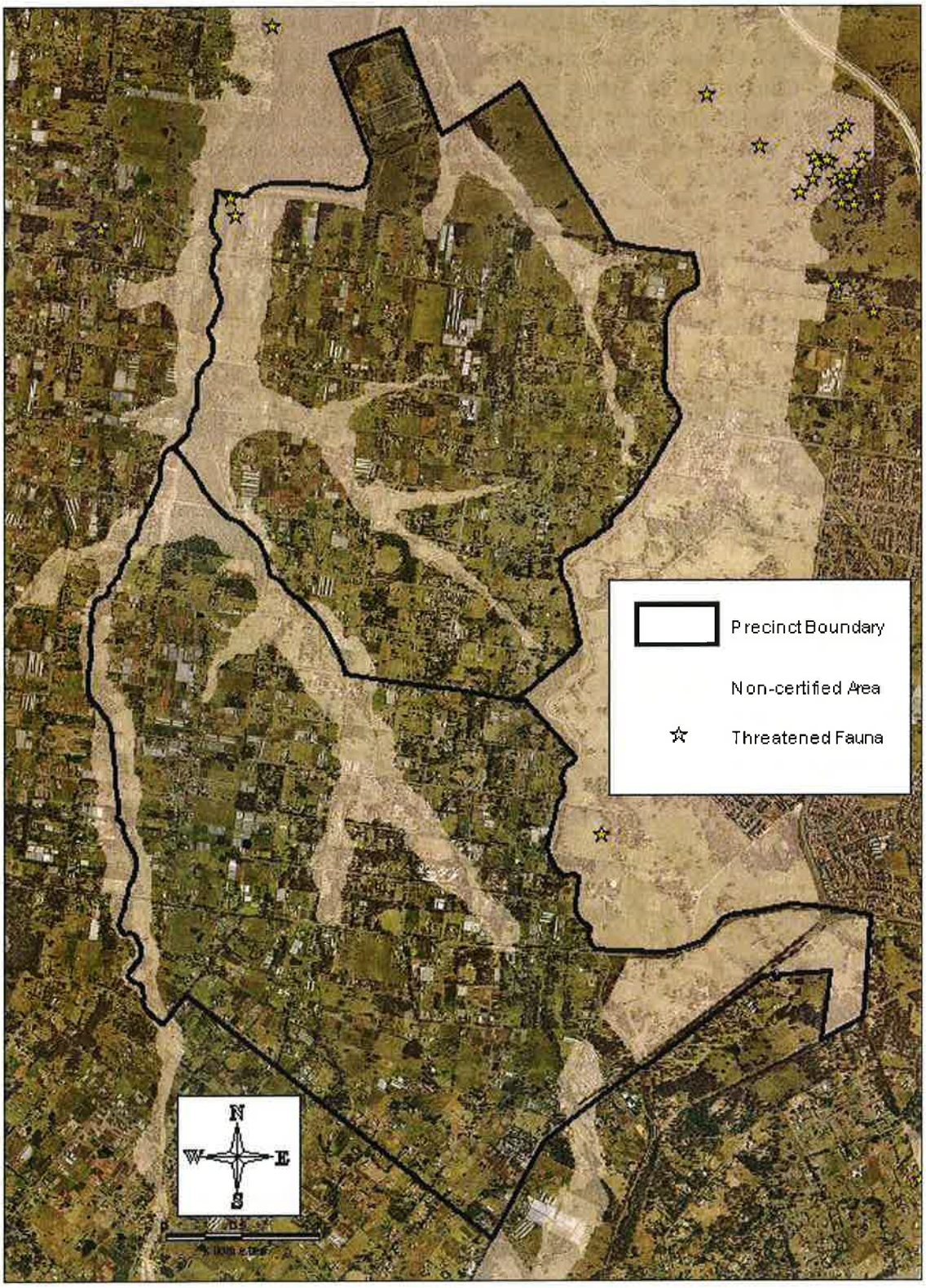

Figure 6.1 Map of threatened fauna recordings* within and surrounding the study site (NPWS, 2010).
*it is noted that multiple species sightings are recorded at the individual locations identified by NPWS (2010).

6.2 Literature and Database Searches Results for Flora

A search of the relevant online databases identified 2,178 flora species occurring in Liverpool and Camden LGAs. These species included 1,536 native species and 642 exotic species. A full floristic list for the Liverpool and Camden LGAs and a listing of threatened flora species is presented in **Appendix F**. Twenty-five species are listed under either the *TSC Act* or the *EPBC Act*.

Appendix G contains the results of the flora Likelihood of Occurrence assessment (**Section 4.1**). Based on the outcomes of this assessment the 17 threatened flora species known, likely or having the potential to occur on site are shown in **Table 6.2**. **Figure 6.2** shows the location of threatened fauna species known to have occurred in the vicinity of the site.

Table 6.2 Threatened flora species that are known, likely or have the potential to occur on site.

Species Name	Common Name	*EPBC Act 2000 Classification*	*TSC Act 1995 Classification*
Marsdenia viridiflora subsp. viridiflora		-	Endangered Population
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered
Allocasuarina glareicola		Endangered	Endangered
Dillwynia tenuifolia	Dillwynia tenuifolia, Kemps Creek	-	Endangered Population
Pultenaea parviflora		Vulnerable	Endangered
Pultenaea pedunculata	Matted Bush-pea	-	Endangered
Acacia pubescens	Downy Wattle	Vulnerable	Vulnerable
Eucalyptus benthamii	Camden White Gum	Vulnerable	Vulnerable
Eucalyptus scoparia	Wallangarra White Gum	Vulnerable	Endangered
Melaleuca deanei	Deane's Paperbark	Vulnerable	Vulnerable
Pterostylis saxicola	Sydney Plains Greenhood	Endangered	Endangered
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	-	Vulnerable
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Vulnerable	Vulnerable
Pomaderris brunnea	Brown Pomaderris	Vulnerable	Vulnerable
Persoonia hirsuta	Hairy Geebung	Endangered	Endangered
Persoonia nutans	Nodding Geebung	Endangered	Endangered
Pimelea spicata	Spiked Rice-flower	Endangered	Endangered

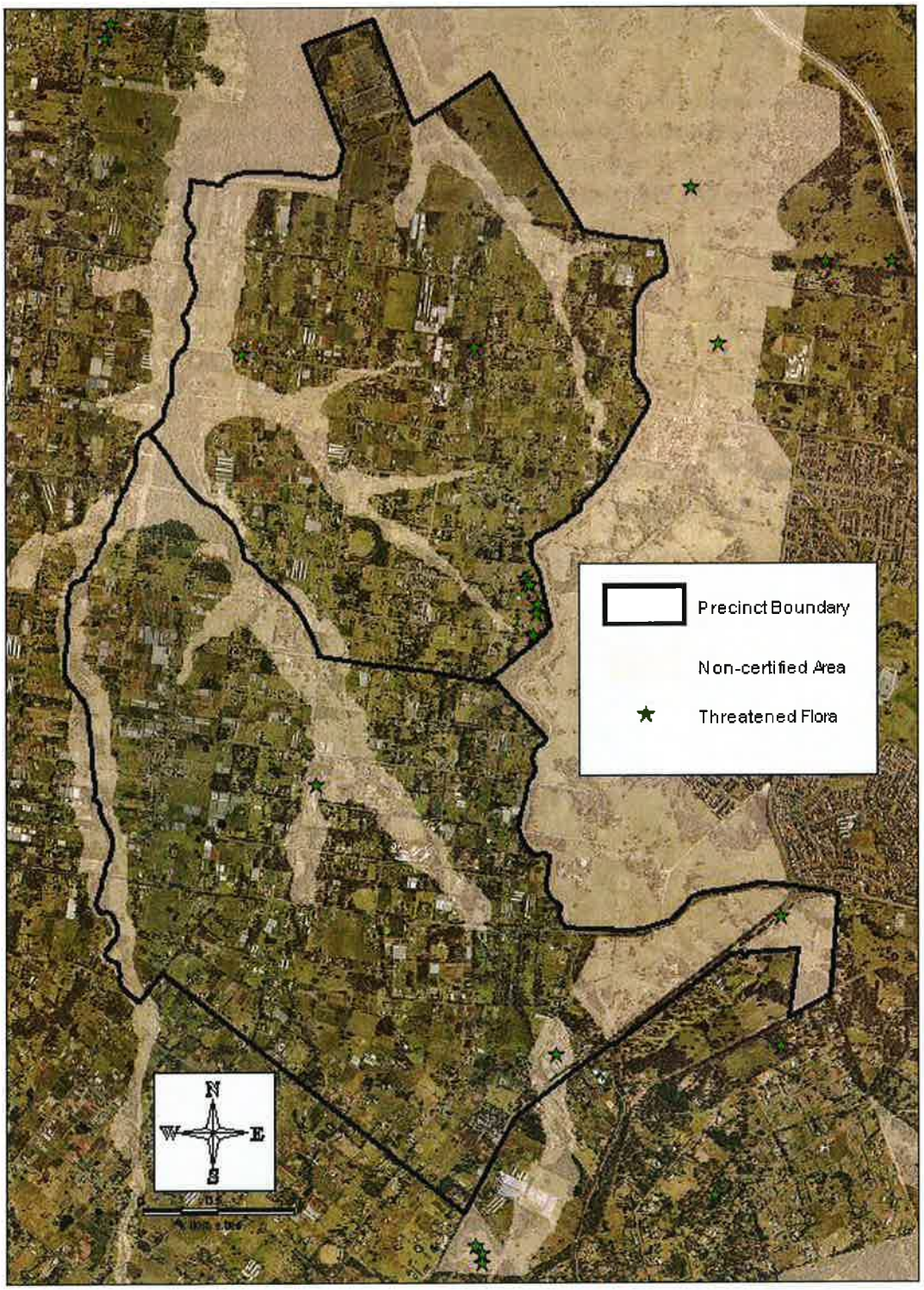

Figure 6.2 Threatened flora species located within and surrounding the study site (NPWS, 2010).
*it is noted that multiple species sightings may be recorded at the individual locations identified by NPWS (2010).

6.3 Results - Identification and Assessment of Benchmark Vegetation and Habitat

The identification and assessment of high quality vegetation areas capable as acting as benchmark Reference Sites within the precincts was difficult due to the lack of undisturbed remnant vegetation present. The majority of areas identified as Existing Native Vegetation (ENV) under the Biodiversity Certification, while seen to be consistent with the RBMs definition of ENV (i.e. greater than 10% canopy cover, a patch area of greater than 0.5ha and identified as vegetation in the draft *Growth Centres Conservation Plan*), were typically found to be lacking understory and groundcover components. The presence of characteristic groundcover and understory species are key elements of the Threatened Ecological Communities identified as occurring on site (**Section 2.2.5**). Consequently, the field studies included significant time in establishing the relative condition of vegetation and identifying potential benchmark areas.

The selected benchmark sites are shown in **Figure 6.3**. The majority of these are located within allocated nature reserves and on undeveloped flood prone land.

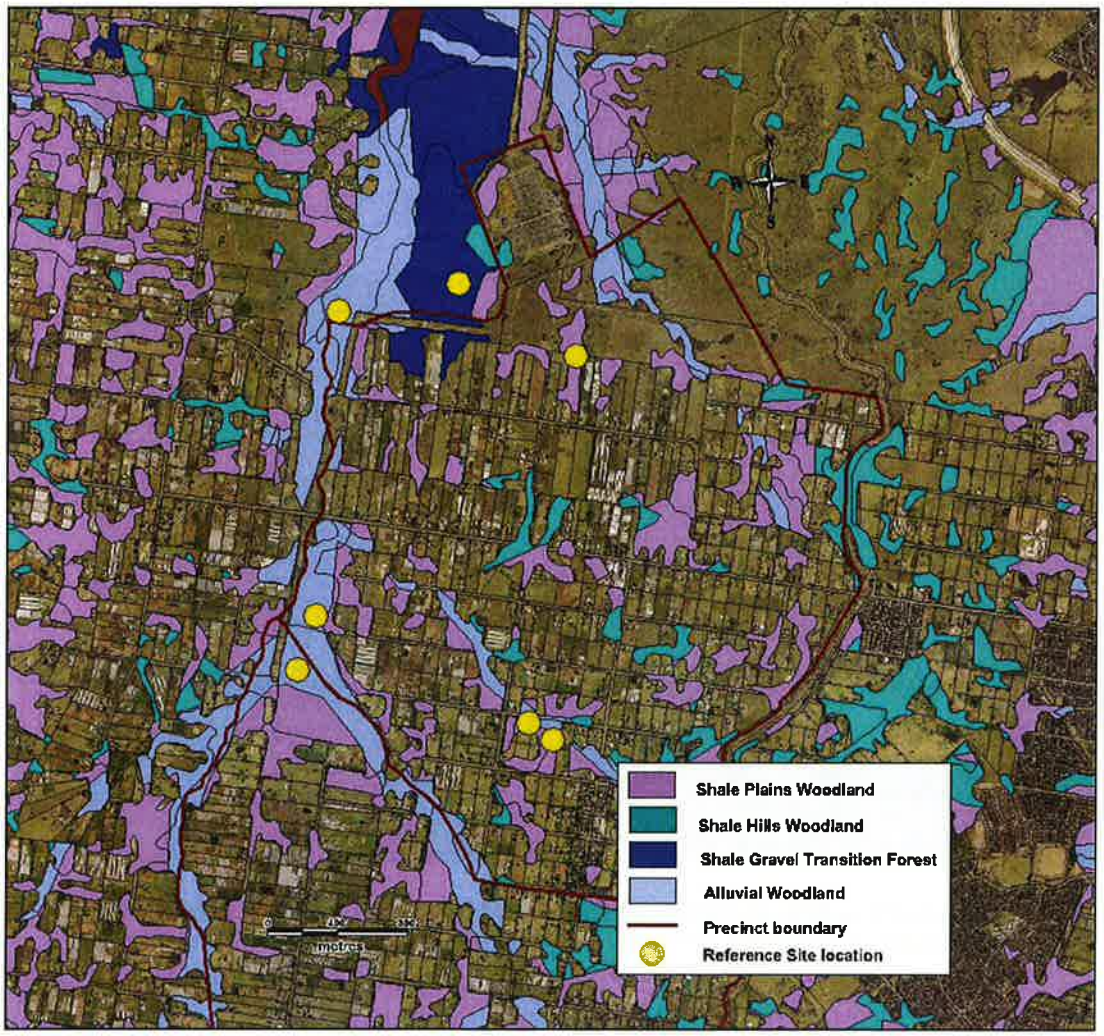

Figure 6.3 Location of Reference Sites

6.3.1 Full Floristic Diversity Field Survey Results

The field survey undertaken within the study site identified 96 flora species across the entire site. The species included 57 native species (i.e. 60%) and 39 exotic species (i.e. 40%). The full list of species recorded in the study site is in **Appendix H**.

The floristic results for the Reference Sites were seen to generally correspond to the characteristic species for the appropriate respective communities. For all three Threatened Ecological Communities present, the Reference Sites corresponded strongly in terms of the over-story, but varied significantly in terms of the understory and groundcover. The different community types (i.e. Alluvial Woodland, Shale Plains Woodland, and Shale Transition Forest) were distinguishable in terms of species composition (a maximum of 51% similarity was observed in terms of species composition between the Shale Plains Woodland and Alluvial Woodland Ecological Communities). The majority of exotic species were present within the ground and shrub layers, while the over-story layers were generally intact and dominated by native species.

A total of 12 species recorded in the study site are listed as noxious weeds, these are:

- *Araujia sericifera* (Moth Plant);
- *Asparagus asparagoides* (Bridal Creeper);
- *Eragrostis curvula* (African Lovegrass);
- *Ligustrum sinense* (Small-leaved Privet);
- *Lycium ferocissimum* (African Boxthorn)
- *Olea europaea* (Olive);
- *Onopordum acanthium* (Scotch Thistle)
- *Opuntia stricta* (Prickly Pear);
- *Senecio madagascariensis* (Fireweed);
- *Sida rhombifolia* (Common Sida)
- *Sonchus spp.* (Milk Thistle); and
- *Tredescantia albiflora* (Wandering Jew).

No threatened species were observed during the floristic diversity surveys.

6.3.2 Reference Site Community Structure Assessment Results

Vegetation communities encompassed by each Reference Site supported at least three community strata. The density and floristic diversity within each strata were influenced by the prevailing land management practices (i.e. biodiversity conservation versus cattle grazing).

Surveys revealed little difference in the structure and composition of vegetation identified by NPWS (2002) as Shale Hills Woodland or Shale Plains Woodland (**Figure 2.2**). Furthermore, elevation mapping done in GIS confirmed no significant elevation differences between the two vegetation communities. Therefore, Shale Hills and Shale Plains

Woodlands were grouped as one category (Shale Plains Woodland) as a Reference Site and this category was used for the Rapid Condition Assessments (i.e. Remote Sites identified as Shale Hills Woodland were compared against the Shale Plains Woodland Reference Site).

Detailed results of the assessments can be found in **Appendix I**.

As per **Table 6.3**, high quality Shale Plains Woodlands are comprised of eucalypt species in the T1 and T2 layers, while the shrub layer (S1) supported eucalypt saplings and *Bursaria spinosa*. The ground layer consists of various grass species and *Pratia purpurascens*. Across the three sites sampled, an average of 47% of species identified were weed species. This indicates that even the Reference Sites (the best habitat areas identified within the site) are disturbed and do not reflect the highest quality Shale Plains Woodland communities.

Table 6.3 Shale Plains Woodland Reference Site benchmark scores

Shale Plains Woodland					
Vegetation Layer	Present/ Absent	% Cover	Species Richness	Dominant Species	Non-Native Cover
T1	P	50%	2	Cm,Ec,Em, Et, Ee	0
T2	P	10%	2	Cm,Ec,Em, Et, Ee	0
Shrub	P	30%	5	Em,Cm, Bs	0
Ground	P	80%	20-25	Grass, Pp, Ta *Dichondra spp.*, *Desmodium spp.*	15%

Cm = *Corymbia maculata* Em = *Eucalyptus moluccana* Ec = *Eucalyptus crebra*
Et = *Eucalyptus tereticornis* Ee = *Eucalyptus eugenioides* Bs = *Bursaria spinosa*
Pp = *Pratia purpurascens* Ta = *Themeda australis*

High quality Alluvial Woodland sites (**Table 6.4**) are predominantly composed of eucalypt and She-oaks in the T1 and T2 layers. The shrub layers are comprised of *Acacia* species, *Melaleuca decora* and *Bursaria spinosa*, while the ground layer supports a variety of grass species. The Alluvial Woodland sites varied significantly in the proportionate contribution of non-native species to species richness (approximately 10% - 60% of species richness was composed of non-native species). The Alluvial Woodland habitat showing just 10% presence of non-native species was located within the Kemps Creek Nature Reserve immediately to the north of the Austral precinct (i.e. within vegetation classified as Higher Long Term Management Viability vegetation under the Growth Centres Conservation Plan (Eco Logical, 2007)).

Table 6.4 Alluvial Woodland Reference Site benchmark scores

Alluvial Woodland					
Vegetation Layer	Present/ Absent	% Cover	Species Richness	Dominant Species	Non-Native Cover
T1	P	50%	3	Em, Ea, Et, Cg	0
T2	P	40%	2	Md, Em, Ea, Et, Cg	0
Shrub	P	20%	4	Md, Bs, *Acacia spp.*	0
Ground	P	90%	15-20	Grass, Ta, Ma	15%

Ea = *Eucalyptus amplifolia* Cg = *Casuarina glauca* Em = *Eucalyptus moluccana*
Et = *Eucalyptus tereticornis* Md = *Melaleuca decora* Bs = *Bursaria spinosa*
Ta = *Themeda australis* Ma = *Microlaena australis*

High quality Shale Transition Forests (**Table 6.5**) are comprised of mostly eucalypts and *Melaleuca* species in the T1 and T2 layers. The shrub layer contains *Dillwynia sieberi*, *Melaleuca decora*, *Bursaria spinosa*, *Daviesia ulicifolia* and Lisanthe species. The ground layer consists of various grasses. Only a single patch of High quality Shale Transition forest was observed within or in close proximity to the study site; a site within the Kemps Creek Nature Reserve to the north of the Austral precinct. In terms of species richness this site had a 15% presence of non-native species.

Table 6.5 Shale Transition Forest Reference Site benchmark scores

Shale Transition Forest					
Vegetation Layer	Present/ Absent	% Cover	Species Richness	Dominant Species	Non-Native Cover
T1	P	40%	2	Em,Ef, Et, Md	0
T2	P	50%	2	Em,Ef, Et, Md	0
Shrub	P	20%	6	Ds,Md, Bs, Du, *Lissanthe spp.*	0
Ground	P	50%	20-25	Grass, Ta, Mss, *Lomandra spp.*,	15%

Ef = *Eucalyptus fibrosa* Em = *Eucalyptus moluccana* Et = *Eucalyptus tereticornis*
Md = *Melaleuca decora* Ds = *Dillwynia sieberi* Bs = *Bursaria spinosa*
Du = *Daviesia ulicifolia* Wg = *Wahlenbergia gracilis* Mss = *Microlaena stipoides var stipoides*
Ta = *Themeda australis*

Tables 6.3 – 6.5 provide details of the average results for the five elements (i.e. presence/absence, percentage cover, species richness, dominant species, non-native cover) assessed within each vegetative layer. These averages were utilised as the benchmarks for comparison for the Remote Site Assessment.

6.3.3 Remote Site Assessment Results

Appendix J contains the full results of the remote site assessment surveys across the 260 vegetation patches present. 151 different vegetation compositions were identified (i.e.

several of the Remote Sites were considered to have the same vegetative composition as other Remote Sites).

In terms of the presence / absence of vegetation layers, it was seen that across all vegetation community types approximately 56% of Remote Sites contained at least some vegetation within all four vegetation layers identified within the Reference Sites. The high proportion of Remote Sites in which a vegetation layer was absent (44%) reflects the agricultural and cleared nature of the area. Predominantly, the T2 and Shrub layers were identified as the absent layers.

In terms of percentage cover, it was found that across all vegetation community types only 2% of Remote Sites had a cover within 10% of the cover at the Reference Sites for all vegetation layers. The majority of sites received a percentage cover score of between 5 and 7.5, indicating a close similarity within one or two layers (typically the T1 layer and ground cover) while diverging in regards to the T2 and Shrub layers.

In terms of species richness, it was found that across all vegetation community types only ten Remote Sites demonstrated the same level of species richness as the Reference Sites and only three Remote Sites had an overall greater species richness than the Reference Sites. Within this species richness, the Dominant Species data indicated that on average the sites shared 5 common dominant species (across all layers (**Tables 6.3 – 6.5**)) with the Reference Sites. All sites were found to share at least 1 dominant species with the relevant Reference Site.

Non-native cover was difficult to assess in the Remote Assessment, particularly for the ground cover which utilised best judgement estimates. However, differences in comparison to the Reference sites were observed through the presence of non-native species in the canopy and shrubs layers which were more readily identifiable. Only 4% of Remote Sites had an equal or lesser cover of non-native species that the Reference Sites. This supports the identification of the Reference Sites as representative of high quality vegetation within the study site.

Combining these five elements (i.e. presence/absence, percentage cover, species richness, dominant species, non-native cover) together provided an overall Site Condition Value for each Remote Site out of 50 (Reference Sites were assigned a score of 50). The highest Site Condition Value of the Remote Sites assessed was 44.36, and the lowest 12.92. The majority of the Remote Sites received a score of at least 25 (65%). Only 5% of Remote Sites were assigned a score greater than 40. Site condition values of the communities assessed provide a critical element in evaluating the communities Functional Conservation Value (**Figure 4.2, Section 6.4.1**).

6.3.4 Fauna Habitat Assessment

The only fauna sampling undertaken during this study was opportunistic sightings during site inspection. No threatened species were observed to occur on site. The following species were observed during the course of the Remote and Reference Site Assessments:

Aves

- Noisy Miner (*Manorina melanocephala*);
- Bell Miner (*Manorina melanophrys*);

- Australian Magpie (*Cracticus tibicen*);
- Laughing Kookaburra (*Dacelo novaeguineae*);
- Galah (*Cacatua roseicapilla*);
- Sulphur Crested Cockatoo (*Cacatua galerita*);
- Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*);
- Red-rumped Parrot (*Psephotus haematonotus*);
- Magpie-lark (*Grallina cyanoleuca*);
- White-faced Heron (*Ardea novaehollandiae*);
- Torresian Crow (*Corvus orru*);
- Superb Fairy-wren (*Malurus cyaneus*);

Reptilia

- Red-bellied Black Snake (*Pseudechis porphyriacus*);
- Common Garden Skink (*Lampropholis guichenoti*);
- Eastern Water Skink (*Eulamprus quoyii*);
- Bluetongue lizard (*Tiliqua scincoides scincoides*);
- Eastern Water Dragon (*Physignathus lesueurii lesueurii*);
- Lace monitor (*Varanus varius*); and

Mammalia

- Fox (*Vulpes vulpes*).

In addition to the opportunistic sightings, a fauna habitat assessment was undertaken. The full results of the habitat assessment are provided in **Appendix K**.

Across all seven Reference Sites (**Figure 6.3**) assessed for fauna habitat, habitat features recorded included, 2 hollow bearing trees, 17 fallen logs, 9 hollow stumps, 1 digging (most likely rabbit), 10 scats, 2 tree hollows at the base of trees, and 1 Eastern Dwarf Tree Frog (*Littoria fallax*) call.

The single Shale Transition Forest Reference Site (within the Kemps Creek Nature Reserve) had the most number of fauna habitat features recorded with 2 hollow bearing trees, 3 fallen logs, 4 hollow stumps, and 4 varieties of scat (most likely including Brushtail Possum (*Trichosaurus vulpecula*), rabbit spp. and wallaby spp.).

6.3.5 Threatened Flora Survey Results

Condition 17 of the Relevant Biodiversity Measures for the Biodiversity Certification for the South West Growth Centres requires that potential populations of *Acacia pubescens* are

surveyed at Thirty-Second Avenue, Austral (**Figure 6.4**). A targeted survey was conducted to confirm and record the presence of this species and determine its habitat quality.

Figure 6.4 *Acacia pubescens* field survey results

During the field survey, six individual *Acacia pubescens* specimens were recorded (see **Figure 6.4**). The shrubs were located in a highly disturbed area adjacent to Thirty-Second Avenue in Austral. Four of the shrubs were situated alongside the Sydney Catchment Authority Upper Canal, and two shrubs were located on neighbouring farmland. The land surrounding the canal and the farmland were both cleared of much of the vegetation apart from other shrubs growing alongside the *Acacia pubescens*. Further details of the investigations into *Acacia pubescens* have been provided in a separate report.

As shown in **Figure 6.4**, the land surrounding the *Acacia pubescens* populations previously identified by the DoP, is also markedly disturbed and cleared of most vegetation.

No other threatened flora species were observed during any of the field work undertaken during the site assessment.

6.4 Results of Ecological Value Assessment

The Ecological Value ascribed to all 260 sites was determined through the cumulative sum of three components (**Section 4.5**):

- Functional Conservation Value;
- Threatened Status Value; and
- Recovery Potential Value.

Appendix N provides the full results of the Ecological Value assessment.

6.4.1 Functional Conservation Value

The Functional Conservation Value was composed of the Site Condition Value (**Section 6.3.3)** as well as estimations of the geospatial character (i.e. patch size and perimeter / area ratio) and connectivity of the Remote and Reference Sites (**Section 4.5.1**). Combined, these elements provided a score out of 150 for each Remote and Reference Site.

Of the 260 individual communities, only 24% of sites were found to have Functional Conservation Values of over 100. The majority of these sites were those associated with Kemps Creek due to:

- Larger patch sizes;
- The undeveloped / undisturbed nature of the riparian vegetation; and
- The continuity of vegetated areas along the creek line.

The majority of the Remote Sites scored between 50 and 100 (68%) with only 7% scoring less than 50. The majority of sites scoring less than 50 consisted of communities with small patch areas and were typically isolated pockets of roadside vegetation.

6.4.2 Threatened Status Value

The assessment of Threatened Status Value (**Section 4.5.2**) incorporated the known presence of the threatened species of flora or fauna, the Functional Conservation Value (**Section 6.4.1**), a threatened species likelihood of occurrence assessment and the specific habitat type of the vegetation patch in question. The decision matrix utilised to assign value is provided in **Section 4.5.2**.

Of the 260 distinct vegetation communities assessed, only 6 received the highest rating. The majority of sites (65%) received a mid range score, reflecting the number of threatened species known to occur within the study site and the generally low-medium Functional Conservation Values (**Section 6.4.1**).

6.4.3 Recovery Potential Value

The assessment of Recovery Potential (**Section 4.5.3**) was based upon the known land use and condition within the vegetation community of interest, its connectivity to surrounding vegetation, and the presence of saplings and weeds within the community. A decision matrix

(**Section 4.5.3**) was utilised to assign each patch a score from 1 – 6 (scaled to 25 – 150 for equal weighting with the Threatened Status Value and Functional Conservation Value).

Only 2 of the 260 identified vegetation communities were assigned a value of 150, with a further 23 scoring 125. Approximately 30% of the vegetation communities assessed received values of 50 or less (i.e. the lowest two scores within the decision matrix), and in one case, a vegetation community was assigned a score of zero reflecting that the vegetation community was identified to be on a site of an electrical easement which is regularly cleared for operational reasons. Due to the systematic clearing of vegetation, the recovery potential of this site is considered to be nil.

6.4.4 Total Ecological Value

Combining these three (**Section 6.4.1** – **Section 6.4.3**) elements together provided a Total Ecological Value score out of 450 for each of the 260 identified vegetation communities (**Appendix N**). To allow ease of comparison, vegetation communities with a score greater than or equal to 300 were classified as "High Quality", while communities with a score greater than or equal to 150 but less than 300 were classified as "Medium Quality". Vegetation communities with a score less than 150 were classified as "Low Quality".

The number of vegetation communities with Total Ecological Values of High, Medium and Low, and the total area of these classifications are as follows:

Total Ecological Value	Number of patches	% of Patches	Total Area (Ha)	% of Area
High	57	22%	332.99	51.08%
Medium	195	75%	315.21	48.35%
Low	8	3%	3.72	0.57%
TOTAL	**260**	**100%**	**651.92**	**100%**

It is considered that communities classified as having a High total ecological value should be conserved where possible as they represent the most valuable communities within the local region and they may be able to contribute toward the 2000 ha of ENV that is to be protected as one of the conditions for Biodiversity Certification. (**Figure 6.5** shows the distribution of high, medium and low quality vegetation in the Austral and Leppington North precincts). Medium Quality communities are considered to form an important part of the local ecosystem which, with appropriate management, can provide valuable natural habitat and social recreation opportunities (particularly where large areas of Medium Quality vegetation are in close proximity to each other). Low Quality communities are considered to be severely degraded through clearing, disturbance or isolation. Such communities are considered to contribute little benefit to the overall ecological value of the area.

The abundance of communities with a Medium total ecological value reflects the partial degradation of vegetation observed in site inspections whereby agricultural grazing and clearing of the shrub and ground cover has diminished the ecological value of the vegetation, while the canopy layer has remained largely intact.

6.5 Vegetation Mapping

The distribution of the vegetation community classes (i.e. High, Medium or Low Quality total ecological value) across the precincts was mapped in GIS and is shown in **Figure 6.5**.

The majority of high ecological value vegetation occurs within the riparian corridors associated with Kemps Creek and its tributaries (*c.f.* **Figure 2.1**). **Figure 6.5** indicates that the majority of high ecological value vegetation also falls within non-certified land (**Section 1.2**). Any clearance of land within these areas would require further assessment.

Figure 6.5 also shows low ecological value vegetation present is typically comprised of small, isolated areas of vegetation with little connectivity, particularly within the Leppington North Precinct.

Figure 6.6 shows all vegetation ground truthed by Cardno as well as vegetation identified as ENV by Cardno (c.f. **Figure 4.4**).

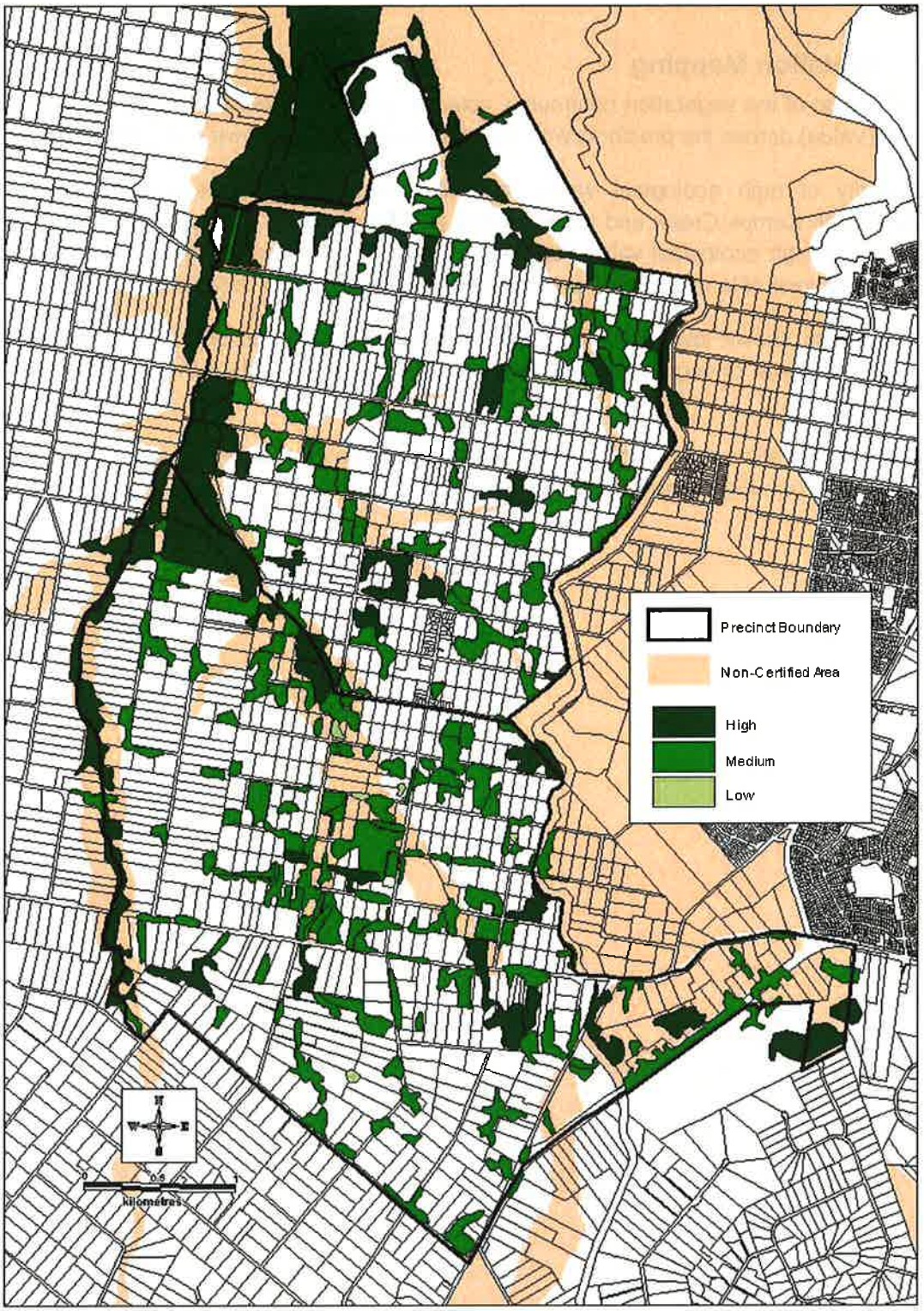

Figure 6.5 Ground truthed (Cardno, 2010, 2012) vegetation results showing communities with high, medium and low total ecological value vegetation quality results within the study site within certified and non-certified areas.

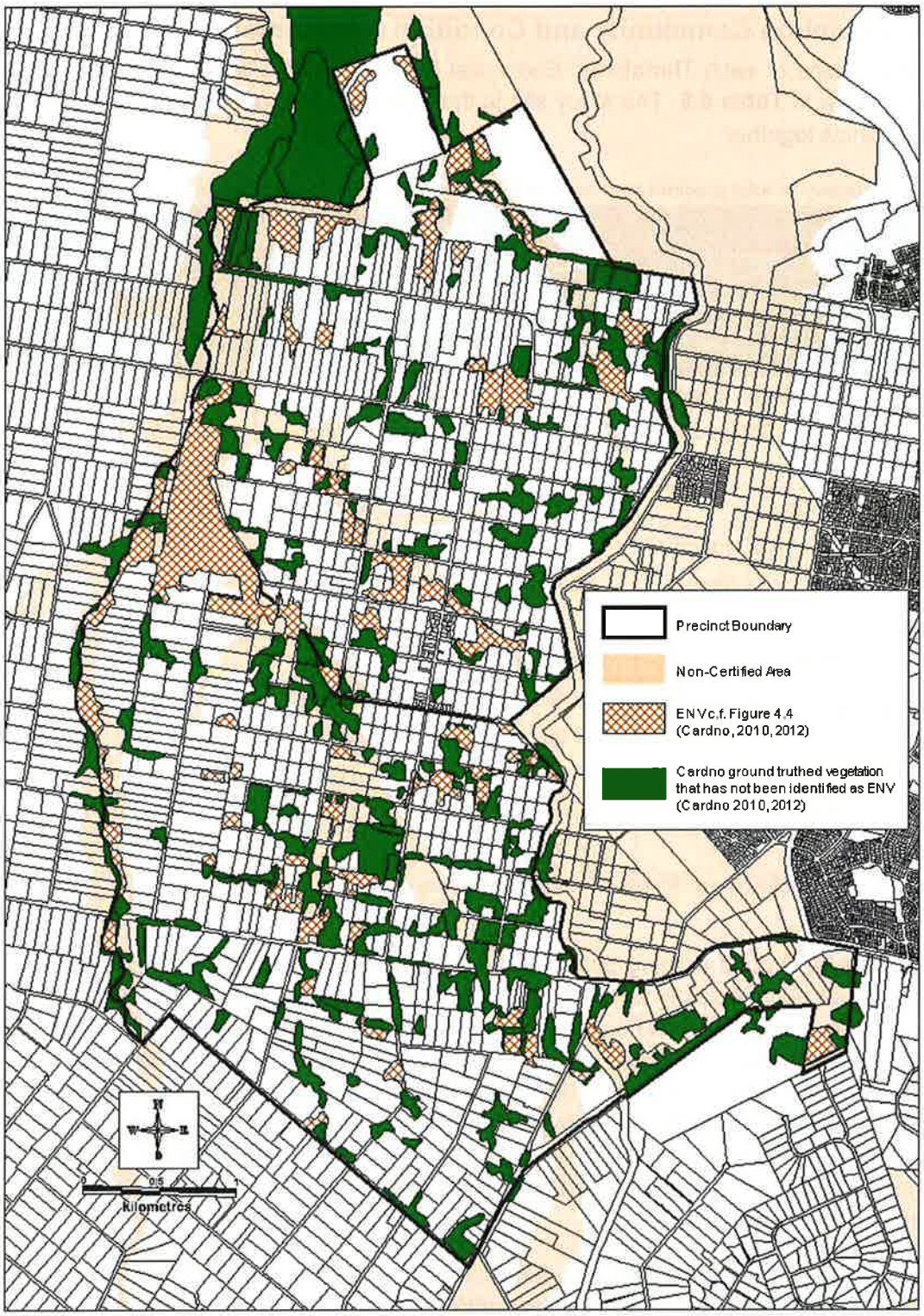

Figure 6.6 All Cardno ground truthed vegetation showing ENV and non ENV.

6.6 Vegetation Community and Condition Assessment

Area calculations of each Threatened Ecological Community type within the study site are provided below in **Table 6.6**. The study site is the total land area of Austral and Leppington North precincts together.

Table 6.6 Summary of total precinct area occupied by Threatened Ecological Communities

Community	Condition Code as defined by NPWS	Total Hectares as defined by NPWS	% of Study site as defined by NPWS	Field Survey Vegetation Quality (Ecological Value) Results	Total Hectares	% of Study site
Shale Plains Woodland	ABC (good)		6.4	Low	0.91	0.04
	TX (poor)	250.47	12.3	Medium	267.85	13.21
				High	113.06	5.57
Total		381.11	**18.7**	**Total**	**381.8**	**18.8**
Alluvial Woodland	ABC (good)	114.43	5.6	Low	2.81	0.14
	TX (poor)	52.74	2.6	Medium	38.24	1.89
				High	82.46	4.07
Total		167.17	**8.2**	**Total**	**123.5**	**6.1**
Shale/Gravel Transition Forest	ABC (good)	10.46	0.52	Low	0.00	0.00
	TX (poor)	0.00	0	Medium	0.00	0.00
				High	3.38	0.17
Total		10.46	**0.52**	**Total**	**3.4**	**0.2**
Total		**558.75**	**27.42**		**508.7**	**25.1**

Refer to **Section 2.2.5.1 for explanation of condition codes assigned.

The field survey ground truthing undertaken for this study and the NPWS (2002a) survey both show that approximately 25% of the study site supports an EEC under the *TSC Act*. The field survey results indicate only a small percentage (in terms of total EEC area) of the EECs are of low quality (0.73%) and the majority of the EECs are comprised of medium quality vegetation (approximately 60.17%) and high quality vegetation (approximately 39.10%). This differs from the percentage distribution of classes by number of communities (e.g. 3% of communities are of Low Quality (**Section 6.4.4**)). This difference reflects the tendency for High Quality vegetation to have larger patch areas, and Low Quality vegetation to have smaller patch areas.

Additionally, there was a difference in identification of Shale/Gravel Transition Forest areas and Shale Plains Woodland areas. The NPWS (2002) survey identified approximately 7.08ha more of the Shale/Gravel Transition Forest than the ground truthing survey. This has been attributed to contradictory identification of an area of EEC in the northwest corner of Austral (**Figure 6.7**) The ground truthing survey has identified this area as Shale Plain Woodland, while the NPWS survey identified it as Shale/Gravel Transition Forest.

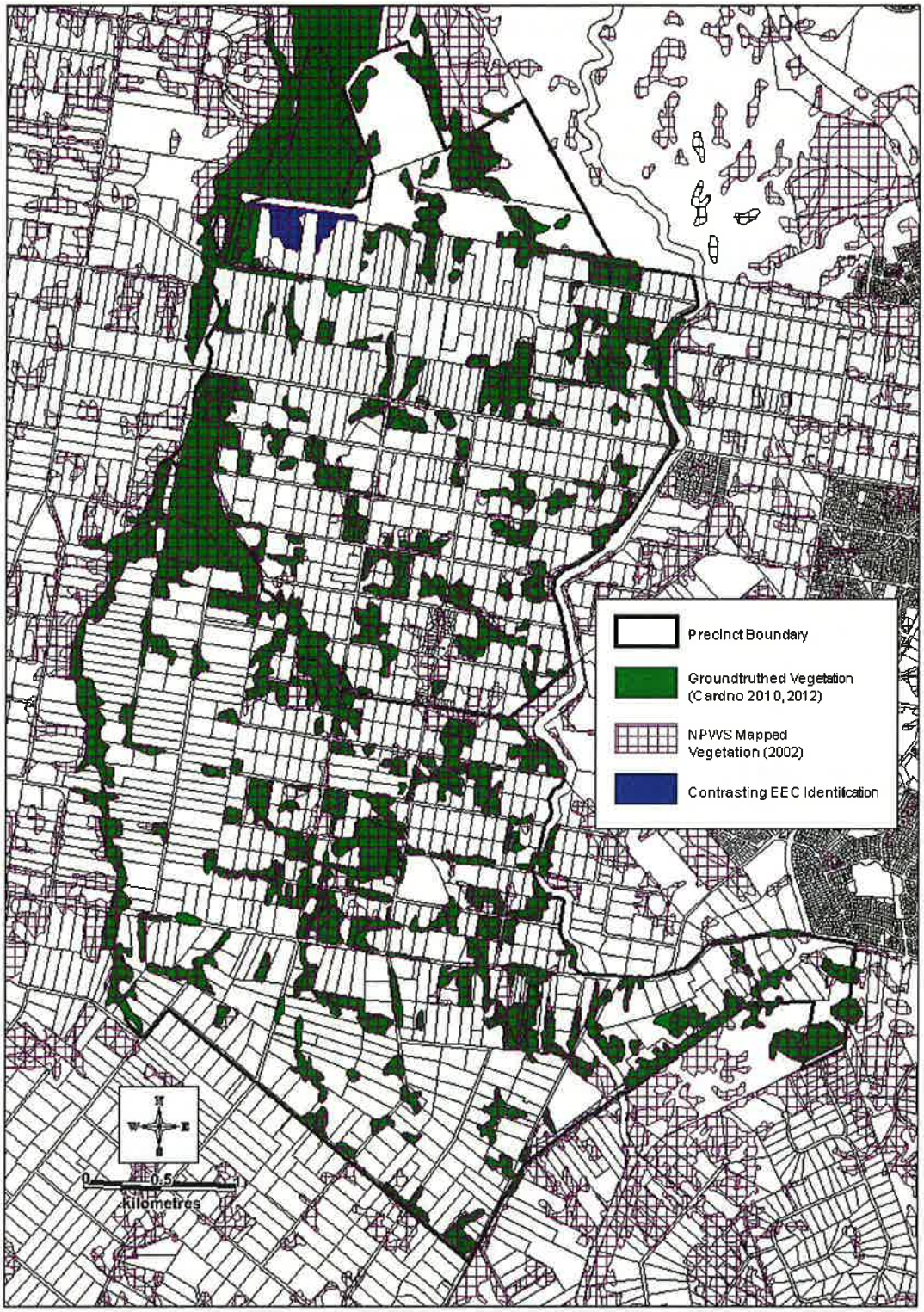

Figure 6.7 Comparison of ground truthed vegetation extents with NWPS extents, showing contrasting EEC types.

Table 6.7 reports the area composition of the various EECs within the Biodiversity Certified areas of the precincts. In comparison to the results of **Table 6.6**, which covers the entire Precinct area, it can be seen there is a significant reduction in the amount of High Ecological Value Vegetation and a corresponding increase in the proportion of Medium Ecological Value Vegetation. The amount of Alluvial Woodland within Biodiversity Certified Land is minimal.

Table 6.7 Summary of area occupied by EECs and their condition within Certified Land

Community	Field Survey Vegetation Quality (Ecological Value) Results	Total Hectares Within Certified Areas	% of Study Site (the total land area of Austral and Leppington North precincts).
Shale Plains Woodland	Low	0.90	0.04
	Medium	222.14	10.95
	High	66.56	3.28
	Total	**289.60**	**14.27**
Alluvial Woodland	Low	1.20	0.06
	Medium	10.75	0.53
	High	8.34	0.41
	Total	**20.29**	**1.00**
Shale/Gravel Transition Forest	Low	0.00	0.00
	Medium	0.00	0.00
	High	1.36	0.07
	Total	**1.36**	**0.07**
	Total	**311.25**	**15.3**

The results also show that the most dominant EEC within the certified land area is the Shale Plains Woodland type, making up approximately 14% of the study site (**Table 6.7**). The Shale Plains Woodland communities also comprise the highest percentage of high quality areas within certified land areas covering approximately 3.28% (66.56ha) of the study site. Shale/Gravel Transition Forest communities are sparsely located on certified land and only make up a small percentage of the study site with approximately 0.07% (**Table 6.7**).

6.6.1 Consistency of Existing Native Vegetation

A comparison of the native vegetation, on non-certified land, mapped by Cardno in 2010 and 2012 during the ground truthing survey (**Section 4.2**) to ENV (as identified by DoPI 2011[2]) on non-certified land, shows a difference between the data sources. Discrepancies are largely attributed to the fact that vegetation is known to have been cleared since Cardno's groundtruthing in 2010 which DoPI has mapped in their annual vegetation reporting, and the

[2] ENV as defined by the RBMs means areas of indigenous trees (including any sapling) that:
(a) has 10% or greater over-storey canopy cover present;
(b) is equal to or greater than 0.5 ha in area; and
(c) is identified as "vegetation" on maps 4 and 5 of the draft *Growth Centres Conservation Plan*

granting of approval to clear vegetation during construction of the SWRL. These known vegetation changes have been accounted for in Cardno's ground truthed ENV mapping, and the calculations presented in this report. The results from the ground truthing survey found approximately 120.71ha of native vegetation on non-certified land which meets the ecological criteria for ENV[3], while the ENV on non-certified land shown in the draft *Growth Centres Conservation Plan* (revised following Cardno Ground Truthing) displays approximately 101.58ha of ENV (**Table 6.8**). The ground truthing survey recorded a 43.58ha increase of native vegetation, of which 19.13ha is on non-certified land, which has been termed "Additional High Conservation Value Vegetation" or AHCVV (**Figure 6.8**). Whilst AHCVV meets the ecological criteria for ENV, these additional areas are not eligible to be counted toward the 2000 ha of ENV that is to be protected because one of the conditions for Biodiversity Certification is that areas must be identified in the draft *Growth Centres Conservation Plan*.

Table 6.8 Comparison of Native Vegetation identified in the ground truthing field survey and ENV identified in the draft *Growth Centres Conservation Plan*.

ENV on non-certified land as identified in the RBMs (Reduced following Cardno Ground Truthing)	Ground Truthing Field Survey of native vegetation which meets the ecological criteria for ENV on non-certified land	AHCVV on non-certified land	Areas previously identified as ENV which field survey identified as non-ENV within non-certified land
101.6ha	120.7ha	19.1ha	16.5ha
22.0% of non-certified land	**26.2%** of non-certified land	**4.2%** of non-certified land	**3.6%** of non-certified land

Figure 6.9 shows areas of vegetation identified as ENV in the draft *Growth Centres Conservation Plan* that the ground truthing survey found not to be ENV within certified land.

The differences between ground truth mapping and the ENV identified in the RBMs are considered to be principally due to the following reasons:

- Differences in survey methodologies: To support this report, Cardno ecologists conducted on-site field surveys to estimate canopy cover and ground-truthing of vegetation extents to verify patch size, whereas the ENV survey provided by DoPI is primarily based on remote aerial imaging.
- Access to subject sites was not always possible during the ground truthing, with the result that some of the ground truth mapping was conducted remotely as described in **Section 4.3.** This means that the accuracy with which each parcel of land can be mapped was partly dependent on the view which could be obtained in the field at the time of mapping.
- Due to the requirement for vegetation to be a minimum path size of 0.5ha in order to be classified as ENV, the exact location of a patch boundary can influence whether or not vegetation is classified as ENV. In particular, in the case where patches of vegetation are in close proximity, mapping them as two discrete patches could mean that the vegetation does not meet the definition of ENV, whereas mapping them as one larger patch may lead to a combined area >0.5 ha, and classification as ENV.

[3] Ecological criteria for ENV only needs to meet criteria (a) and (b) of the RBMs definition of ENV and does not need to be identified on maps 4 and 5 of the draft *Growth Centres Conservation Plan*.

In general the field survey results are considered to be relatively consistent with the aerial maps of ENV. It is noted that any inaccuaracy in boundaries of vegetation which is not classified as ENV will not affect the results or conclusions of the report, since only land meeting the definition of ENV is used when calculating the area of ENV which will be protected within the precincts.

The conditions of Biodiversity Certification Order require that a total of 107.14ha of ENV be protected. This comprises:

- 48ha of ENV be protected in Austral;
- 52ha in Leppington North; and
- 7.14ha in investigation areas (details of investigations areas can be found in **Section 1.1**).

Ground truthing indicates that the actual area of ENV in non-certified lands is 101.58ha. This has incorporated the 0.52ha of ENV on non-certified land known to be impacted by the approved South West Rail Link (SWRL). The SWRL development would offset the amount of non-certified ENV that would be impacted, and therefore, the amount of ENV within the Precincts that requires protection under the Biodiversity Certification Order has been reduced by 0.52ha. This results in a revised total of 106.62ha of ENV requiring protection under the Biodiversity Certification Order.

Any development of land within the area of the non-certified ENV communities would be required to comply with the relevant provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Threatened Species Conservation Act 1995* (TSC Act).

The Austral and Leppington North Precinct Plan proposes the protection of 116.62ha of ENV within both Precincts. This is 10.00ha more than is required to be protected by the Biodiversity Certification Order.

It is proposed that the boundaries of the non-certified areas are changed (refer to Annex E in **Appendix M**), mostly based on the 1:100 year floodline, and to ensure that vegetation to be protected outside floodprone land is also on non-certified land. Under the proposed new boundary lines, the ground truthing indicates the area of ENV in non-certified areas would be approximately 116.62ha. This is 10.00ha more than is required to be protected by the Biodiversity Certification Order (Annex C in **Appendix M**).

Table 6.9 presents the results of the Biodiversity Conservation Assessment for the currently proposed non-certified land boundaries under the final Precinct Plan.

	Key Statistics	Data source / comment	Area of ENV (ha)
A	ENV required by the Biodiversity Certification Order to be protected within Austral and Leppington North Precincts and investigation areas prior to the impact from the SWRL	48ha in Austral, 52ha in Leppington North, and 7.14ha in Investigation Areas	107.14ha
B	Approved Impacts on ENV by SWRL in non-certified areas	Calculated from Cardno's ground truthed	0.52ha

	Key Statistics	Data source / comment	Area of ENV (ha)
		ENV (Figure 4.4) and maps provided	
C	ENV required by the Biodiversity Certification to be protected within Austral and Leppington North Precincts and investigation areas	Requirement of Biodiversity Conservation Order =A-B	106.62ha
D	ENV which is currently in non-certified areas which will become certified following the proposed certified land boundary changes	Calculated from Cardno's ground truthed ENV (Figure 4.4), current and proposed non-certified area (Appendix M Annex E)	4.03ha
E	ENV which is currently in certified areas which will become non-certified following the proposed certified land boundary changes	Calculated from Cardno's ground truthed ENV (Figure 4.4), current and proposed non-certified area (Appendix M Annex E)	22.48ha
F	Total ENV protected within Austral and Leppington North precincts under the Proposed Non-Certified Land Boundaries	Calculated from Cardno's ground truthed ENV (Figure 4.4), and proposed non-certified area (Appendix M Annex E)	116.62ha
G	**Total ENV to be protected beyond the Biodiversity Certification Order requirement**	**=F-C**	**10.00ha**

It is recommended that non-certified ENV areas are avoided for any development proposals and that non-certified areas recorded as ENV (as mapped in both the draft *Growth Centres Conservation Plan* and identified during the ground truthing surveys) are retained to the greatest extent practical.

Consideration should also be given to the potential to utilise the quantity of ENV identified on site as offset areas for removal of other communities within ENV elsewhere within the Sydney Growth Centres area in accordance with the issued Biodiversity Certification and RBMs.

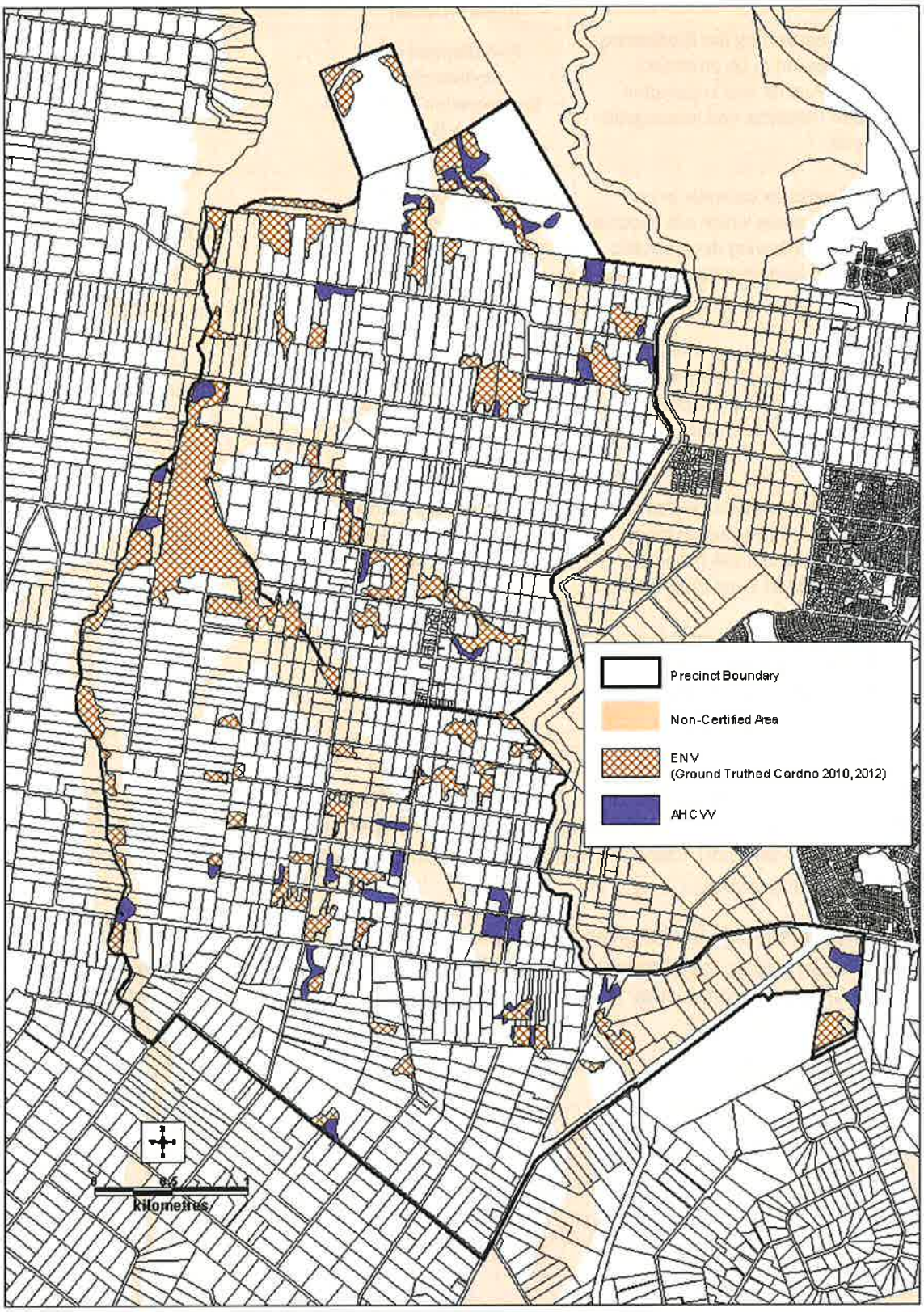

Figure 6.8 Vegetation ground truthed (Cardno, 2010 2012) which meet the ecological criteria for ENV, termed "Additional High Conservation Value Vegetation" (AHCVV)

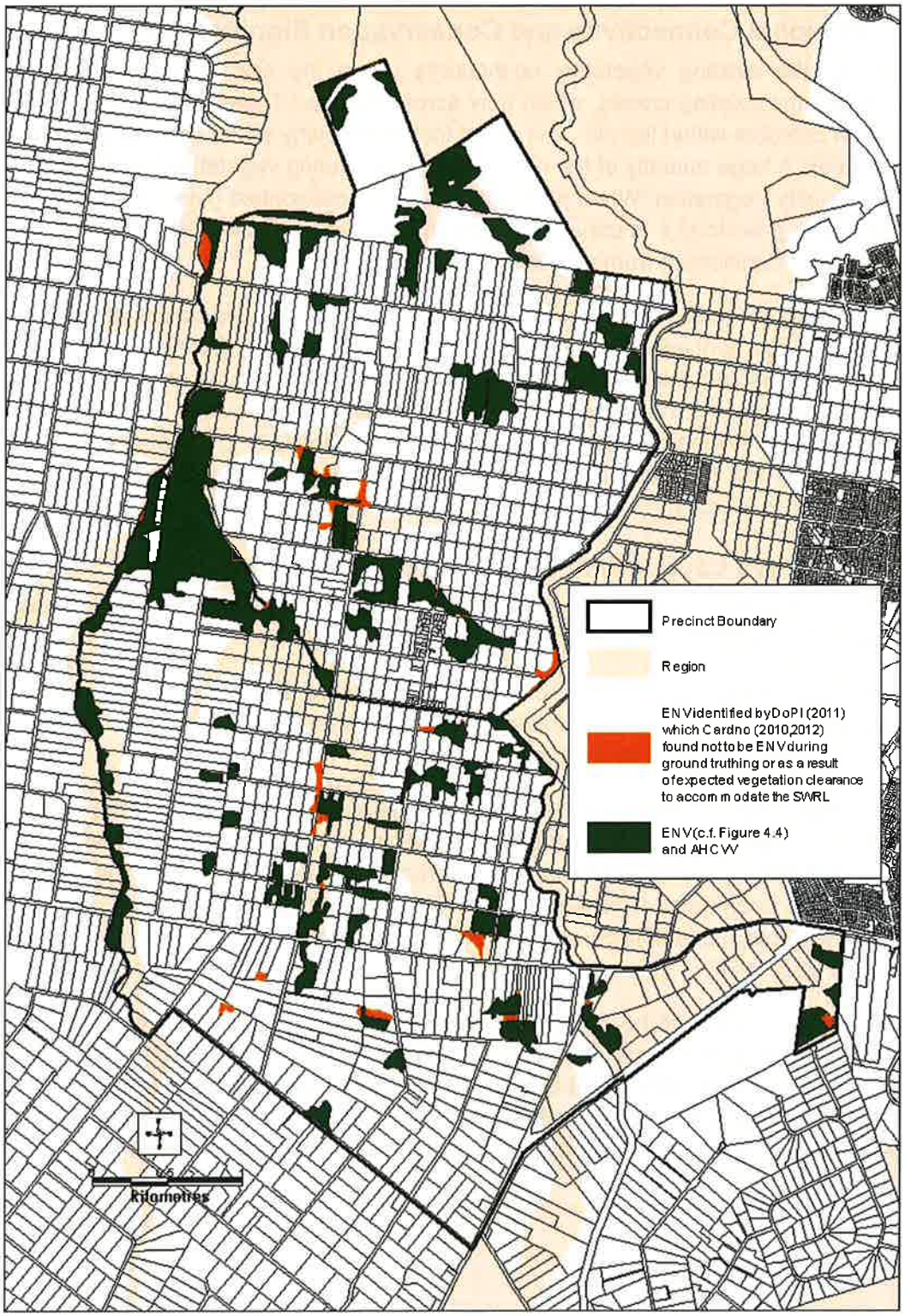

Figure 6.9 ENV identified by DoPI which Cardno identified not to be ENV following the ground truth survey (Cardno, 2010, 2012), or as a result of expected vegetation clearance to accommodate the SWRL.

6.7 Regional Connectivity and Conservation Significance

In general, the existing vegetative connectivity within the site is provided through the alignment of the existing creeks, which flow across the site. There are no other continuous vegetation corridors within the site. It is noted that, particularly within Leppington North along Bonds Creek, a large quantity of the riparian and surrounding vegetation has been classified Medium Quality Vegetation. When placed within a regional context (i.e. connectivity to areas outside of the precincts) it is considered that these Medium Quality Vegetation areas may take on higher significance from an ecological point of view.

It should also be recognised that a significant amount of revegetation work has been undertaken to the northeast of the study site, within the Western Sydney Parklands, which may provide valuable habitat connectivity into the future. Similarly, the existing Kemps Creek Nature Reserve in the northwest corner of the study site provides the highest quality vegetation within the region and has some existing connectivity to vegetation communities within the study site (**Figure 6.5**). It is considered that these connections are of high value and should be conserved.

6.8 Indicative Layout Plan Consistency Assessment

The ILP, in its current form, will conform to the Biodiversity Certification Order through the retention of the vegetation within the non-certified areas.

The Precinct Plan proposes new certified land boundaries and other mechanisms that will protect a total of 116.62ha of ENV over both Precincts and the investigation areas. This is 10.00ha more than required by the Biodiversity Order.

In comparison to the original ENV mapping provided by OEH and shown in the draft *Growth Centres Conservation Plan*, the ground truthing survey recorded a 43.58ha increase of native vegetation, of which 19.13ha is in currently non-certified areas. The extra native vegetation has been termed "Additional High Conservation Value Vegetation" or AHCVV as it meets the ecological definition of ENV (i.e. a greater than 0.5 patch area, and a canopy cover of at least 10%).

The total ENV required to be protected by the Biodiversity Certification within Austral and Leppington North Precincts is 106.62ha. Under the proposed non-certified land boundary lines (Annex E of **Appendix M**), the ground truthing indicates the area of ENV in the non-certified areas is approximately 116.62ha. This is 10.00ha more than is required to be protected by the Biodiversity Certification Order (Annex C in **Appendix M**).

7 Results – Aquatic Habitats

7.1 Literature and Database Searches

The literature and database searches undertaken identified a range of fish species as likely or known to occur within the site. A list of these species is provided in **Table 7.1**. Only two threatened fish species, five threatened amphibian species, two insects and one plant species were considered as potentially occurring on site.

Table 7.1 Aquatic species list of species likely or known to occur on-site

Species Name	Common Name	*EPBC Act 2000 Classification*	*TSC Act 1995 Classification*
Fish			
Mordacia mordax	Shortheaded lamprey		
Anguilla australis	Shortfinned eel		
Anguilla reinhardtii	Longfinned eel		
Potamalosa richmondia	Freshwater herring		
Galaxias maculatus	Common jollytail		
Retropinna semoni	Australian smelt		
Prototroctes maraena	Australian grayling	Vulnerable	Protected***
Carassius auratus	Goldfish*		
Cyprinus carpio	Common carp*		
Tandanus tandanus	Freshwater catfish**		
Gambusia holbrooki	Mosquito fish*		
Psuedomugil signifer	Pacific blue-eye		
Notesthes robusta	Bullrout		
Ambassis agassizii	Olive perchlet**		
Macquaria australasica	Macquarie perch	Endangered	Vulnerable
Macquaria novemaculeata	Australian bass		
Myxus petardi	Freshwater mullet		
Mugil cephalus	Sea mullet		
Philypnodon grandiceps	Flathead gudgeon		
Philypnodon sp.	Dwarf flathead gudgeon		
Gobiomorphus coxii	Cox's gudgeon		
Gobiomorphus australis	Striped gudgeon		
Hypseleotris compressa	Empire gudgeon		
Hypseleotris galii	Firetailed gudgeon		
Hypseleotris klunzingeri.	Western carp gudgeon**		
Macrophytes			
Typha orientalis	Cumbungi		
Phragmites australis	Common reed		
Persicaria elatior	Tall knotweed	Vulnerable	Vulnerable
Amphibians			
Crinia signifera	Common eastern froglet		
Limnodynastes tasmaniensis	Spotted marsh frog		
Limnodynastes peronii	Stripped marsh frog		
Litoria verreauxi	Verreaux's tree frog		
Litoria fallax	Dwarf tree frog		

Species Name	Common Name	*EPBC Act 2000 Classification*	*TSC Act 1995 Classification*
Heleioporus australicus	Giant burrowing frog	Vulnerable	Vulnerable
Litoria aurea	Green and Golden bell frog	Vulnerable	Endangered
Litoria raniformis	Growling grass frog	Vulnerable	Vulnerable
Litoria littlejohni	Heath frog	Vulnerable	Vulnerable
Mixophyes balbus	Stuttering frog	Vulnerable	Endangered
Mixophyes iteratus	Giant barred frog	Endangered	Endangered
Pseudophryne australis	Red-crowned toadlet		Vulnerable
Insects			
Austrocordulia leonardi	Sydney hawk dragonfly		Endangered***
Archaeophya adamsi	Adam's emerald dragonfly		Endangered***

* = introduced species, ** = translocated native species outside of its natural range , *** = vulnerable species under the FM Act 1994.

It is considered unlikely that all the threatened species listed in **Table 7.1** would occur in the site, either due to a lack of suitable habitat or the highly modified nature of their preferred habitat. From the Hawkesbury River upstream to South Creek and eventually to Kemps Creek and Bonds Creek the composition of fish assemblages is likely to change, due to differences in habitat, species interactions, physical tolerances, the presence of barriers to passage and localised disturbance. In particular, with regard to the two threatened fish species identified as potentially occurring (i.e. Macquarie Perch and Australian Grayling) it is considered that the study site is outside of the current known distribution of these species.

7.2 Aquatic Habitat Assessment

Kemps Creek is nominally the major waterway within the Study Area and flows from south to north along the western boundaries of the Austral and Leppington North precincts, with a number of additional tributaries (including Bonds Creek, Scalabrini Creek and a number of unnamed waterways (**Figure 5.1**) providing aquatic habitat. It is noted that Kemps Creek continues in a northerly direction outside the study area and has been artificially impounded just upstream of its confluence with South Creek. This large earth embankment represents a considerable barrier to flows and fish passage. South Creek continues to the north and eventually discharges into the Hawkesbury River just downstream of Windsor.

In general the watercourses present were found to be significantly degraded and their riparian zones were narrow and fragmented or absent. The channel banks were frequently steep, unstable and held together by pasture grasses. The channel beds lacked complex structure and were composed primarily of fine silts and clay. Submerged large woody debris, an important fish habitat, was scarce. The watercourses were dominated by long pool sections while little natural riffle habitat was observed. In addition to the lack of natural habitat, many instream barriers were identified as modifying the natural flow regime within the study site (e.g. inappropriate road crossings, fences and car bodies) and reducing the aquatic habitat value of the site.

Table 7.2 summarises the results of the "Riparian, Channel and Environmental Inventory" (RCE) score assessment (**Section 5.5.1**) as well as the SIGNAL habitat condition results (**Section 5.4**) for each of the 13 study sites assessed (**Figure 5.1**).

Table 7.2 Habit Assessment Scores

Site	Easting	Northing	Waterway	RCE Score*	Avg SIGNAL Fish Habitat Score**
1	0298132	6241075	Bonds Creek	25	3.4
2	0298573	6240189	Bonds Creek	23	-
3	0296968	6241237	Scalabrini Creek	26	3.0
4	0295719	6241505	Kemps Creek	24	3.4
5	0295662	6243569	Kemps Creek	29	3.5
6	0297594	6241941	Bonds Creek	21	-
7	0297296	6242516	Bonds Creek	21	2.7
8	0296937	6243217	Bonds Creek	21	-
9	0297825	6243549	Unnamed	19	-
10	0297280	6243961	Unnamed	19	-
11	0296402	6243943	Bonds Creek	20	2.4
12	0296262	6245662	Kemps Creek	27	3.2
13	0298552	6245602	Unnamed	17	-

*RCE scores range can from 13 (a heavily disturbed stream with no riparian vegetation) to 52 (a stream with no obvious physical disruption).
SIGNAL scores less than four signify the presence of macroinvertebrate assemblages (Section 7.5**) typical of severely polluted or disturbed habitats. SIGNAL scores were only able to be calculated at sites amenable to macroinvertebrate sampling (Table 5.2).

None of the creeks present on site recorded RCE scores greater than 30 or SIGNAL scores greater than four, indicating a consistently low quality of habitat across all creeks. The habitat characteristics of the major creeks sampled (**Figure 5.1**) are as follows:

- **Kemps Creek** (Site 4,5, and 12) - The riparian habitat present was relatively narrow and completeness varied amongst sites. Riparian vegetation was composed of young Casuarina trees and pasture grasses. The channel banks were frequently steep, unstable and erosion was common. The channel substratum was composed primarily of clay and silt and was relatively featureless. Barriers to upstream passage were observed at Sites 5 (dumped car bodies and corrugated iron) and 12 (steep drop downstream of the Gurner Avenue road crossing). It is considered that the potential fish habitat within Kemps Creek is of moderate quality.
- **Bonds Creek** (Sites 1,2,6,7,8 and 11) - The Bonds Creek waterway was found to be highly degraded. Riparian habitat was either absent or narrow and incomplete, and was composed of planted Casuarina trees and pasture grasses. Channel banks were generally steep and unstable and erosion was common. Although nominally a tributary of Kemps Creek, Bonds Creek was considerably wider and often deeper

than Kemps Creek. The channel substratum was similar to that of Kemps Creek being composed primarily of clay and silt and relatively featureless. Bonds Creek contained moderate to minimal fish habitat with barriers to upstream passage including road crossings, fences and shallow channel sections choked by dense cumbungi beds.

- **Scalabrini Creek** (Site 3) - Riparian vegetation was composed of Casuarina trees and pasture grasses. Channel banks were undercut and pasture grasses had colonised the shallow sections of the channel downstream of the Bringelly Road, indicating that this section of channel probably flows intermittently. The creek provides minimal fish habitat and the pools present were either choked with cumbungi or were featureless with little woody debris. The channel immediately downstream of the road crossing was very shallow and would probably represent a barrier to fish passage for a range of flow conditions.

- **Unnamed Watercourse** (Sites 9 and 10) - The unnamed watercourse surveyed at Sites 9 and 10 joins Kemps Creek just downstream of its confluence with Bonds Creek (**Figure 5.1**). The watercourse was ephemeral and had negligible flow despite significant recent rainfall in the catchment at the time of site inspection. The channel was relatively indistinct and is colonised by pasture grasses. There was not enough aquatic habitat to sample for macroinvertebrates and the waterway was considered unlikely to be fish habitat.

- **Unnamed Watercourse** (Site 13) - The unnamed watercourse surveyed at Site 13 (**Figure 5.1**) joins Kemps Creek channel to the north of the site. The watercourse was ephemeral and had negligible flow. There was no riparian habitat. The channel had been straightened and extensively modified for local drainage and flood mitigation. Pooling water was observed to have accumulated in depressions either side of a culvert at the Eighteenth Avenue road crossing. These ephemeral pools supported small stands of cumbungi and pasture grasses.

These findings are consistent with those of previous aquatic habitat assessments done within the local area. Bioanalysis (2003) inspected a number of study sites within in the South West Growth Centre and noted the following:

- Catchments within this area were highly degraded as a result of intensive agriculture and poor land use practices;

- The riparian zones along many of the creeks were highly degraded; and

- The flow along some of the creeks was disrupted by road crossings, culverts and other structures, all of which hinder fish passage.

Two of the sites inspected under the Bioanalysis (2003) study are of particular interest, as they were located on two of the major watercourses that flow through the both Austral and Leppington North precincts. Bioanalysis noted that within Austral, significant quantities of emergent aquatic vegetation were observed along the channel of Bonds Creek. At Leppington North, the aquatic habitat in Kemps Creek was degraded with the filamentous green algae *Enteromorpha* sp., floating rubbish and the introduced mosquito fish, *Gambusia holbrooki* being common.

It is also noted that there are numerous farm dams in the area which may provide additional aquatic habitat, particularly for frog species. Field survey undertaken as part of this assessment did not review these habitat areas. However, Parsons Brinckerhoff (2010) note that the condition of these habitats is generally poor with limited or no emergent aquatic vegetation and poorly-developed terrestrial vegetation buffers.

7.3 Water Quality Sampling Results

The water quality within the site was observed to be below average, consistent with a disturbed freshwater ecosystem. **Table 7.3** summarizes the water quality results obtained through sampling. The full water quality sampling results are provided in **Appendix O**.

Table 7.3 Comparison of in situ water quality measurements taken at each site with ANZECC/ARMCANZ (2000) guidelines for lowland watercourses in south-east Australia

Site	Waterway	Conductivity (us/cm)	pH	Dissolved Oxygen (% sat.)	Turbidity (NTU)
	Guideline	*125 - 2200*	*6.50 - 8.50*	*85 - 110*	*6 - 50*
1	Bonds Creek	↑	✓	↓	✓
2	Bonds Creek	✓	✓	↓	✓
3	Scalabrini Creek	✓	✓	↓	✓
4	Kemps Creek	↑	✓	↓	✓
5	Kemps Creek	↑	✓	↓	✓
6	Bonds Creek	↑	✓	↓	✓
7	Bonds Creek	↑	✓	✓	✓
8	Bonds Creek	↑	✓	✓	✓
9	unnamed	✓	✓	↓	✓
10	unnamed	✓	✓	✓	✓
11	Bonds Creek	↑	✓	↓	✓
12	Kemps Creek	↑	✓	↓	✓
13	unnamed	✓	✓	↓	↓

↓ = below guidelines, ↑ = above guidelines, ✓ = within guidelines

It can be seen that the majority of sites and waterways were consistent with the ANZECC/ARMCANZ (2000) guidelines for lowland watercourses in south-east Australia in regards to pH and turbidity. However, the dissolved oxygen levels observed were generally below guideline levels, while conductivity typically exceeds the guideline levels. Low dissolved oxygen concentrations (i.e. below 40% saturation) in particular can indicate poor creek health. However, none of the sites sampled recorded dissolved oxygen concentrations of less than 48% (Appendix O). It should be noted that dissolved oxygen levels can vary significantly over the course of a day (typically higher in the morning) and are typically higher following rainfall events. Further sampling would be required to accurately establish the baseline water quality conditions within the site.

7.4 Aquatic Flora Survey Results

The aquatic flora present within the creeks was seen to be highly limited and weed infested. The diversity of the macrophyte assemblages was low with stands of cumbungi with epiphytic filamentous green algae predominating, particularly in reaches with little or no riparian habitat to shade the channel. **Table 7.4** summarizes the flora species observed onsite at each of the 13 sites sampled. The most common species observed included:

- *Typha orientalis* (Cumbungi);
- *Rumex crispus* (Curled doc); and
- *Rorippa nasturtium aquaticum* (Watercress).

Of these, both Curled doc and Watercress are introduced species. The abundance of weeds within the watercourses reflects the low aquatic habitat scores observed and the history of disturbance and development within the site.

Table 7.4 Macrophytes observed during site survey (weeds marked in bold)

Species Name	Common Name	Bonds Creek	Bonds Creek	Scalabrini Creek	Kemps Creek	Kemps Creek	Bonds Creek	Bonds Creek	Bonds Creek	Unnamed	Unnamed	Bonds Creek	Kemps Creek	Unnamed
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13
Alternanthera philoxeroides	**Alligator weed**			✓	✓	✓		✓						
Azolla filiculoides	Pacific azolla				✓			✓						
Azolla pinnata	Ferny azolla				✓			✓						
Cotula coronopifolia	Waterbuttons					✓			✓			✓	✓	
Cyperus eragrostis	**Umbrella sedge**			✓							✓			
Eleocharis sphacelata	Tall spikerush	✓												
Myriophyllum aquaticum	**Parrots feather**						✓							
Persicaria decipiens	Slender knotweed	✓		✓			✓			✓	✓			
Potamogeton crispus	Curly pondweed					✓								
Potamogeton ochreatus	Blunt pondweed				✓									
Rorippa nasturtium aquaticum	**Watercress**				✓		✓	✓				✓	✓	
Rumex crispus	**Curled doc**	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	
Spirodella sp.	Duckweed					✓								
Triglochin procerum	Water ribbons					✓								
Typha orientalis	Cumbungi	✓	✓	✓	✓		✓	✓	✓	✓		✓		✓

Of particular concern is the presence of Alligator Weed (*Alternanthera philoxeroides*). Alligator weed is a Weed of National Significance (DWESPC/DAFF2009). It poses a significant environmental and economic threat and is highly invasive. Infestations can take over wetlands such as creeks and drainage channels, displacing native vegetation, preventing flow and reducing oxygen exchange. It can also invade land and displace or cause the failure of agricultural crops. Alligator weed does not produce viable seed in Australia, but instead grows through vegetative reproduction and is spread easily from fragments. It has been spread in landfill and attached to machinery and vehicles (e.g. bulldozers).

Alligator weed was observed in the Study Area in Scalabrini Creek, Bonds Creek and Kemps Creek. Alligator weed has been declared a noxious weed in the Liverpool City Council and Camden Council areas, which cover the sections of the Study Area north and south of Bringelly Road, respectively. It is considered a Class 3 weed in both council areas and as such must be fully and continuously suppressed and destroyed.

No threatened aquatic macrophyte species were found on site.

7.5 Aquatic Fauna Survey Results

The results of the electrofishing undertaken to characterise the fish and large macroinvertebrate populations within the creeks are summarised in **Table 7.5**. It can be seen that Site 12 within Kemps creek had the highest diversity and abundance of species. However, across all sites and creeks the dominant species identified were seen to be the invasive Mosquito fish (*Gambusia holbrooki*) along with species of freshwater shrimp.

Table 7.5 Number of fish species observed within field survey sites

Species Name	Common Name	Number of Individuals Records									
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 7	Site 8	Site 11	Site 12	Site 13
Anguilla reinhardtii	Longfinned eel	1			1					3	
Anguilla australis	Shortfinned eel				2					1	
Cyprinus carpio	Common carp*							1			
Carassius auratus	Goldfish*					2				1	
Gambusia holbrooki	Mosquito fish*	9	7	5	10	8	7	12	25	22	4
Philypnodon grandiceps	Flathead gudgeon									6	
Philypnodon sp.	Dwarf flathead gudgeon						3			2	

Species Name	Common Name	Number of Individuals Records									
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 7	Site 8	Site 11	Site 12	Site 13
Hypseleotris compressa	Empire gudgeon	1									
	Freshwater shrimp	> 50	> 20	> 50	> 50	> 50	> 50	> 50	> 50	> 50	

*invasive or pest species

Overall the fish and macroinvertebrate fauna observed was not diverse. Only eight species of fish were observed over the entire study area, three of which (carp, goldfish and mosquito fish) were introduced. Predation by the mosquito fish has been listed as a key threatening process on Schedule 3 of the TSC Act, as it has been implicated in the decline of a number of threatened Litorid frog species, including the Green and Golden Bell Frog. The presence of instream barriers, changes to the natural flow regime and degradation of riparian and aquatic habitats are likely to have contributed to the low fish diversity.

No threatened aquatic fauna species were observed on site. In general it is considered that the habitat present is not typical of core species habitat for the threatened species identified and it is considered unlikely that any of the threatened species identified as potentially occurring within the region (**Table 7.1**) would occur within the site. However, it is noted that the habitat present is largely consistent with the habitat requirements of the Green and Golden Bell Frog (*Litoria aurea*). Within NSW the species has been commonly observed to occupy disturbed habitats and frequently breed in ephemeral ponds adjacent to grassy areas. The presence of the Mosquito fish (*Gambusia holbrooki*) has been implicated in the decline of Green and Golden Bell frog populations through predation. However, it is equally noted that populations of the frog have been known to persist with the presence of the Mosquito fish under favourable site conditions.

Appendix P provides detail as to the ecological characteristics of the potentially occurring threatened species and their suitability to occur onsite given the findings of the habitat assessment (**Section 7.2**).

8 Terrestrial and Aquatic Ecology Discussion

The terrestrial and aquatic ecology study undertaken show the site as a whole to be of relatively low biodiversity and conservation value. Long term disturbance through agricultural grazing and clearing has left the majority of habitat areas within the precincts devoid of understory and dominated by non-native species. This is significant in that the conservation and rehabilitation potential for many of the sites is highly dependent upon the existence of a viable native seed bank and the ability to control weed species.

However, it is noted that over-story species remain intact across the study site, with very few instances of non-natives occurring within the canopy layer. The presence of a strong canopy layer is vital as it provides considerable niche habitat for fauna species, which in turn play a significant role in the ecological dispersal of native shrub and ground cover. The canopy layer also plays a significant role in the formation of suitable climate / habitat of ground and shrub species of the Cumberland Plain. Consequently, it is considered that the presence of the over-story layer does provide potential for re-establishment of high quality vegetation at several locations around the study site.

The connectivity of the terrestrial vegetation within the site is largely confined to the riparian corridors. The mapping of the vegetation shows a strong link between the quality of vegetation and the proximity to watercourses. This is thought to primarily be driven by development restrictions around watercourses. As a result of this, the quantity of high quality Alluvial Woodland (being a primarily riparian community) within the study site is higher than that of Shale Plains Woodland. It is considered that the existing connectivity present on site should be retained and extended as far as practicable. In particular, providing connection between the few remnant isolated pockets of high quality Shale Plains Woodland, will allow for these areas to contribute to the overall improvement of Biodiversity within the precincts. If high quality vegetation communities remain isolated their ability to sustainably host a high diversity of fauna is limited (particularly as all isolated vegetation communities assessed within this precincts were relatively small (i.e. < 5 ha)). Consideration should be given to the conservation of the Medium Quality Vegetation along Bonds Creek. Similarly, the vegetation associated with Scalabrini Creek (although more disturbed) should be considered for conservation.

The presence of a large area of high quality vegetation immediately to the north of the Austral precinct (Kemps Creek Nature Reserve) is of high value and appropriate developmental buffer areas should be provided to limit disturbance and the potential for weed infestation. Where possible, connectivity to this high quality area should be prioritised.

Riparian vegetation is also important ecologically as it provides a source of organic matter; shade and a source of large woody debris to both terrestrial and aquatic systems. From an aquatic point of view it also stabilises river beds and banks, protecting the channels against erosion and acts as a filter for sediments and nutrients entering watercourses. The riparian vegetation along all the watercourses surveyed was significantly degraded and often narrow and fragmented or absent. Channel banks were seen to be steep, relatively unstable and usually only held in place by pasture grasses.

Within the creeks themselves, the channel bed was typically found to lack complex structure and had a narrow range of sediment sizes, being composed primarily of fine silts and clay. There was little submerged large woody debris ('snags'), which normally provides complex habitat for aquatic macroinvertebrates and fish, including refugia from predation and habitat for prey. The watercourses were dominated by long pool sections. No natural riffle habitat was observed.

The flow regime is a key driver of river ecology and changes to flow can alter the geomorphological process of sediment erosion, transport and deposition that structure a variety of important channel habitat forms, change macrophyte communities, influence water properties important to biological assemblages and alter in-stream connectivity. The natural flow regime within the Study site has been significantly modified by the presence of instream barriers, such as road crossings, fences, car bodies.

The poor flow regime and riparian vegetation was reflected in the poor water quality within the study site. Conductivity levels were generally very high and exceeded the ANZECC/ARMCANZ (2000) upper threshold limits for the protection of aquatic ecosystems at most sites while dissolved oxygen levels were mostly below the ANZECC/ARMCANZ (2000) lower threshold limits. This poor quality was also reflected in the nearly ubiquitous presence of algae and weeds and very low number of native fish species.

Overall it is considered that, while in poor condition, there is significant rehabilitation potential given the nature of the remnant vegetation and patches of remnant high quality vegetation. As such, future development of the study site represents an opportunity to rehabilitate the degraded terrestrial, riparian and aquatic habitats.

8.1 Recommendations for Conservation and Management Measures

The issue of Biodiversity Certification for the Austral and Leppington North Precincts removes the majority of the ecological constraints from the Precincts. There is a significant quantity of ENV present within the certified area. However, the results of this assessment indicate that the majority of this area is of relatively low – medium quality vegetation.

Consistent with the issued Biodiversity Certification Order and the Growth Centres Development Code, it is noted that open space areas and other sympathetic land uses (e.g. stormwater detention) should be located such they optimize the retention of native vegetation. **Figure 8.1** indicates the key vegetation communities which we recommend are retained, as well as the non-certified areas of vegetation which would require further assessment prior to any development approval.

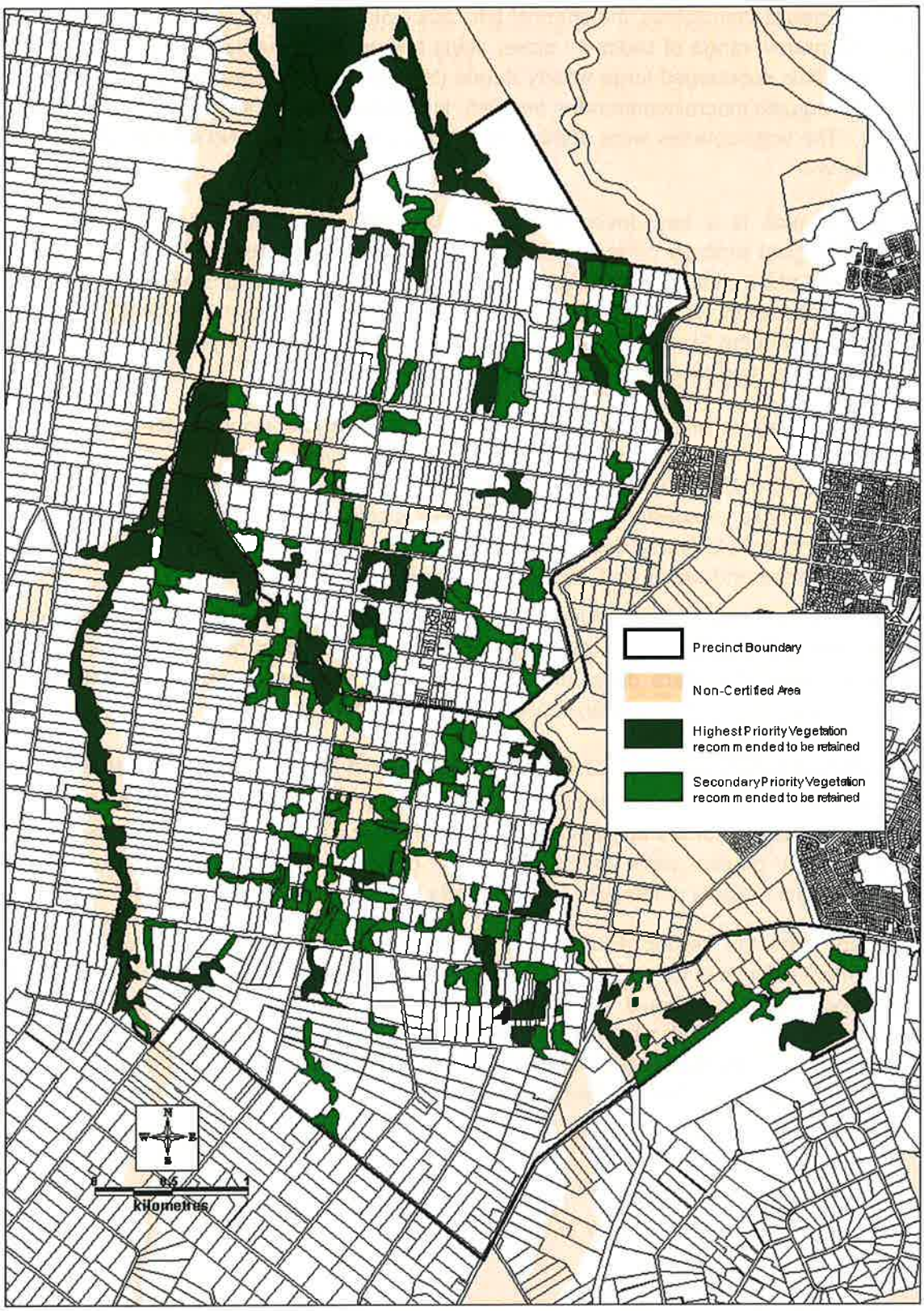

Figure 8.1 Recommended areas for vegetation protection

The majority of the vegetation recommended for retention is riparian in nature, although there are a number of more isolated pockets of existing remnant vegetation. In general, the riparian vegetation was seen to be of moderate condition, often dominated by weeds. Several areas of vegetative regrowth have been heavily recolonised by *Casuarina glauca* following clearing, to the extent that the previous habitat (typically more diverse) has been unable to, and is unlikely to, establish itself without revegetation and management.

The key to conserving the identified communities is provision of connectivity where possible. Primarily, this will be through the retention of appropriate riparian corridor widths in accordance with stream order. Where possible, the streams within the site should be provided with a 40m core riparian zone and additional 10m buffer. The potential connectivity to key habitat areas to the north of the site (i.e. Western Sydney Parklands and the Kemps Creek Nature Reserve) should also be recognised and enhanced where possible.

Very few threatened species have been previously identified on site and only one threatened species (*Acacia pubescens*) was identified during the site surveys for both the aquatic and terrestrial assessment components. The level of disturbance within the site and low connectivity values indicate that the likelihood of significant threatened species populations occurring on site is low. This is particularly so for the biodiversity certified areas which typically do not contain riparian habitat and where vegetation communities are typically isolated through historic clearing.

However, the presence of *Acacia pubescens* is of significance, and should be considered in development planning for the precincts. The species is known to be associated with a number of ecological communities including Alluvial Woodland, Shale/Gravel Transition Forest, and Shale Plains Woodlands. As such, it is considered that many of the vegetation communities recommended for retention (**Figure 8.1**), would also be suitable habitat for the growth of this species. Implementation of planting and rehabilitation programs should be considered as part of on-going ecological management of the precincts. Areas known to contain *Acacia pubescens* are included within the recommended vegetation communities to be retained. It should be noted that *Acacia pubescens* is a clonal species and as such a high number of sightings within an area may over-estimate the number of genetically distinct individuals and the robustness of a community. Typically, plants within 300m of each other are defined as being within one population, reflecting the ability for *Acacia spp.* to disperse.

Although it is considered unlikely that the Green and Golden Bell Frog is present within the study site, appropriate targeted frog surveys should be carried out as a precautionary measure for specific developments as the observed habitat is considered suitable for this species. Certified areas are not required to be surveyed.

Where required, the guidelines on survey methodology for this species recommend that a field survey be done either in conjunction with or after a habitat assessment and should:

- Include a combination of visual encounter, call and night drive survey techniques;
- Include a minimum of four nights sampling to increase the detection rate;
- Take place between September and March, at the time of peak activity for the species;
- Occur during warm and windless weather conditions following rainfall;

- Include use of a nearby reference site that supports a population of green and golden bell frogs to confirm that green and golden bell frogs are active and calling on that particular night;
- Be done by a suitably qualified person with experience in frog surveys; and
- Include connected and surrounding suitable habitats during field surveys.

With the exception of *Acacia pubescens*, the Cumberland Land Snail and the Green and Golden Bell Frog discussed above, no other threatened species are considered likely to be present at the site.

Overall, it is considered that the future development of the study site represents an opportunity to rehabilitate the degraded terrestrial, riparian and aquatic habitat. Priorities should include (but not be limited to):

- Regeneration and revegetation of native vegetation and removal of exotics;
- Establishment of vegetation corridors between areas of high quality vegetation;
- Riparian bank stabilisation;
- Removal of instream barriers to improve passage and rehabilitation of existing road crossings to permit connectivity over the major range of watercourse flows; and
- Design all works in and around creeks in a manner which will improve riparian aquatic habitat.

In conclusion, the terrestrial and aquatic biodiversity and conservation value of the study site is relatively low at present due to surrounding land use practices, clearing, disturbance to riparian vegetation, degradation of aquatic habitat and presence of in-stream barriers. The Precinct Planning Process for the study site represents an opportunity to rehabilitate these degraded communities and preserve the few remaining areas of High Quality Vegetation.

8.2 Impact Assessment

As the Austral and Leppington North Precincts have Biodiversity Certification, there is no further requirement under the TSC Act to conduct threatened species assessments for works on certified areas. It is recommended that the non-certified areas be protected and managed in accordance with the requirements of the Biodiversity Certification Order.

In particular, land uses surrounding non-certified areas will need to be carefully managed in order to not negatively affect the ecological integrity of the protected areas.

It is recommended that a management plan be established for all areas to be retained for biodiversity certification.

It was found that according to the proposed vegetation clearing within the ILP and with consideration of the offsetting mechanisms under the certification, the EECs located in the study area would not suffer significant adverse impacts.

Additionally, the proposed non-certified boundary lines will protect 10.00ha more ENV than required by the Biodiversity Certification Order, (Annex C in **Appendix M**).

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Appendix A

Relevant Biodiversity Measures (RBMs)

THREATENED SPECIES CONSERVATION ACT 1995

Order to confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006

I, Verity Firth, Minister Assisting the Minister for Climate Change, Environment and Water (Environment), do by this order confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (the SEPP) for the purposes of the *Threatened Species Conservation Act 1995* (the Act).

I am satisfied that the SEPP, and other relevant measures, will lead to the overall improvement or maintenance of biodiversity values.

Pursuant to section 126H of the Act, the biodiversity certification of the SEPP is subject to the conditions listed in Schedules 1, 2, 3 and 4 below. The conditions are necessary to ensure that the SEPP and other relevant measures will lead to the overall improvement or maintenance of biodiversity values, including the limiting of certification to specified lands, procedures for the allocation of conservation funding for offsets, and mechanisms for the on-going review of progress in delivering offsets.

This order is made under section 126G(1) of the Act.

This order is to take effect on and from the date of its publication in the Government Gazette.

Pursuant to section 126J of the Act, biodiversity certification of the SEPP shall remain in force from the date the biodiversity certification order takes effect until 30 June 2025.

VERITY FIRTH, M.P.
Minister Assisting the Minister for Climate Change,
Environment and Water (Environment)

Signed at Sydney, this 11th day of December 2007.

SCHEDULE 1 – CONDITIONS OF BIODIVERSITY CERTIFICATION

Definitions

In Schedules 1 to 4:

- "Act" means the *Threatened Species Conservation Act 1995*.

- "biodiversity certification maps" means the maps marked "North West Growth Centre – Biodiversity Certification" and "South West Growth Centre – Biodiversity Certification" dated November 2007 and included in Schedule 2.

- "biodiversity values" has the same meaning as in the Act.

- "certified area" means an area marked as a certified area on a biodiversity certification map.

- "clearing" of existing native vegetation means any one or more of the following:

  (a) cutting down, felling, thinning, logging or removing existing native vegetation in whole or in part,
  (b) killing, destroying, poisoning, ringbarking, uprooting or burning existing native vegetation in whole or in part.

- "conditions of biodiversity certification" means Schedules 1 to 4.

- "conservation agreement" means:

  (a) a conservation agreement under the *National Parks and Wildlife Act 1974*,
  (b) a biobanking agreement under Part 7A of the Act,
  (c) a planning agreement under the *Environmental Planning and Assessment Act 1979*, where the agreement provides for the conservation and/or enhancement of the biodiversity values of an area of land to which the agreement relates, or
  (c) a legally binding agreement that provides for the conservation and/or enhancement of the biodiversity values of an area of land.

- "Conservation Fund" means the Fund referred to in condition 21.

- "conservation value" includes, but is not limited to, vegetation type, condition and rarity.

- "draft Growth Centres Conservation Plan" means the document titled "Growth Centres Conservation Plan Exhibition Draft" prepared by the GCC dated February 2007 and placed on public exhibition in February 2007.

- "existing native vegetation" means areas of indigenous trees (including any sapling) 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.

- "DECC" means the Director-General of the Department of Environment and Climate Change.

- "financial year" means the twelve month period from 1 July to 30 June.

- "GCC" means the Growth Centres Commission constituted under the *Growth Centres (Development Corporations) Act 1974*.

- "Growth Centre" has the same meaning as in the SEPP.

- "Growth Centres Development Code" means the document with that title produced by the GCC (dated October 2006) as updated and in force from time to time.

- "Minister" means the Minister administering the Act.

- "Minister for Planning" means the Minister administering the *Environmental Planning and Assessment Act 1979*.

- "non-certified area" means an area marked as a non-certified area on a biodiversity certification map.

- "plan of management" means:

  (a) a plan of management adopted under the *National Parks and Wildlife Act 1974* or *Local Government Act 1993,* or
  (b) a plan that provides for the management and protection of biodiversity values to the satisfaction of the DECC.

- "precinct" has the same meaning as "growth centre precinct" in the SEPP.

- "precinct plan" has the same meaning as in the Growth Centres Development Code.

- "protected area network" means a system of lands especially dedicated to the protection and maintenance of biodiversity, and of natural and associated cultural resources, and managed through legal or other effective means.

- "protection" or "protected" in relation to land means land that is protected by a land use zoning under an environmental planning instrument or public ownership arrangements that provide for the protection of biodiversity values as a priority, or another arrangement that provides in-perpetuity security for biodiversity on the subject land.

- "Report on Public Submissions" means the document titled "Growth Centres Draft Conservation Plan - Report on Public Submissions" prepared by the GCC and dated July 2007.

- "SEPP" means *State Environmental Planning Policy (Sydney Region Growth Centres) 2006*.

- "Special Infrastructure Contribution Practice Note" means the document with that title prepared by the GCC (dated December 2006) as updated and in force from time to time.

- "threatened species" and "threatened species, populations and ecological communities" have the same meaning as in the Act.

Explanatory notes

A. Nothing in this biodiversity certification order:

   i. restricts any future decisions that may be made by the Minister under Part 7, Division 5 of the Act,

   ii. removes, alters or over-rides any requirement to obtain any necessary approvals under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

B. In accordance with section 126K of the Act, following any review of the SEPP under the *Environmental Planning and Assessment Act 1979* or any rezoning of land to which the SEPP applies, the Minister is to reassess the grant of biodiversity certification to determine whether it should be maintained or modified.

General

1. In the event of any inconsistency between the draft Growth Centres Conservation Plan, the Report on Public Submissions and the conditions of biodiversity certification, the conditions of biodiversity certification shall prevail.

2. This biodiversity certification order does not affect any consent or approval granted under Part 3A, Part 4 or Part 5 of the *Environmental Planning and Assessment Act 1979* before the order took effect, or any development or activity carried out in accordance with such a consent or approval.

3. The Minister, from time to time and as considered appropriate, may amend the conditions of biodiversity certification in accordance with the Act to address anomalies, errors, boundary revisions and/or to take into account new information, but only if the Minister is satisfied that any amendments will not detract from the ability of the SEPP, and other relevant measures, to lead to the overall improvement or maintenance of biodiversity values. Amendments may include, but are not limited to, boundary revisions to reflect updated flood mapping and the outcomes of the assessments completed under conditions 14, 17 and 18. The Minister may, but is not required to, provide for any such amendments to be exhibited for public comment.

4. Copies of all final reports, maps, reviews, plans and monitoring data referred to in the conditions of biodiversity certification must be held by the GCC and made publicly available, either on request and/or by a mechanism that is broadly publicly accessible. This does not apply to material that is commercially sensitive or contains sensitive information regarding the location of threatened species, populations or ecological communities or their habitat.

Areas subject to biodiversity certification

5. Pursuant to section 126H of the Act, the biodiversity certification of the SEPP is limited to the certified areas.

   Note: Pursuant to section 126I of the Act, developments or activities proposed to be undertaken within the certified areas do not need to undertake assessment of impacts on threatened species, populations and ecological communities, or their habitats, that would normally be required by Part 4 or 5 of the *Environmental Planning and Assessment Act 1979*.

Native vegetation to be retained within the Growth Centres

6. A minimum of 2,000 hectares of existing native vegetation must be retained and protected within the Growth Centres, either within the certified areas and/or the non-certified areas, subject to conditions 7 to 13 below.

- **Retention of existing native vegetation during precinct planning**

7. During the precinct planning process, the GCC may determine to make areas of existing native vegetation within the non-certified areas available for development if the clearance of such vegetation is considered necessary for either the provision of essential infrastructure and/or to meet the required Development Parameters specified in the Growth Centres Development Code.

8. In making a determination under condition 7, the GCC must demonstrate by way of information provided during the public exhibition of the precinct plan (where that exhibition occurs after this order takes effect) that the clearing of any existing native vegetation in the non-certified areas will be offset by:

    a. the protection of an equal or greater area of existing native vegetation elsewhere in the Growth Centres; and/or

    b. the revegetation and/or restoration of an area of land elsewhere in the Growth Centres, subject to satisfying the following,

        i. that the clearance of existing native vegetation in the non-certified areas will not affect the capacity to achieve overall improvement or maintenance of biodiversity values for threatened species, populations and ecological communities and their habitats,
        ii. the revegetated and/or restored areas will be protected,
        iii. the extent of revegetation and/or restoration compared to clearing of existing native vegetation must be undertaken at a ratio of at least 3:1 (to reflect the greater ecological risks relative to retaining existing native vegetation),
        iv. areas subject to revegetation and/or restoration must be of a suitable boundary configuration and design to support long-term management,
        v. revegetation and/or restoration of the proposed areas would not be undertaken under another scheme or regulatory requirement already in operation at the time that the clearing is approved (this includes but is not limited to any approvals, and associated conditions of such approvals, that may be required under the *Rivers and Foreshores Improvement Act 1948* and *Water Management Act 2000*),
        vi. revegetation and/or restoration will be undertaken by suitably qualified and experienced persons using indigenous plant stock, and
        vii. sufficient resources will be made available to undertake the revegetation and/or restoration and any necessary follow-up maintenance and monitoring for a minimum period of 5 years following the commencement of the revegetation and/or restoration.

9. Revegetation and/or restoration may be partly counted towards meeting the overall requirement to protect 2,000 hectares of existing vegetation required in condition 6. The amount that may be counted shall be calculated by dividing the total area of revegetation and/or restoration required under condition 8b(iii) by 3.

    Note: for example, if 9 hectares of revegetation is undertaken then 3 hectares may be counted.

- **Retention of existing native vegetation during development**

10. In the non-certified areas, proposals to clear existing native vegetation shall be subject to the relevant development controls in the SEPP and *Sydney Regional Environmental Plan No. 31 – Regional Parklands*, and the requirements of the *Environmental Planning and Assessment Act 1979*.

11. Where there are essential infrastructure proposals, including but not limited to proposals under Part 3A of the *Environmental Planning and Assessment Act 1979*, that involve clearing of existing native vegetation in the non-certified areas and that do not require development consent under the SEPP, such clearing must be offset by applying the same requirements specified in condition 8 above.

    In this case the offsets may be located outside of the Growth Centres (but within the Cumberland Plain of Western Sydney, as defined in condition 32) if the GCC is satisfied that there are no practicable offset options within the Growth Centres and all other requirements of condition 8 will be met. However, any offsets outside the Growth Centres cannot be counted towards meeting the requirements of condition 6.

- **Retention of existing native vegetation shown in areas marked with red hatching**

12. Notwithstanding any other conditions of biodiversity certification, in the lands marked by a red hatching on the biodiversity certification maps existing native vegetation must not be cleared unless it is in accordance with a plan of management or unless such clearance has been agreed to by the DECC.

- **Ground-truthing of existing native vegetation**

13. If new information becomes available after the biodiversity certification order took effect that demonstrates that the vegetation within an area does not otherwise meet the definition of existing native vegetation, then for the purposes of conditions 7 to 8 and condition 11 to 12 only the area of confirmed existing native vegetation shall be considered.

Additional conservation actions within the Growth Centres – native vegetation

14. During or before the preparation of the relevant precinct plan(s) under the Growth Centres Development Code, a further detailed assessment must be undertaken of the areas adjoining or proximate to the Shanes Park Air Services Australia site marked in blue hatching on the biodiversity certification maps.

15. The assessment referred to in condition 14 must examine whether the areas meet the criteria specified in Schedule 3.

16. Based on the outcomes of the assessment the DECC shall provide advice to the Minister on whether the areas should be included within the certified areas or the non-certified areas shown on the biodiversity certification maps.

Additional conservation actions within the Growth Centres – plants

17. During or before the preparation of the relevant precinct plan(s) under the Growth Centres Development Code relating to the areas referred to in the table below, the following actions must be undertaken:

Species	**Required action**
Acacia pubescens	Potential populations at Cross Street, Kemps Creek and Thirty-second Avenue, Austral – as shown in black hatching on the biodiversity certification maps: • survey to confirm the presence of the species, and

	• if the species is present, provide for the protection of the area of suitable habitat for the species to the satisfaction of the DECC.
Pimelea spicata	Potential populations at Denham Court Road - as shown in black hatching on the biodiversity certification maps: • survey to confirm the presence of species, and • if the species is present, provide for the protection of the area of suitable habitat for the species to the satisfaction of the DECC.
Persoonia hirsuta	Potential populations at North Kellyville – as shown in black hatching on the biodiversity certification maps: • survey to confirm the presence of the species, and • if the species is present, provide for the protection of the area of suitable habitat for the species to the satisfaction of the DECC.
Leucopogon fletcheri	Known population at North Kellyville - as shown in black hatching on the biodiversity certification maps: • survey to confirm the extent of the population, and • provide for the protection of the population to the satisfaction of the DECC.
Darwinia biflora *Hibbertia superans* *Epacris purpurascens var purpurascens* *Eucalyptus sp "Cattai"*	Known populations at North Kellyville - as shown in black hatching on the biodiversity certification maps: • survey to confirm the extent of the populations, and • provide for the protection of the populations to the satisfaction of the DECC.

Note: On completion of the above actions the Minister may decide that it is appropriate to amend the boundaries of the area subject to biodiversity certification, in accordance with condition 3.

Additional conservation actions within the Growth Centres – animals

18. During or before the preparation of the relevant precinct plan(s) under the Growth Centres Development Code relating to the area referred to in the table below, the following actions must be undertaken:

Species	**Required action**
Green and Golden Bell Frog	Potential population at Riverstone - as shown in black hatching on the biodiversity certification maps: **Option 1** • survey to confirm the presence of the species, and • if the species is present, provide protection of the area of suitable habitat for the species to the satisfaction of the DECC. **Option 2** • if the species is present at Riverstone but cannot be adequately protected to the satisfaction of the DECC,

	then: (a) undertake targeted survey to confirm the presence of the species elsewhere in the Growth Centres, and (b) if the species is present elsewhere in the Growth Centres, provide for the protection of an area(s) of suitable habitat for the species to the satisfaction of the DECC.

Note: On completion of the above actions the Minister may decide that it is appropriate to amend the boundaries of the area subject to biodiversity certification, in accordance with condition 3.

Additional conservation actions within the Growth Centres – development sites

19. Within twelve months of the biodiversity certification order taking effect, the GCC (in consultation with the DECC) must put in place procedures so that all future precinct plans (excluding any plans that were publicly exhibited before the biodiversity certification order took effect), where practicable, provide for the appropriate re-use of:

    a. native plants (including but not limited to seed collection) and the re-location of native animals from development sites, prior to development commencing; and

    b. top soil from development sites that contain known or potential native seed bank.

    For the purposes of condition 19a and 19b appropriate uses may include, but are not limited to, application in re-vegetation or restoration works and landscaping in the Growth Centres.

Conservation Fund

20. For the purposes of the conditions of biodiversity certification, references to dollar values are taken to be 2005/2006 values. All values shall be indexed in accordance with the "land index" to be published by the GCC, as detailed in the Special Infrastructure Contribution Practice Note.

21. Over the life of the development of the Growth Centres funding shall be provided to establish a Conservation Fund of at least $530 million to be used for biodiversity conservation and regional open space purposes. $397.5 million of the Conservation Fund is planned to be used to acquire lands and/or enter into conservation agreements over lands that are outside of the Growth Centres for the primary purpose of biodiversity conservation.

Timing and delivery of conservation funding

22. For that portion of the Conservation Fund that is to be used to fund the purchase and/or entering into conservation agreements over lands that are outside the Growth Centres, the following conditions apply:

    a. commencing in the 2008/2009 financial year, and continuing every financial year thereafter until the Conservation Fund is exhausted, the

GCC must work with DECC to arrange for the provision of an annual contribution to fund these actions outside the Growth Centres in accordance with an indicative ten-year timetable of payments to be submitted by the GCC for approval of the Minister within six months of the date of this certification order. Once approved, the indicative timetable shall be incorporated as Schedule 4 of the biodiversity certification order in accordance with condition 3;

b. the indicative ten-year timetable of payments is to be generally prepared by determining the proportion of total remaining lot production in the Growth Centres that is expected to occur within a given financial year and to then allocate for that financial year the same proportion of the remaining amount of the planned $397.5 million funding that has not been previously allocated;

c. to ensure adequate tracking of payments against the planned $397.5 million allocation, the GCC must ensure that the indicative ten-year payment timetable identifies the payments in both current and equivalent 2005/06 dollar values;

d. an updated indicative ten-year payment timetable (to provide details of the payments for the subsequent ten years) must be provided annually (by June of each financial year) by the GCC to the DECC;

e. the annual contributions must be used for the purposes detailed in conditions 23 and 24 below;

f. notwithstanding conditions 22a to 22e inclusive, if requested by the DECC the GCC must use its best endeavours to support the provision of additional funding contributions to accelerate land acquisition and/or conservation agreements over land outside the Growth Centres in any given financial year. The following conditions also apply,

    i. if an additional contribution is obtained in a given financial year, the GCC and DECC shall determine how subsequent annual contributions are to be reduced to account for the additional contributions in that financial year, and
    ii. if, despite best endeavours, an additional contribution is not obtained, the provisions of condition 27 will not be triggered with respect to this additional amount.

Use of conservation funding

23. As stated in condition 21, $397.5 million of the Conservation Fund is planned to be used by the DECC to arrange for the purchase and/or establishment of conservation agreements over lands outside the Growth Centres for the primary purpose of biodiversity conservation. This portion of the Conservation Fund must be allocated in accordance with the preferences for location and conservation values that are detailed in conditions 32, 33 and 34.

24. As part of the use of funds under condition 23, the DECC may arrange for allocation of a reasonable proportion towards the administration costs of purchasing land and/or entering into conservation agreements, and for the initial management costs of purchased land. However, from the commencement of the 2012/2013 financial year any such allocations must not exceed 5% of the annual

contribution from the Conservation Fund for the purchase and/or establishment of conservation agreements over lands outside the Growth Centres in any single financial year.

25. Funding that is planned to be allocated from the Conservation Fund within the Growth Centres shall be used to fund the purchase of lands as identified in the SEPP (as gazetted in July 2006), or the establishment of conservation agreements over an area or areas of land within the Growth Centres.

Timing of expenditure

26. The DECC must use its best endeavours to ensure that funds allocated within a financial year for the purchase and/or establishment of conservation agreements over lands outside the Growth Centres are allocated for those purposes as expeditiously as possible.

Non-delivery of funding

27. Despite the requirements of condition 22, if in any financial year ("the first financial year") the full annual contribution is not provided then:

    a. the Minister must consult with the Minister for Planning regarding the continued operation of section 126I of the Act in relation to the certified areas; and

    b. based on the outcomes of that consultation, if the Minister is satisfied that appropriate arrangements have been put in place to rectify the funding shortfall then section 126I shall continue to have effect for the certified areas; or

    c. the Minister shall determine whether to suspend or revoke the biodiversity certification order in accordance with the Act.

28. If no decision has been made in accordance with conditions 27b or 27c within six months of the end of the relevant financial year, then the provisions of section 126I of the Act are taken to no longer have effect in relation to the certified areas, until such time as the outstanding contribution is provided or the Minister is satisfied that appropriate arrangements have been put in place to rectify the funding shortfall. This condition does not affect any consent or approval granted under Part 3A, Part 4 or Part 5 of the *Environmental Planning and Assessment Act 1979* before the condition took effect, or any development or activity carried out in accordance with such a consent or approval.

    For the purposes of condition 27 and 28, "rectify" means amending the indicative timetable referred to in condition 22 to ensure that within four financial years of the first financial year the level of funding provided will be at least equal to the amount of funding that would otherwise have been provided by that time under the provisions of condition 22, or achievement of a comparable or better conservation outcome to the satisfaction of the Minister.

29. Conditions 27 and 28 do not have effect where the annual contribution required under condition 22 has not been provided because the balance of unspent funding being held in the Conservation Fund for the purchase and/or establishment of conservation agreements over lands outside the Growth Centres has reached a limit to be determined by the Minister.

Reporting

30. Commencing at the end of the 2008/2009 financial year, and at the end of every financial year thereafter until the Conservation Fund is exhausted, the GCC must provide the following information to the DECC within 2 months of the end of the relevant financial year:

    a. an estimate of the amount of existing native vegetation, specified by vegetation community type, that has been cleared within the Growth Centres. This may be based on, but is not limited to, the use of information on subdivision development approvals as a surrogate measurement for clearing, or some other basis agreed between the GCC and DECC.

31. Commencing at the end of the 2008/2009 financial year, and at the end of every financial year thereafter until the Conservation Fund is exhausted, the DECC must arrange for the publication of a report detailing the following matters:

    a. the information provided in condition 30;

    b. the amount of funding provided from the Conservation Fund in the financial year for the purchase and/or establishment of conservation agreements over lands outside the Growth Centres;

    c. the amount expended in the financial year, including the amount spent on land purchase, conservation agreements, administration and initial management costs for purchased land;

    d. a summary of the conservation outcomes achieved by that expenditure; and

    e. the predicted funding provision for the program for the next 10 years.

Location of expenditure of funds

32. The funding identified in condition 23 must be spent within the following locations in the order of preference identified below.

    First Preference: Priority areas within the Cumberland Plain

    a. First preference shall be allocated every financial year to the purchase of land and/or entering into conservation agreements over land that is:

        - identified as "Regional Biodiversity Corridors" and "Western Sydney Priority Areas" on the map labelled "Regional Biodiversity Corridors and priority fauna habitats" in the Hawkesbury Nepean Catchment Action Plan; AND

        - also occurs within the Cumberland Plain of Western Sydney; AND

        - generally meets the criteria specified in condition 33.

Where there is insufficient available land, or the cost-effectiveness of purchasing and/or entering into conservation agreements over lands in the above category is considered by the DECC to be too low, or the criteria in condition 33 cannot be met, then the funding may be allocated by DECC to be used on lands in accordance with condition 32b below.

Second Preference: Priority areas within the Hawkesbury Nepean Catchment

b. As second preference, funding shall be allocated every financial year to the purchase of land and/or entering into conservation agreements over land that is:

- identified as "Regional Biodiversity Corridors" and "Western Sydney Priority Areas" on the map labelled "Regional Biodiversity Corridors and priority fauna habitats" in the Hawkesbury Nepean Catchment Action Plan; AND
- is not identified in condition 32a; AND
- generally meets the criteria specified in condition 33.

Where there is insufficient available land, or the cost-effectiveness of purchasing and/or entering into conservation agreements over lands in the above category is considered by the DECC to be too low, or the criteria in condition 33 cannot be met, then the funding may be allocated by DECC to be used on lands in accordance with condition 32c below.

Third Preference: Grassy Woodlands within the Hawkesbury Nepean Catchment

c. As third preference, funding shall be allocated every financial year to the purchase of land and/or entering into conservation agreements over lands that:

- contain grassy woodlands within the Hawkesbury Nepean Catchment; AND
- are not identified in conditions 32a or 32b; AND
- generally meets the criteria specified in condition 33.

Where there is insufficient available land, or the cost-effectiveness of purchasing and/or entering into conservation agreements over lands in the above category is considered by the DECC to be too low, or the criteria in condition 33 cannot be met then the funding may be allocated by DECC to be used on lands in accordance with condition 32d below.

Fourth Preference: Grassy Woodlands within the Sydney Basin

d. As fourth preference, funding shall be allocated every financial year to the purchase of land and/or entering into conservation agreements over lands that satisfy the following criteria:

    - land containing grassy woodlands within the Sydney Basin; AND
    - that is not identified in conditions 32a, 32b or 32c; AND
    - generally meets the criteria specified in condition 33.

    Where there is insufficient available land, or the cost-effectiveness of purchasing and/or entering into conservation agreements over lands in the above category is considered too low, or the criteria in condition 33 cannot be met, then the funding may be allocated by DECC to be used on lands in accordance with condition 32e below.

Fifth Preference: other lands identified by the DECC

e. As fifth preference, funding shall be allocated every financial year to the purchase of land and/or entering into conservation agreements over land that is:

    - within the Sydney Basin; AND
    - is not identified in conditions 32a, 32b, 32c or 32d; AND
    - generally meets the criteria specified in condition 33.

For the purposes of condition 32:

- "cost-effectiveness" means a consideration of the conservation objectives that would be achieved by purchasing or entering into a conservation agreement for a parcel of land and the cost of the purchase and/or conservation agreement, relative to the cost of achieving the same or similar conservation objectives on other parcels of land within the Sydney Basin.

- "Cumberland Plain of Western Sydney" means the geographic area by that name as identified in National Parks and Wildlife Service (2000), *The native vegetation of the Cumberland Plain, Western Sydney – Technical Report*, NSW NPWS, Hurstville.

- "grassy woodlands" mean the vegetation formation by that name as defined in Keith, D. (2004), *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT*. NSW Department of Environment and Conservation. Hurstville, NSW.

- "Hawkesbury Nepean Catchment" means the area of land described in the Hawkesbury Nepean Catchment Action Plan.

- "Hawkesbury Nepean Catchment Action Plan" means the *Hawkesbury-Nepean Catchment Action Plan 2007-2016* published by the Hawkesbury-Nepean Catchment Management Authority (October 2006).

- "Sydney Basin" means the areas as defined by Environment Australia (2000), *Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and development of Version 5.1 – Summary Report.* Department of Environment and Heritage, Canberra.

Conservation values to be protected through the expenditure of funds

33. Within each area specified in condition 32, the lands to be targeted for purchase and/or conservation agreement outside the Growth Centres shall be guided by consideration of the following criteria:

    - large remnants of intact native vegetation with the greatest potential for retaining biodiversity values over time;
    - vegetation communities that are under-represented in the protected area network;
    - areas of equivalent or better conservation value to that which are to be cleared within the Growth Centres;
    - areas that contain habitat for threatened species, including but not limited to species to be affected by development of the Growth Centres;
    - areas that have the highest cost effectiveness;
    - conservation reserve design principles, such as size, boundary configuration and landscape context;
    - previous land uses;
    - likely threats (such as existing or future adjoining land uses); and
    - availability (including the willingness of landowners to either sell land or place it under a conservation agreement). For the purpose of clarification, no land is intended to be compulsory acquired in order to meet any of the conditions of biodiversity certification.

    For the purposes of this condition, and the avoidance of doubt, the above attributes are to be considered and applied as a guide only.

34. The lands to be targeted for purchase and/or conservation agreement outside the Growth Centres must include a known population(s) or suitable habitat for the plant species *Cynanchum elegans*.

    Note: this action is required to ensure an appropriate improve or maintain outcome for this species, which occurs in the Growth Centres but is not currently protected by measures under the Growth Centres SEPP.

Future precinct plans

35. During the preparation of future precinct plans (excluding any precinct plans already publicly exhibited before this order took effect) the GCC must undertake and make publicly available an assessment of the consistency of the proposed precinct plan with the conditions of biodiversity certification. This may occur during or before any public exhibition of future draft precinct plans.

Future threatened species listings or discoveries

36. Where a preliminary determination is made under the Act to list a species, population or ecological community, and that species, population or ecological

community may or is known to occur within the Growth Centres, then the GCC must (as soon as practicable) provide advice to the DECC on whether:

a. the species, population or ecological community is known or likely to be present in the Growth Centres;
b. it was considered during the preparation of the draft Growth Centres Conservation Plan by the GCC; and
c. whether the SEPP, and related measures, provides adequate protection for the species, population or ecological community.

37. Based on the information provided in accordance with condition 36, and any other relevant matters, the DECC shall advise the Minister on whether to formally review, maintain, modify, suspend or revoke the biodiversity certification of the SEPP if the species, population or ecological community is listed under the Act.

Review

38. A review of the biodiversity certification of the SEPP must be undertaken by the DECC every four years after the biodiversity certification order takes effect (to be completed within two months of each four year anniversary). The timing of the review may be adjusted by DECC to coincide with any planned review of the operation of the Special Infrastructure Contribution within the Growth Centres.

39. The purpose of the review is to assess progress in achieving an overall improvement or maintenance of biodiversity values, including review of the arrangements for the provision of funds to the Conservation Fund and the allocation of those funds within and outside of the Growth Centres.

40. To assist in the review required under condition 38, the GCC must provide the following information to the DECC in a timely manner:

a. an estimate of the amount of existing native vegetation, specified by vegetation community type, that has been cleared within the Growth Centres, including maps of known locations, within the four year period (or adjusted period);

b. progress in achieving the requirements of condition 6, including the following,

i. the amount of existing native vegetation that has been retained and protected within planning precincts,

ii. the amount of revegetation and/or restoration that has occurred (or is planned to occur) within planning precincts,

iii. an indicative estimate of the amount of existing native vegetation, and the amount of revegetated and/or restored areas, planned to be protected in the remaining precincts within the Growth Centres that are yet to be released;

c. an overview of any amendments to the SEPP or related measures that have occurred within the four year period (or adjusted period);

d. any recommendations that would improve the operation of the conditions of biodiversity certification including, but not limited to, any modifications

or revisions to the conditions themselves and the arrangements for management and allocation of funds from the Conservation Fund; and

e. any other information that is considered relevant by the DECC to assist in reviewing whether the SEPP, and any other relevant measures, will continue to lead to the overall improvement or maintenance of biodiversity values.

41. Based on the information provided under condition 40, and any other relevant matters, the DECC shall advise the Minister on whether biodiversity certification should be maintained, modified, suspended or revoked.

SCHEDULE 2 – BIODIVERSITY CERTIFICATION MAPS