AIRDS BRADBURY RENEWAL PROJECT

ECOLOGICAL AND BUSHFIRE ASSESSMENT

April 2011

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AIRDS BRADBURY URBAN RENEWAL PROJECT

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1 INTRODUCTION

1.1 Context

This report communicates an assessment into ecological and bushfire planning issues pertaining to urban renewal of the Airds and Bradbury localities, in the Campbelltown Local Government Area, southwestern Sydney.

Approval of the Concept Plan (Figure 1 below) for the Airds Bradbury Urban Renewal Project is being sought from the NSW Department of Planning under Part 3A of the *Environmental Planning and Assessment Act 1979*. This report provides the necessary ecological and bushfire planning assessments to satisfy the Department's Director-General Requirements (DGRs).

Figure 1 *Airds Bradbury Urban Renewal Project - Concept Plan (provided as A3 in Appendix 7).*

The study area for this report is bound generally by the Georges River Road in the north, the Georges River Riverside Reserve (native bushland) to the east, Greengate Road in the south and St John's Road in the west.

The study area has been previously developed primarily for public housing, and is well-supplied with open space areas including sporting fields. Several schools, a juvenile justice centre and village shopping centre are centrally clustered. Refer to Figure 2 below.

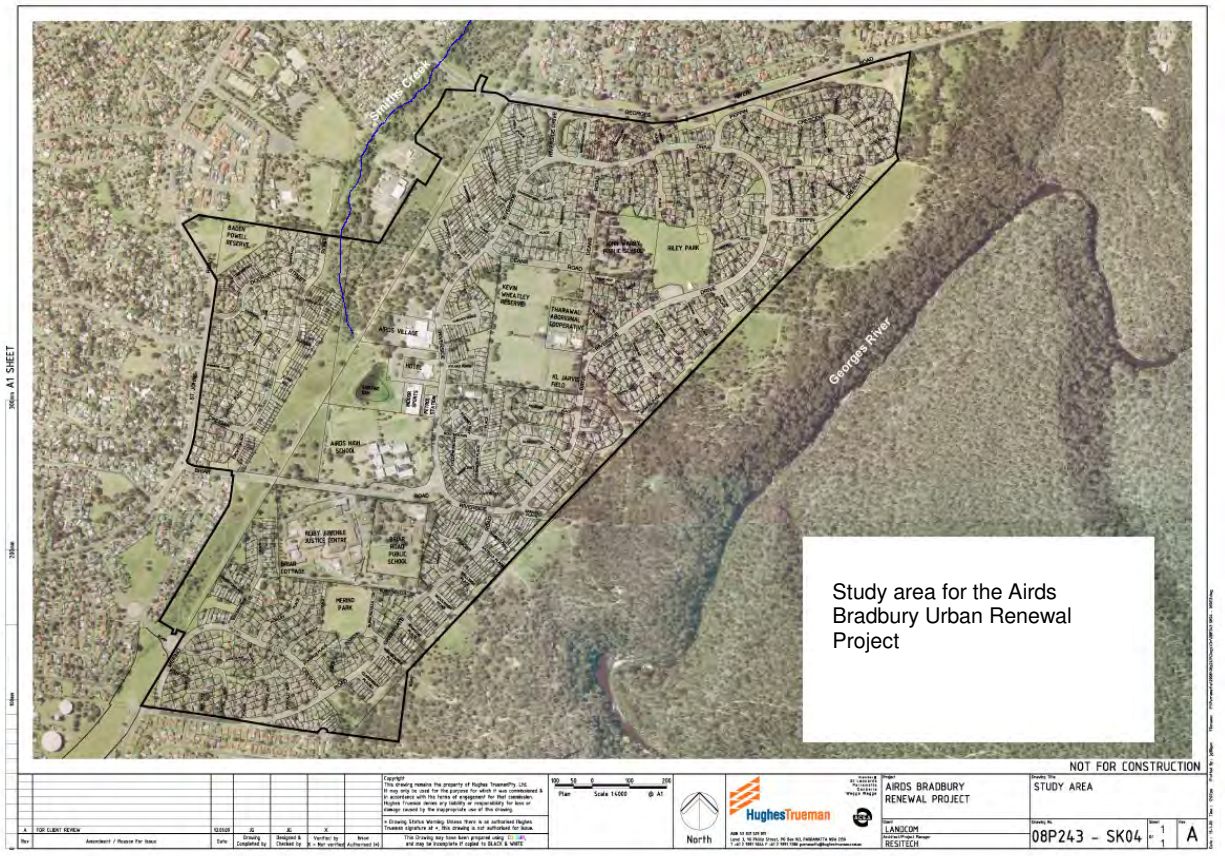

Figure 2 *Aerial view of the study area, and of surrounding lands.*

An undeveloped road corridor runs approximately north-south through the study area. This land is no longer required as a road, and is predominantly cleared.

Smiths Creek drains north from the northern part of the study area, with its headwaters located in the vicinity of Deane Park, just north of the Airds shopping centre.

A moderate sized patch of remnant/regrowth native woodland vegetation occurs north of the Airds shopping centre, in Deane Park, along Smiths Creek, and on lands surrounding a Busways Bus Depot and an electricity substation. Several smaller, scattered and more isolated patches of native woodland vegetation occur on other open space lands within the study area.

The Georges River Riverside Reserve to the east of the study area contains extensive tracts of intact native woodland and forest vegetation, contiguous through to the Holsworthy Military Reserve, Heathcote and Royal National Parks, and Sydney Water Catchment Areas.

The urban renewal of the Airds Bradbury Urban Renewal Area would involve new residential development of currently vacant land, including potentially the undeveloped road corridor, and some demolition and re-construction of existing housing areas.

1.2 Terms and Definitions

DGRs	Director-General Requirements for Airds Bradbury Urban Renewal Project (MP 10_0186)
DECCW	the NSW Department of Environment, Climate Change and Water.
EPBC Act	*Commonwealth Environment Protection & Biodiversity Conservation Act 1999*.
Locality	the area within a 5km radius of the subject site.
Proposal	the Concept Plan, as shown on Figure 1 above.
Study Area	the subject site, and additional surrounding lands shown on Figure 2 above.
Subject Site	the localities of Airds and Bradbury, as illustrated on Figures 1 and 2 above.
TSC Act	*NSW Threatened Species Conservation Act 1995*.

1.3 Objectives

Ecological planning objectives of this investigation are to:

- identify and describe the ecological values of the Airds Bradbury locality, including endangered ecological communities, threatened flora and fauna species, and areas of important and critical habitat;
- identify and describe opportunities for improvement and/or management of existing ecological values within the study area and in the broader locality;
- address the DGRs relating to ecological assessment and biodiversity conservation, including consideration of the DECCW letter dated 9/12/10 that was appended to the DGR's for information only; and
- provide an assessment suitable for submission as part of an Environmental Assessment to be lodged under the Part 3A approvals process.

Bushfire planning objectives of this investigation are to:

- provide an assessment suitable for submission as part of an Environmental Assessment to be lodged under the Part 3A approvals
- address the DGRs relating to bushfire protection planning;
- provide a statement as to the capability of the study area to achieve the required minimum bushfire protection measures for redevelopment;
- investigate the application of Asset Protection Zone (APZ) building setbacks to vegetation/bushland (adjacent the study area or likely to be retained or created within the study area) for all types of development and report on the location and dimensions of any required APZ;
- provide input into the implementation of the Concept Plan;
- provide guidance on the access and egress requirements for public road design and construction; and
- provide guidance on other bushfire protection measures such as the requirement for particular building construction standards and the provision of utilities for fire fighting or otherwise.

2 METHODS

2.1 Desktop Research and Review

A desktop analysis of the study area included interpretation of aerial photography, topographic contours layers in Geographical Information Systems (GIS), and reference to the CMA 1:25000 topographic map, and the 2008 Sydway Street Directory.

Database searches included the DECCW Wildlife Atlas, the inter-agency BioNet database, Commonwealth DEWHA on-line Protected Matters search tool, and NSW DPI noxious weeds database. Data was obtained in December 2008, January 2009, March 2010, August 2010 and December 2010.

A number of flora and fauna investigations have been previously conducted within the study area. These studies were reviewed and compared, particularly with regard to previous vegetation mapping, and identification of areas of ecological value.

Threatened fauna species recorded within 10km of the study area since 1980 (previous studies, databases) are listed in Appendix 1 of this report, along with researched known details of their habits, habitat and foraging requirements, and distributions.

The following reports were reviewed as part of the desktop analysis:

- Flora and Fauna Assessment for the Airds Neighbourhood Renewal Masterplan Study (AMBS Consulting 2001);
- Additional Flora and Fauna Studies for the Airds Neighbourhood Renewal Masterplan Study (AMBS Consulting 2002);
- Flora and Fauna Studies in the Airds Bradbury Housing Estate Landcom Owned Land (Anne Clements & Associates P/L (2003);
- Native Vegetation of the Cumberland Plain, Final Edition (NSW NPWS 2002);
- Liverpool Military Area Fire Management Plan (BES 2006).

2.2 Site Inspections

General diurnal inspections of the study area were conducted by Rebecca Hayes in January 2009 and May 2010, to assess the general nature and condition of flora and fauna habitats present, to confirm the extent of areas of native vegetation within the study area, and to evaluate the regional importance and connectivity of the study area.

An inspection of the study area was also conducted by David Peterson, including the eastern bushland interface, the Smiths Creek riparian corridor, and other open space areas, to ground-truth the findings of the desk-top review with respect to bushfire planning.

2.3 Flora Field Surveys

A general botanical survey was conducted across the study area over the 1st and 2nd of January 2009, having regard to the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC 2004).

The survey was principally conducted as a 'random meander' to target threatened plant species. It was possible to conduct quite thorough searches within each remnant area of native vegetation due to the extent of previous clearing and development within the study area.

Effort was also directed towards confirming the previous AMBS (2001 & 2002) and Anne Clements (2003) ecological community identifications, and to confirming where boundaries between these communities occur.

Identification of ecological communities and determination of their boundaries was based upon descriptions provided in Final Determinations of the NSW Scientific Committee to list the communities under the TSC Act. Two experienced field botanists familiar with the relevant ecological communities conducted a walked 'zig-zag' along previously mapped community boundaries, to determine the most accurate location for community boundaries.

An inventory was compiled of all plant species recorded during the survey (Appendix 2). This is not a comprehensive list of all plant species occurring in the study area. It is a list of plant species recorded opportunistically whilst conducting searches for threatened plant species. Comprehensive plant species lists are provided in previous flora and fauna reports (AMBS 2001; Anne Clements 2003 – refer to Appendix 6).

Plant identifications conform to nomenclature in Harden (1990-1993) and to recent reclassifications and name changes listed in *Cunninghamia* and *Telopea*.

Table 1 *Summary of Flora Field Surveys*

Surveyor	**Dates**	**Location and Effort**
Hayes Environmental	1-2 Jan 2009	Thorough searches of each stand of remnant native vegetation within the subject site. 'Random Meander' in other open space areas.
Anne Clements & Associates	23 Jan 2003	Landcom owned land comprising the eastern half of the main stand of CPW within the subject site. 7 transects (each comprised of 3 contiguous 10m by 10m quadrats), and 4 spot locations (each comprised of a 10m radius at the spot).
AMBS	26 August 2002	Open space areas including the northern part of the undeveloped road corridor and Landcom owned land. Three 20m x 20m quadrats, one in the main patch of CPW, one in adjacent SSTF, and one in the northern highly degraded area of SSTF.
AMBS	20 July 2001	The majority of open space areas within the subject site, including all of the undeveloped road corridor, Shopping centre, high school, sports complex and bus depot areas. Random meander with three additional 'zig-zag' transects. One 20m x 20m quadrat in the main patch of CPW.

2.4 Fauna Field Surveys

Previous fauna surveys have been conducted within the subject site by AMBS (2001 & 2002). Anne Clements & Associates (2003) provides vegetation information pertinent to habitat assessment.

The surveys conducted by Hayes Environmental for this report were designed to supplement and confirm the results of these previous surveys, and particularly, to target threatened fauna species previously recorded in the study area, and threatened species regarded as potentially present, based on desktop research.

A range of fauna surveys were conducted within the subject site by a team of two surveyors on the 1st and 2nd of January 2009. These included:

- review and verification of previous AMBS (2001 & 2002) fauna habitat descriptions, with a focus on hollow-bearing trees, and other features of potential value for threatened fauna known to occur in the locality;
- opportunistic recording of all fauna species, through sightings and indirect evidence (*ie* scats, tracks, dens, scratchings *etc*);
- active diurnal searches for the Cumberland Plain Land Snail *Meridolum corneovirens* in areas of Cumberland Plain Woodland, and adjacent areas of Shale Sandstone Transition Forest within the study area. Searches involved turning of all logs, large woody debris and digging in areas of deep leaf litter around the base of trees. The extent of potential habitat for this species within the subject site is extremely limited, and the number of potential shelter features so few, that it was possible to search virtually every feature;
- active diurnal searches for the Koala, and for evidence of the Koala (*ie* scats, scratches on trees), primarily within the main bushland remnant along the undeveloped road corridor, and around the Busways Bus Depot land. Due to the small extent of potential habitat for this species within the subject site, surveyors were able to opportunistically inspect the majority of trees within this area, whilst carrying out other survey techniques;
- diurnal bird and reptile surveys conducted opportunistically throughout the two survey days, including a 30min specific bird survey conducted each day within the main patch of native vegetation northwest of the Airds shopping centre;
- diurnal and nocturnal amphibian surveys, including active searches for frogs around the edges of the existing pond behind the shopping centre and along Smiths Creek over two evenings, approximate total of at least 2 person-hours;
- call playback for the Green and Golden Bell Frog *Litoria aurea* at one location adjacent to the existing pond. Calls were broadcast for 5 mins, followed by 15 mins of listening, and then repeated;
- spotlighting for forest owls and arboreal mammals with two observers on two consecutive nights for 1.5 hours, immediately following 1 hour of stag watching of larger trees in the main patch of vegetation northwest of the Airds shopping centre. Stag watching commenced 30mins prior to dusk, and continued until 30mins after dusk.
- detection of microchiropteran bat calls on two consecutive nights using an ultrasonic echolocation detection device (Anabat SD1). The device was set in the main patch of vegetation northwest of the shopping centre, from commencement of stag-watching surveys until surveyors left the site for the evening. The device could not be left overnight on site due to risk of tampering or theft. Approximate total of 3 hours of recording per night.

Other survey methods such as trapping were not deemed necessary for this study, based on existing knowledge of fauna occurring on the site from previous surveys, and based on discussion in Appendix 1 of threatened fauna species likely to occur on the site.

Weather conditions during the fauna survey were warm to hot (18ºC-26ºC) during the day, cooling overnight, with light SW winds, no rain.

An inventory was compiled of fauna species recorded during the survey, and of species recorded previously during the AMBS (2001 & 2002) surveys (Appendix 3).

Table 2 *Summary of Fauna Field Surveys*

Surveyor	Dates	Weather	Location and Effort
Hayes Environmental	1-2 Jan 2009	Warm to hot (18ºC-26ºC) during the day. Cooling overnight. Light SW winds. No rain.	All stands of native vegetation within the subject site, particularly the main patch of CPW, and vegetation linked to the Smiths Creek corridor. Active diurnal searches for the Cumberland Plain Land Snail in all areas of suitable habitat. Diurnal searches for the Koala in all areas of remnant vegetation, including searches for scats and scratches. 30min bird census on each day. 2 person-hours amphibian searches over 2 evenings. Call playback for *Litoria aurea* adjacent to the pond. Spotlighting/stagwatching for 2.5hrs per evening. Anabat detection – total of 3 hours recording.
AMBS	26 Aug 2002	No details.	Open space areas including the northern part of the undeveloped road corridor and Landcom owned land. Targeted Koala surveys including searches for scats and examination of tree trunks for scratches in three 40m x 40m quadrats, along a 50m by 10m transect, and around individual trees in cleared and degraded areas between Smiths Creek, College Road and Georges River Road.
AMBS	16-25 July 2001	Cold but fine and sunny between 16 and 20 July. Overcast on 23 July. Some rainfall on 25 July.	The majority of open space areas within the subject site, including all of the undeveloped road corridor, Shopping centre, high school, sports complex and bus depot areas. Targeted searches for Cumberland Plain Land Snail on 20 July throughout all of study area, with focus on remnant bushland. Targeted searches also conducted on 25 July in remnant bushland adjacent to Smiths Creek. Targeted diurnal and nocturnal amphibian surveys, including aural detection around the existing dam and creeklines, turning of surface material and habitat features, spotlight searches of the dam and Smiths Creek. Targeted diurnal and nocturnal searches for reptiles and for birds throughout all parts of the study area, including searches for Koalas, scats and scratchings. Spotlighting for arboreal mammals in bushland areas over 3 evenings. Anabat detection in bushland areas and around the dam during 3 evenings. Detectors were hand-held.

2.5 Project Team

Site Inspections, research and reporting by Rebecca Hayes (CV provided in Appendix 5).

Flora and fauna field surveys were conducted by Peter Monsted, assisted by Alex Townsend (Peter Monsted's CV is provided in Appendix 5). Bat calls were identified by Glen Hoye of Fly By Night Bat Surveys Pty Ltd.

Bushfire Assessment conducted by David Peterson (CV provided in Appendix 5).

2.6 Agency Consultation

Consultation occurred with agencies during workshops where preliminary assessment findings were presented and discussed. Those agencies and their representatives consulted as part of the assessment process are included in Table 3 below.

Table 3 Agency consultation

Agency	Date(s) of consultation	Comments and actions
Mr Doug Stevens NSW Rural Fire Service	5th May 2010	(A presentation of the proposal and bushfire assessment was also provided at the Agency Workshop with RFS in attendance) Comply with Planning for Bushfire Protection 2006
Dr Robert Close UWS Koala Research	31st Jan 2011	Dr Close agreed that the Concept Plan does not appear to create issues for Koalas. A tagged resident male is known to wander the Smiths Creek corridor, and is occasionally visited by females. There could be an opportunity to increase quality of habitat along Smiths Creek at Airds, and opportunity to improve safety of Koalas crossing Georges River Road at Smiths Creek. Speed of traffic within Koala areas is a critical factor for Koala safety. Koalas tend to follow creeklines and reside near areas of water. Koalas may choose to spend time in trees near the pond when it is restored. This may create road crossing issues between the pond and the retained area of CPW. Koalas not deterred by sparsity of tree cover, and will choose to cross open areas. Koalas may shelter in and travel through non feed tree species such as Turpentine, Lily Pilly and Radiata Pine. Koalas require dense cover for protection from Powerful Owls. Kunzea scrubland can provide safe pathways. Several possible Koala migration routes within residential parts of Airds may require restrictions on boundary fencing. Koalas can climb chain-link fences. Koalas would also be likely to climb ladders set in corners on colourbond fences. Ladders could be chain wire, or timber trellis' *etc*. Koala feed trees in the local area include stringybarks and Grey Gum *E punctata*, Tallowwood *E microcorys*, *E nicholii* [this is not an indigenous species) and occasional Forest Red Gum *E tereticornis*. Female territories along the Georges River are approx 15-10ha each. Young animals are being pushed towards Airds. Further consultation with Dr Close should occur during the detailed design for each stage.

3 EXISTING ENVIRONMENT

3.1 General Description

The study area is characterised generally as residential land, with several predominantly cleared open space areas, and a central cluster of schools and retail businesses. Refer to Figure 2.

An undeveloped predominantly cleared major road corridor runs approximately north-south through the study area, providing further informal open space.

Native vegetation is limited generally to scattered trees throughout the residential areas, and a moderate-sized patch of woodland situated between the Airds shopping centre and a Busways Bus Depot to the north. This patch is linked tenuously to smaller patches adjacent to the Georges River Road.

Across Georges River Road to the north, a broad corridor of native vegetation follows Smiths Creek north almost to the Leumeah Railway Station. Smiths Creek at this point drains into the Bow Bowing Creek/Canal.

The study area is bound to the north by the residential suburb of Ruse, to the east by extensive tracts of reserved native bushland, to the south by the residential suburb of St Helens Park, and to the west by the residential suburbs of Campbelltown, Bradbury and Ambarvale.

3.2 Flora

Native vegetation within the study area has been previously described and/or mapped by AMBS (2001 & 2002), NPWS (2002) and by Anne Clements (2003) (reports provided in Appendix 5). Recent surveys conducted by Hayes Environmental (2009) confirm that the previous descriptions and mapping of AMBS and Anne Clements still provide a good assessment of the study area.

No plant species listed as "*threatened*" under either the TSC Act or EPBC Act have been recorded within the study area.

A vegetation map of the study area is provided as Figure 3, based on the previous AMBS (2002), NPWS (2002) and Anne Clements (2003) mapping, and the Hayes (2009) surveys.

The following is an overview of salient points:

1. A small patch of Cumberland Plain Woodland occurs immediately to the north of the Airds shopping centre. This patch consists of scattered old remnant trees, surrounded by younger regrowth trees. The shrub layer is generally absent or very sparse, and of limited species diversity. The groundcover, although mown, contains a good variety of native species, but also many exotic grasses and herbs. The patch has been disturbed through selective clearing, rubbish dumping, and edge effects, and is criss-crossed by tracks and services. Differences in the reporting of dominant understorey species between AMBS (2001 & 2002) and Anne Clements (2003) could be accounted to different seasonal and climatic conditions, and the variability of vegetation within the patch.
2. The northern section of the undeveloped major road corridor, and lands along Smiths Creek to the west and north of the Busways Bus Depot, contain a mosaic of modified but regenerating Shale Sandstone Transition Forest and abandoned pasture. There is a patchy canopy of native eucalypts, with some aged remnant trees located within the riparian zone of Smiths Creek. There is a patch of exotic grassland immediately east of the electricity substation.

3. Vegetation within the riparian zone of Smiths Creek has been degraded through weed-invasion to the extent that it barely constitutes a native vegetation community. This area is considered to have a very low regeneration potential.
4. The southern section of the undeveloped major road corridor, *ie* south from approximately level with Hartigan Way which is on the western side of the corridor, consists of cleared open grassland with scattered trees. The grassland contains a mixture of native and exotic grass species. The area is disturbed through mowing and burning, and is not representative of any native ecological community.
5. An existing pond is located to the southwest of the Airds shopping centre. The pond collects run-off from the upslope residential development, and has been significantly affected by rubbish dumping and weed invasion. The pond is ringed by macrophytic vegetation, with open water in its centre. Surrounding lands consist of cleared open grassland dominated by exotic species.
6. Scattered trees occurring throughout the residential and business zones of the study area (including the open space areas within the Georges River Road reserve) are generally remnant native species from the ecological communities that would once have occurred across these parts of the study area, *ie* Cumberland Plain Woodland and Shale Sandstone Transition Forest, along with some planted ornamental specimens. There are no intact areas of native bushland in these zones.
7. The western fringes of the Georges River Riverside Reserve (immediately east of the study area) have been substantially disturbed through clearing, thinning and burning adjacent to the existing residential development. However, to the east of the disturbed fringe, the reserve contains large areas of relatively intact native vegetation, identified by NPWS (2002) as predominantly Shale Sandstone Transition Forest and Upper Georges River Sandstone Woodland.

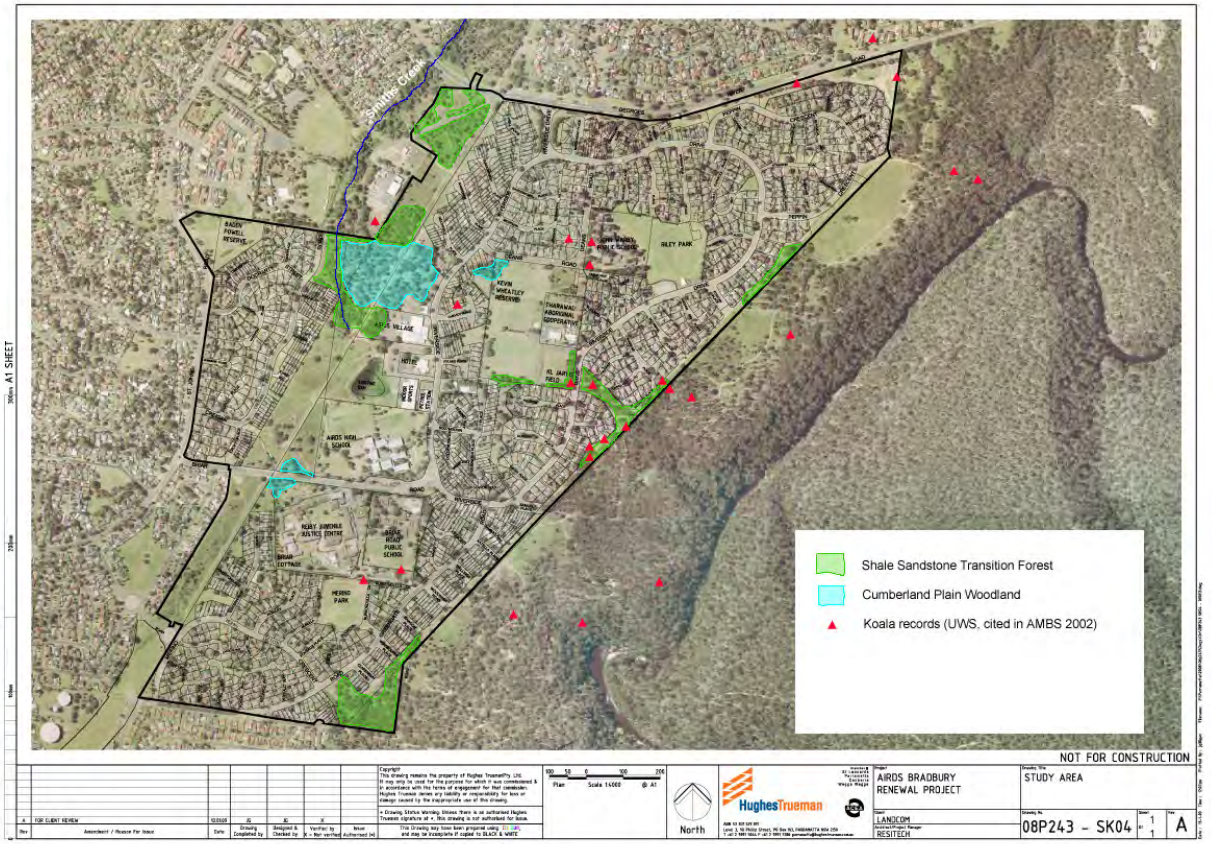

Figure 3 *Extent and distribution of Ecological Communities within the study area, and distribution of previous Koala records (provided as A3 in Appendix 7).*

3.3 Fauna

3.3.1 Fauna habitats

Fauna habitats are described in AMBS (2001 & 2002).

In general, the study area contains poor quality fauna habitat, due to the extent of previous clearing, fragmentation and isolation of areas of habitat, anthropogenic disturbances, and loss of understorey shelter due to mowing and burning.

Notable features include:

- aged remnant trees present along Smiths Creek, to the north of the study area;
- aged remnant trees containing hollows in the patch of Cumberland Plain Woodland north of the Airds shopping centre;
- sandstone outcrops within the Smiths Creek riparian zone of potential habitat value for reptiles such as the Eastern Water Skink;
- the pond to the southwest of the Airds shopping centre, albeit highly degraded and infested by the Plague Minnow, an exotic fish that preys on young tadpoles;
- dense understorey vegetation, albeit largely exotic, within the riparian zone of Smiths Creek. This would provide some shelter for a range of disturbance-tolerant small insectivorous birds.

It should be noted that extensive tracts of intact habitat occur immediately to the east of the study area, and that these areas would be used in preference to the study area by virtually all mobile or wide-ranging native fauna.

3.3.2 Fauna species

In general, a low diversity of fauna species were recorded during the surveys (particularly non-avian species), corresponding to the poor quality and limited array of habitat types and features. The fauna species recorded within the study area are typically common, wide-ranging and relatively disturbance-tolerant species. The majority of these are considered characteristic of urban environments.

A list of fauna species recorded within the study area during the recent 2009 surveys, and previous AMBS (2001 & 2002) surveys is provided as Appendix 3 to this report.

A list of threatened (TSC Act &/or EPBC Act) fauna species known to have occurred on or within 10km of the study area (previous surveys, databases) is provided as Appendix 1 to this report. Appendix 1 also includes details of their habits and habitat requirements, and a discussion as to their likelihood of occurring in the subject site, or being affected by an urban renewal of the subject site.

Based upon details and discussion within Appendix 1, the following threatened fauna species require further consideration:

- Cumberland Plain Land Snail *Meridolum corneovirens*

  A population of this threatened species has been previously recorded within the subject site (AMBS 2001). Recent targeted surveys (Hayes Env 2009 & 2010) found several empty shells of this species, but no live individuals. Given the high levels of ground disturbance within the area of CPW habitat for this species, including mowing, burning, trampling, and removal of tree debris, and that these disturbances have continued throughout a period of sustained drought, it seems likely that the population of Cumberland Plain Land Snail previously recorded within the subject site has become extinct.

  Thorough surveys were conducted for this species in early January 2009, following a wetter than average Spring 2008, and more than 100mm of rainfall in December 2008. Surveys were conducted at an appropriate time of year, time of day, and during appropriate soil moisture conditions to maximise detection of this species. No live individuals were recorded.

- Microchiropteran bats (Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail Bat *Mormopterus norfolkensis*, Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris*, Greater Broad-nosed Bat *Scoteanax rueppellii*)

  Several threatened microchiropteran bat species have been recorded within the subject site. Microchiropteran bats are wide-ranging species that may be roosting/sheltering off-site (such as in the Georges River area), and only using the site as an opportunistic foraging resource. However, it is possible that the above listed tree-roosting species could be affected by tree removal within the subject site.

- Koala *Phascolarctos cinereus*

  There is a large, viable, and apparently increasing Koala population in the Georges River area, immediately to the east of the subject site. University of Western Sydney records (cited in AMBS 2002) indicate that the Koala has previously ventured into the Airds residential area, as far as the Busways Bus Depot. There are also records from Merino Park in the south of the subject site (refer to Figure 3).

  These incursions appear to be associated with a small reserved corridor of open space between Boonoke Place and Templeton Way, which links the Georges River Riverside Reserve with small stands of trees around the perimeter of the Tharawal Aboriginal Co-op and Kevin Wheatley Reserve. These areas in turn have a very tenuous link through to the patch of native vegetation located to the north of the shopping centre, and surrounding the bus depot.

  However, despite these occasional incursions, it appears that the subject site does not support a resident population of Koalas (based on lack of records, or evidence, of the Koala during targeted fauna survey work conducted by AMBS (2001 & 2002) and more recently Hayes Env (2009).

  AMBS (2002) suggest that Koalas may utilise the study area as part of a dispersal corridor between the Georges River and Kentlyn to the north of Airds. This is considered unlikely given that a shorter, better vegetated, less disturbed and far safer route would follow the Riverside Reserve northeast direct to Kentlyn.

  The suburb of Airds poses many dangers to Koalas, such as vehicles and dogs, with a discontinuous tree canopy forcing Koalas to descend and cross open ground, making them vulnerable to attack. To move north from the study area along the Smiths Creek riparian corridor, Koalas would need to cross the busy Georges River Road.

  In conclusion, it seems that the Georges River area contains actively growing Koala populations, causing young animals to disperse randomly in a search for new habitat. It seems that whilst potential habitat for Koalas does occur within the Airds Bradbury study area, the habitat has not been adequate to entice Koalas to stay. It is probable that anthropogenic disturbances associated with the Airds residential area would deter Koalas from using otherwise suitable habitat.

  It is unlikely that the study area provides an important resource for Koalas, or is of significance with regard to the long term survival of Koalas in the Georges River area.

3.4 Bushfire Hazard

An analysis of the bushfire hazard (vegetation and bushland) within and adjoining the study area is essential in determining the location and extent of necessary bushfire protection measures such as APZs. An assessment of the hazard is based on an understanding of the vegetation type (fuels) that currently occur and are likely to occur in the future, and the topography or slope upon which the vegetation is found.

Certain characteristics of the vegetation can influence bushfire behaviour and may need to be considered in the design of bushfire protection measures. Such characteristics include vegetation type (as a surrogate for fuel structure, moisture and loading), location with reference to the development, size (*ie* possible length of fire run), and orientation and exposure to the development. Similarly, slope of terrain with respect to where the vegetation is found is also important to consider, such as the gradient of the slope (*eg* steeper slopes can significantly increase the rate of spread of fires), the

length of the slope, effect of topographic anomalies such as cliff lines and gullies, and whether the slope is upslope or downslope leading away from the development.

The study area is dominated by the presence of the Georges River Riverside Reserve and adjacent Holsworthy Military Area which border the study area to the east. The Airds plateau gently falls away to the east forming the steep gully formation of the Georges River (Figure 1). The vegetation community along the eastern interface of the study area is categorised as 'Dry Sclerophyll Forest (Shrub/grass formation)' under 'Planning for Bushfire Protection 2006' (RFS 2006) and Keith (2006).

The next significant bushland feature is the patch of Cumberland Plain Woodland situated to the north of the shopping centre, and the adjoining riparian corridor associated with Smiths Creek. The geomorphology of the creek line and hence riparian corridor is typical of the Cumberland Plain and consists of a gentle sloping catchment characterised by a channel of low to no flow. The remnant vegetation in this area is Cumberland Plain Woodland and Shale Sandstone Transition Forest, and is categorised by PBP and Keith (2006) as 'Woodland (Grassy)'. These community classifications are consistent with the findings of previous (AMBS 2001 & 2002; Anne Clements 2003) and current (Hayes Env) flora surveys.

4 ECOLOGICAL ASSESSMENT

4.1 Impacts and Benefits of the Proposal

Development in accordance with the Concept Plan (Figure 1) would have the following impacts and benefits on ecological values within the subject site (refer to Figure 4):

1) retention of the majority (approximately 3 hectares) of the existing patch of Cumberland Plain Woodland which occurs in the vicinity of the Airds shopping centre. There is an existing cleared corridor through the centre of the patch. This clearing would be utilised for installation of services, and for construction of a connecting cycleway. The cycleway through the patch of Cumberland Plain Woodland would have a compacted sandstone surface rather than concrete pavement, to minimise impacts upon adjacent vegetation.
2) the patch would be conserved to maintain its ecological values, but would also be managed to meet social and safety concerns. The existing network of informal trails would be rationalised. Some trails would be retained and formalised. Tall shrubs and dense thickets would be reduced. Prickly shrubs would be planted to discourage off-track trampling of vegetation and anti-social behaviour.
3) retention of the small stand of Cumberland Plain Woodland (approximately 0.19 hectares) in the northwestern corner of the juvenile justice centre.
4) loss of the northeastern fringe of the main patch of Cumberland Plain Woodland within the subject site, and loss of two small isolated stands (a combined area of approximately 1.21 hectares).
5) retention of approximately 3.73 hectares of Shale Sandstone Transition Forest within the site. These areas would be managed as per the retained patch of Cumberland Plain Woodland (refer to Point 2 above).
6) loss of approximately 4.41 hectares of Shale Sandstone Transition Forest from the site.
7) retention of a 20m wide riparian vegetation corridor along Smiths Creek, which would link the retained patch of Cumberland Plain Woodland to other remnant native vegetation to the north of the study area.
8) impacts on Koala habitat are directly relational to impacts on native vegetation and trees within the site.

9) retention of two existing narrow corridors of bushland which lead into the site from the Georges River Riverside Reserve. These areas appear to be used occasionally by Koalas, and provide a potential refuge for Koalas fleeing bushfire. Existing vegetation within these corridors would be retained. Additional trees and shrubs shall be planted to facilitate use of the corridors by Koalas, including planting of Koala feed tree species, and planting of shrubs to provide ground-level protection to Koalas.

10) tree links shall be retained from the end of each of the corridors, to direct Koalas toward open parkland areas within the subject site. Tree links on private land may be protected through covenants. Fencing within the tree link areas shall be of a type that can be climbed and crossed by Koalas. Dogs shall be kept excluded from tree link areas.

11) retention of the existing pond in approximately its current location, although the pond will be drained and reconfigured before being restored and re-vegetated. A Fauna Management Plan shall be prepared and implemented prior to commencement of draining of the pond, to manage native fauna throughout the reconfiguration process.

12) The pond will be retained within a feature park for recreation. Some reed beds shall be planted within the pond, to provide habitat for native fauna.

13) The road which separates the pond from the retained patch of Cumberland Plain Woodland will be designed to reduce traffic speed, for safer crossing by pedestrians and by wildlife (such as ducks).

Figure 4 *Retention and loss of native vegetation that would result from development in accordance with the Concept Plan (provided as A3 in Appendix 7).*

4.2 NSW Threatened Species Conservation Act 1995

The *NSW Threatened Species Conservation Act 1995* (TSC Act) modified the *NSW Environmental Planning & Assessment Act 1979* (EP&A Act) by including in Section 5A eight factors which were to be considered when determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*". The *NSW Threatened Species Legislation Amendment Act 2004* has further modified the EP&A Act such that the eight factors have been replaced by a set of seven factors.

These seven factors "*must be taken into account*" by a consent or determining authority when deciding "*whether there is likely to be a significant effect on threatened species, populations or ecological communities*", particularly in administering Sections 78, 79 and 112 of the EP&A Act.

4.2.1 Relevant Threatened Biota

Species

No plant species listed as "*threatened*" under either the TSC Act or the EPBC Act were recorded within the subject site.

Based on considerations in Appendix 1, the Koala *Phascolarctos cinereus* and four microchiropteran bat species (Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail Bat *Mormopterus norfolkensis*, Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris*, Greater Broad-nosed Bat *Scoteanax rueppellii*), could be affected by development in accordance with the Concept Plan.

The potential impacts of development in accordance with the Concept Plan upon these threatened fauna species have been assessed, pursuant to s.5A of the EP&A Act. Details of the assessment are provided in Appendix 4, and are summarised in Ch 4.2.2 below.

Populations

No flora or fauna species being part of an "*endangered population*" listed under the TSC Act were recorded within the subject site, nor would be affected by development in accordance with the Concept Plan.

Ecological Communities

Development in accordance with the Concept Plan would result in loss of approximately 0.58 hectares of Cumberland Plain Woodland, a "*critically endangered ecological community*" listed under the TSC Act, and loss of approximately 2.94 hectares of Shale Sandstone Transition Forest, an "*endangered ecological community*" listed under the TSC Act. Refer to Figure 4.

The potential impacts of development in accordance with the Concept Plan upon these two ecological communities have been assessed, pursuant to s.5A of the EP&A Act. Details of the assessment are provided in Appendix 4, and are summarised in Ch 4.2.2 below.

4.2.2 Assessment of Significance

Koala Phascolarctos cinereus

In summary of the seven parts (with full details in Appendix 4):

(a) the Airds Bradbury Renewal Project would not be likely to have an adverse effect on the life cycle of the Koala, such that a viable local population of this species would be placed at risk of extinction;

(b) the Koala is not part of any relevant "*endangered population*" listed under the TSC Act;

(c) the Koala is not an ecological community;

(d) development in accordance with the Concept Plan would result in loss of approximately 4 hectares of occasional habitat for the Koala (this being directly relational to areas of vegetation within the subject site), and may further fragment retained such habitat for the Koala across the site. The habitat that would be affected is not of particular importance for the long-term survival of the Koala in the locality;

(e) there is no declared "*critical habitat*" of relevance to the subject site. Development in accordance with the Concept Plan would not affect any area of "*critical habitat*";

(f) a '*Recovery Plan for the koala* (*Phascolarctos cinereus*)' has been prepared by DECC (November 2008). The Concept Plan would not hinder the objectives or actions of the Recovery Plan. No threat abatement plans are of specific relevance to the Airds Bradbury Renewal Project;

(g) there are several key threatening processes which have previously occurred on the site, some of which are likely to be ongoing. Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. However, the proposal would not result in loss of important or significant habitat for the Koala. The increase of the impact of this threatening process in the locality for the Koala is not significant.

Microchiropteran Bats

Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail Bat *Mormopterus norfolkensis*, Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris*, Greater Broad-nosed Bat *Scoteanax rueppellii*

In summary of the seven parts (with full details in Appendix 4):

(a) development in accordance with the Concept Plan would not be likely to have an adverse effect on the life cycle of any of the four threatened microchiropteran bat species, such that a viable local population of any of the species would be placed at risk of extinction;

(b) none of the four threatened microchiropteran bat species are part of any relevant "*endangered population*" listed under the TSC Act;

(c) none of the four threatened microchiropteran bat species are an ecological community;

(d) development in accordance with the Concept Plan would result in loss of approximately 5.62 hectares of highly degraded potential habitat for microchiropteran bats. The proposal may contribute to increased fragmentation of habitats for microchiropteran bats, although not to a significant extent. The habitat that would be affected is not likely to be of particular importance for the long term survival of any microchiropteran bat species in the locality;

(e) there is no declared "*critical habitat*" of relevance to the Airds Bradbury Renewal Project. Development in accordance with the Concept Plan would not affect any area of "*critical habitat*";

(f) there are no Recovery Plans for any of the four threatened microchiropteran bat species. No threat abatement plans are of specific relevance to the Airds Bradbury Renewal Project;

(g) there are several key threatening processes which have previously occurred in the study area, some of which are likely to be ongoing. Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. However, the proposal would not result in loss of important or significant habitat for microchiropteran bats. The increase of the impact of this threatening process in the locality for microchiropteran bats is not significant.

Cumberland Plain Woodland

In summary of the seven parts (with full details in Appendix 4):

(a) Cumberland Plain Woodland is not a "*threatened species*";

(b) Cumberland Plain Woodland is not an "*endangered population*";

(c) development in accordance with the Concept Plan would result in loss of some vegetation on the northeastern fringe of the main stand, loss of two small isolated occurrences of Cumberland Plain Woodland, and may affect the structure of retained areas of Cumberland Plain Woodland within the site;

(d) development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of habitat for Cumberland Plain Woodland, and may further fragment habitat for this community in the locality. The habitat to be affected is of some importance, but has not been identified as being of particular importance for the long term survival of Cumberland Plain Woodland in the locality;

(e) there is no declared "*critical habitat*" of relevance to the subject site. The Airds Bradbury Renewal Project would not affect any area of "*critical habitat*";

(f) DECCW have prepared a Cumberland Plain Recovery Plan (2011), including actions for the recovery of Cumberland Plain Woodland. The subject site is not part of any area identified as 'priority conservation land', and would not be of particular value as a 'stepping stone' reserve between such areas. The Airds Bradbury Renewal Project would not interfere with implementation of the DECCW (2011) Cumberland Plain Recovery Plan. No threat abatement plans are of specific relevance to the subject site;

(g) 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. The proposal would result in loss of approximately 0.58 hectares of Cumberland Plain Woodland.

Shale Sandstone Transition Forest

In summary of the seven parts (with full details in Appendix 4):

(a) Shale Sandstone Transition Forest is not a "*threatened species*";

(b) Shale Sandstone Transition Forest is not an "*endangered population*";

(c) development in accordance with the Concept Plan would result in loss of the majority of Shale Sandstone Transition Forest from the site, and may prevent recovery of the shrub layer in retained areas of this community. These actions may place the local occurrence at risk of extinction;

(d) development in accordance with the Concept Plan would result in loss of approximately 4.41 hectares of degraded habitat for Shale Sandstone Transition Forest, and would contribute to further fragmentation of this community. The habitat that would be affected has not been identified as being of particular importance for the long term viability of this community in the locality;

(e) there is no declared "*critical habitat*" of relevance to the subject site. The Airds Bradbury Renewal Project would not affect any area of "*critical habitat*";

(f) DECCW have prepared a Cumberland Plain Recovery Plan (2011), including actions for the recovery of Shale Sandstone Transition Forest. The subject site is not part of any area identified as 'priority conservation land', and would not be of particular value as a 'stepping stone' reserve between such areas. The Airds Bradbury Renewal Project would not interfere with implementation of the DECCW (2011) Cumberland Plain Recovery Plan. No threat abatement plans are of specific relevance to the subject site;

(g) 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. The proposal would result in loss of approximately 4.41 hectares of Shale Sandstone Transition Forest.

4.2.3 Conclusions

Based upon the considerations detailed above, in Appendix 1 and in Appendix 4, development in accordance with the Concept Plan would not be likely to significantly affect any threatened species or populations listed on the schedules of the NSW TSC Act.

Having regard to the critically endangered status of Cumberland Plain Woodland, and giving due consideration to the seven factors listed under s.5A of the EP&A Act, the impact upon this community from development in accordance with the Concept Plan could be significant.

Similarly, due to the proportion of the local occurrence of Shale Sandstone Transition Forest that would be removed from the site, the impact upon this community from development in accordance with the Concept Plan could be significant.

Consequently, a justification for the Concept Plan is provided in Chapter 4.5 below. A strategy to compensate for the impacts upon Cumberland Plain Woodland and Shale Sandstone Transition Forest is provided in Chapter 4.6 below.

4.3 Commonwealth Environment Protection & Biodiversity Conservation Act 1999

The *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* requires that an action which has, will have or is likely to have a significant impact upon one or more matters of National Environmental Significance (NES) must be referred to the Commonwealth Minister for Environment & Heritage for approval. These actions are referred to as 'controlled actions'.

Matters of NES include World Heritage properties, Ramsar Wetlands of international importance, listed threatened species and communities, listed migratory species, nuclear actions and Commonwealth marine areas.

4.3.1 Matters of National Environmental Significance

Nine fauna species listed as threatened under the EPBC Act are known to occur in the locality, as listed in Appendix 1. Based on considerations in Appendix 1, none of these species would be likely to be affected by development in accordance with the Concept Plan.

Development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of Cumberland Plain Woodland and approximately 4.41 ha of Shale Sandstone Transition Forest, both of which are listed under the EPBC Act.

Twelve bird species listed as migratory under the EPBC Act are known to have occurred either within the site or in the locality (Appendix 3). Some of these species could occur on the site on occasions.

No other matters of NES are likely to be affected by development in accordance with the Concept Plan.

4.3.2 Requirement for Referral to the Commonwealth

Critically Endangered Ecological Community – Cumberland Plain Woodland

According to the administrative guidelines on significance, the proposed development would be likely to have a significant impact upon a critically endangered ecological community if it does, will or is likely to:

- lead to a long term adverse effect on an ecological community; or
- reduce the extent of a community; or
- fragment an occurrence of the community; or
- adversely affect habitat critical to the survival of an ecological community; or
- modify or destroy abiotic (non-living) factors (such as water, nutrients, soil) necessary for the community's survival; or
- result in invasive species that are harmful to the endangered community becoming established in an occurrence of the community; or
- interfere with the recovery of an ecological community.

The Concept Plan as a whole, including the proposed mitigation measures and off-sets set out in Chapter 4.6 of this report, would not be likely to impose a significant impact upon Cumberland Plain Woodland (CPW).

Endangered Ecological Community – Shale Sandstone Transition Forest

According to the administrative guidelines on significance, the proposed development would be likely to have a significant impact upon an endangered ecological community if it does, will or is likely to:

- lead to a long term adverse effect on an ecological community; or
- reduce the extent of a community; or
- fragment an occurrence of the community; or
- adversely affect habitat critical to the survival of an ecological community; or
- modify or destroy abiotic (non-living) factors (such as water, nutrients, soil) necessary for the community's survival; or
- result in invasive species that are harmful to the endangered community becoming established in an occurrence of the community; or
- interfere with the recovery of an ecological community.

The Concept Plan as a whole, including the proposed mitigation measures and off-sets set out in Chapter 4.6 of this report, would not be likely to impose a significant impact upon Shale Sandstone Transition Forest (SSTF).

Migratory Species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify, destroy or isolate an area of important habitat of the migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

Development in accordance with the Concept Plan would not be likely to impose a significant impact upon migratory species on the basis that:

- the proposal would result in clearing of approximately 5.62 hectares of native vegetation, which is not significant in relation to the extent of native vegetation that would be retained on the site (approximately 6.92 ha), in the locality, and along the adjacent Georges River corridor;
- there would be no significant adverse impact upon corridor values within the site or locality;
- the proposal would not remove or destroy any important, unique or critical habitat features for the migratory species; and
- the proposal would not be likely to contribute to threatening processes for migratory species, such as further establishment of harmful species.

4.3.3 Conclusion

The Concept Plan as a whole, including the proposed mitigation measures and off-sets set out in Chapter 4.6 of this report, would not be likely to impose a significant impact upon any matter of National Environmental Significance.

However, given the scale of the project, and the variety of threatened species and ecological communities present, it is recommended that the project be referred to the Commonwealth Minister for Environment and Heritage under the EPBC Act, for certainty.

4.4 State Environmental Planning Policy No 44 (SEPP 44)

SEPP 44 applies to lands for which a development application has been made, which are greater than 1 hectare in size, and which are located within local government areas listed on Schedule 1 of SEPP 44.

The subject site is greater than 1 hectares in size. The Campbelltown local government area is listed on Schedule 1. Therefore, SEPP 44 applies.

4.4.1 Step 1 - *'Potential Koala Habitat'*

SEPP 44 defines 'potential koala habitat' as "*areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component*".

Koala 'feed tree species' listed in Schedule 2 of SEPP 44 are:

Forest red gum	*Eucalyptus tereticornis*
Tallowwood	*Eucalyptus microcorys*
Grey Gum	*Eucalyptus punctata*
Ribbon or manna gum	*Eucalyptus viminalis*
River red gum	*Eucalyptus camaldulensis*
Broad leaved scribbly gum	*Eucalyptus haemastoma*
Scribbly gum	*Eucalyptus signata*
White box	*Eucalyptus albens*
Bimble box or poplar box	*Eucalyptus populnea*
Swamp mahogany	*Eucalyptus robusta*

Some patches of vegetation within the subject site contain Koala 'feed tree species' and are likely to constitute 'potential koala habitat' under SEPP 44.

On this basis, assessment under SEPP 44 proceeds to Step 2.

4.4.2 Step 2 - *'Core Koala Habitat'*

SEPP 44 defines 'core koala habitat' as "*an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population*".

There are records of Koalas occurring on the subject site (refer to Figure 3). However, these occurrences appear to be occasional and temporary. There is no evidence of any Koalas being resident on the site.

The subject site does not support a 'resident population of koalas', and so does not constitute 'core koala habitat', as defined by SEPP 44

4.4.3 Step 3 - *Requirement for a Plan of Management*

SEPP 44 states that "*before a council may grant consent to a development application for consent to carry out development on land to which this Part applies that it is satisfied is a core koala habitat, there must be a plan of management prepared in accordance with Part 3 that applies to the land*".

The subject site does not constitute 'core koala habitat' as defined by SEPP 44, therefore, there is no requirement to prepare a formal plan of management in accordance with Part 3 of SEPP 44.

4.4.4 Conclusion

Some patches of vegetation within the subject site are likely to constitute 'potential koala habitat', based on the tree species present.

The site does not constitute 'core koala habitat', based on lack of evidence of a resident population of Koalas.

There is no requirement under SEPP 44 to prepare a Koala Plan of Management.

4.5 Justification for the Proposal

4.5.1 Social and Health

The Airds Bradbury Urban Renewal Project was prompted by a recognised need to improve the quality of life and health of residents of Airds and Bradbury, and to reduce the social disadvantage and stigma experienced by residents of these suburbs.

The Project seeks to create a socially mixed community through increasing private ownership within the suburbs, and renewal of housing such that the distinction between publicly owned and privately owned cottages is removed.

The Project seeks to infuse new life into the suburbs through improvement of road, cycle and pedestrian connections, and new facilities.

Existing public housing within the site is currently occupied, such that any demolition of cottages and flats will require relocation of residents. This presents some significant social issues, and significantly constrains the Renewal Project.

Airds and Bradbury currently contain substantially more open space areas than are needed or wanted by the community. These areas provide potential locations for new facilities, new housing and new roads required to achieve the objectives of the Renewal Project.

4.5.2 Ecological Values

The Concept Plan was designed to retain areas identified as being of 'primary' conservation value within the site. The Concept Plan would retain the majority of other vegetation and habitat identified as being in moderate to good condition.

The Concept Plan would result in removal of most areas of vegetation identified as being in very poor condition, with low regeneration potential, and also removal of several very small and isolated stands of vegetation that are not considered to be viable.

4.6 Avoidance of Impacts, Mitigation and Compensation

4.6.1 Analysis of Ecological Constraints and Opportunities

Hayes Environmental was commissioned in the early masterplanning stages of the project to identify ecological constraints to development within the subject site. Hayes Environmental mapped areas and features of ecological value within the subject site, and then prepared a Constraints Map to facilitate ongoing discussion and design of options for the project. Refer to Figure 5.

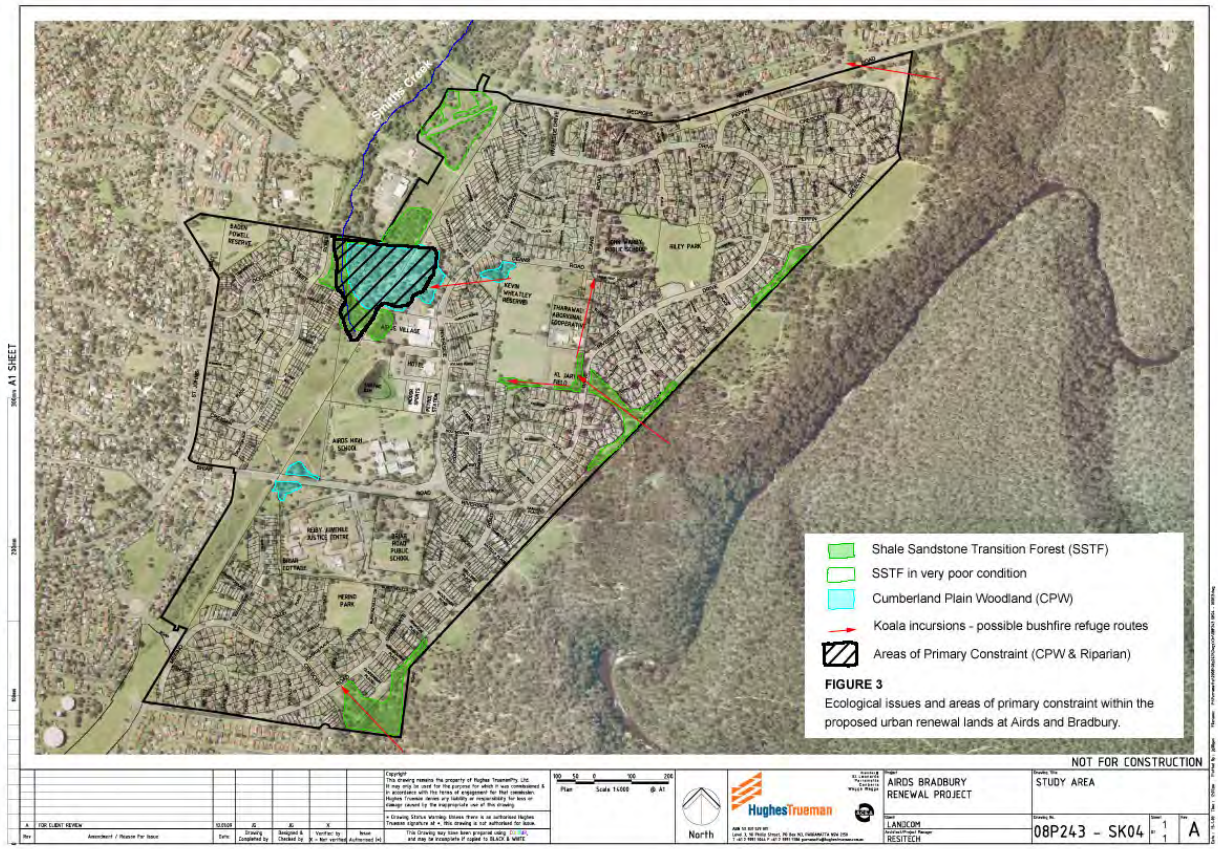

Figure 5 *Ecological issues and areas of primary constraint within the subject site (provided as A3 in Appendix 7).*

On the basis of the ecological constraints work, the following important ecological values were retained and protected:

- the main patch of Cumberland Plain Woodland (CPW);
- linkage of the main patch of CPW to the Smiths Creek corridor;
- space for a vegetated corridor to be re-established along Smiths Creek;
- narrow corridors of vegetation extending into the site from the Georges River reserve area in the east which provide potential access for Koalas.

Other mitigation measures such as street tree planting arrangements and species, Koala friendly fencing, traffic calming measures, detailed revegetation works *etc* have been discussed, and will be implemented during the detailed design of each progressive stage of the project.

Opportunities identified include:

- weed removal and revegetation of the Smiths Creek riparian corridor, using plant species appropriate to the Shale Sandstone Transition Forest ecological community.
- additional planting of Koala feed tree and shelter species.
- implementation of Koala protection measures, as recommended in the Campbelltown Koala Plan of Management.

- revegetation of currently cleared parts of the Georges River Riverside Reserve, to improve connectivity for Shale Sandstone Transition Forest, and to provide additional Koala habitat.

4.6.2 Mitigation and Compensation for Loss of Native Vegetation

Cumberland Plain Woodland

Cumberland Plain Woodland (CPW) is listed as a 'critically endangered ecological community' under both the TSC Act and the EPBC Act.

Development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of CPW from the Airds Bradbury site (comprised of the northeastern fringe of the main patch which is to be retained northwest of the existing Airds Shopping Centre, and two isolated and highly degraded stands – refer to Figure 4).

Having regard to the critically endangered status of CPW, and giving due consideration to the seven factors listed under s.5A of the EP&A Act, this impact could be significant.

The impact upon CPW would be compensated by the following actions and measures:

1. Enhancement of the retained 3 hectare patch of CPW northwest of the existing Airds Shopping Centre, through removal and control of weeds, rationalisation of existing tracks, controlled pedestrian and bike access, and supplementary tree and understorey plantings.

   These actions would be set out within a Bushland Management Plan, prepared in consultation with Council.

   The purpose of new plantings would be to revegetate existing clearings within the patch, to improve the structure of the community, and to increase floristic diversity of the community, particularly within the understorey.

   Initial weed removal activities would be followed by 2 years of maintenance weeding, details to be set out in the Bushland Management Plan.

   This patch of CPW is currently in poor condition, with a low floristic diversity. It is threatened by weed invasion and by ongoing incremental damage to the understorey.

   The above management actions would improve the ecological function of the community, and maximise the long-term viability of this patch.

2. Planting of CPW tree, shrub and groundcover species in groupings around the existing pond southwest of the Airds Shopping Centre.

   This area has been previously cleared of native vegetation and is highly degraded. It does not currently support CPW.

   New plantings in the pond area would serve a dual purpose – i) providing public amenity and an aesthetic surrounding to the pond, and ii) providing habitat for native fauna and an ecological extension to the retained patch of CPW.

3. There is a possible further opportunity for enhancement of the existing small patch of CPW located in the northwestern corner of the Reiby Juvenile Justice Centre. Additional planting in this area would support this small and degraded patch of CPW. This possibility has not been explored at this stage.

The areas of CPW that would be removed from the site are highly degraded, and generally are represented by a stand of trees, with little to no native understorey vegetation. These areas have limited ecological function.

Trees and shrubs cleared from areas of CPW within the Airds Bradbury site would be replaced at a ratio of 4 trees/shrubs planted to 1 tree/shrub removed. Planting would occur primarily within the retained 3 ha patch of CPW, and around the pond.

New plantings would be within or adjacent to the existing patch of CPW, and would complement existing ecological function within this patch. This provides considerable certainty in the outcome of the proposed planting works, in contrast to revegetation projects which start from scratch on cleared land.

Shale Sandstone Transition Forest

Shale Sandstone Transition Forest (SSTF) is listed as an 'endangered ecological community' under both the TSC Act and the EPBC Act.

Development in accordance with the Concept Plan would result in loss of approximately 4.41 hectares of SSTF from the Airds Bradbury site (comprised of approximately 2.41 ha of vegetation in very poor condition, with a very low regeneration potential, and approximately 2 ha of vegetation in poor to moderation condition with some limited regeneration potential).

Due to the proportion of the local occurrence of SSTF that would be removed from the site, the impact upon this community from development in accordance with the Concept Plan could be significant.

The impact upon SSTF would be compensated by the following actions and measures:

1. Revegetation of SSTF on available lands along the Smiths Creek corridor, and implementation of weed control strategies for the corridor.

   These actions would be set out within a Bushland Management Plan, prepared in consultation with Council.

   The intent of works would be to increase viability of retained areas of SSTF within the Airds Bradbury site, to compensate for loss of habitat within the site, and to improve habitat connectivity along the Smiths Creek corridor for Koalas known to be resident in the Smiths Creek area.

2. Additional planting of SSTF trees and shrubs within the two retained SSTF corridors at the eastern edge of the Airds Bradbury site. Planting in these areas would improve the structure and floristic diversity of SSTF, and would also facilitate Koala use of these corridors.

3. Use of SSTF tree and shrub species as street trees and in landscape plans within the Airds Bradbury site, where suitable.

4. Revegetation of cleared lands to the east of the Airds Bradbury site, adjacent to the Georges River Riverside Reserve, to achieve the appropriate ratio of off-set planting to compensate for loss of SSTF on the site.

The areas of SSTF that would be removed from the Airds Bradbury site are highly degraded, with questionable viability. There is little to no native understorey vegetation, and apparently limited ecological function.

On this basis, a ratio of 4 hectares of extent of SSTF revegetated per 1 hectare of SSTF cleared would be likely to adequately compensate for impacts of development in accordance with the Concept Plan.

An estimated loss of 4.41 ha of SSTF would require revegetation of 17.74 ha of land (comprising lands along Smiths Creek within the Airds Bradbury site, and lands adjacent to the Georges River Riverside Reserve).

The density of plants in revegetated areas should mimic the density of plants in nearby areas of relatively intact SSTF within the Georges River Riverside Reserve.

4.6.3 Mitigation and Compensation for Impacts upon Koalas

Koala's have been recorded within the Airds Bradbury site on a number of occasions, but do not reside within the site.

Development in accordance with the Concept Plan would not be likely to impose a significant effect upon the Koala, based on assessment pursuant to s.5A of the EP&A Act (the 'seven-part test').

Future detailed design of each stage within the Concept Plan would include details to maintain accessibility of treed areas providing potential bushfire refuge for Koalas, and would incorporate measures to increase protection of Koalas from vehicle collisions and dog attacks.

It is recommended that Dr Robert Close be consulted during the detailed design and planning of the each stage of the project, to incorporate features that increase protection of Koalas. Measures could include speed restrictions and better street lighting to minimise the risk of Koalas being hit by vehicles.

4.6.4 Mitigation and Compensation for Impacts upon Microchiropteran Bats

Several threatened microchiropteran bat species are known and/or likely to occur within the subject site.

Development in accordance with the Concept Plan would not be likely to impose a significant effect upon any microchiropteran bat species, based on assessment pursuant to s.5A of the EP&A Act (the 'seven-part test').

A Protocol for tree removal within the subject site shall be developed by an ecologist prior to commencement of clearing works.

Tree removal works shall be conducted in a manner (and at times) that minimises disturbance and risk of injury to roosting microchiropteran bats.

5 BUSHFIRE PLANNING & MANAGEMENT

5.1 Bushfire Planning Framework

The study area has been identified as containing Bush Fire Prone Land as mapped by Campbelltown City Council and the NSW Rural Fire Service (RFS) under a requirement of the Rural Fires Act 1997 (RF Act). In NSW, Bush Fire Prone Lands are those identified as lands that can support a bushfire or are likely to be subject to bushfire attack and are generally lands that contain or are within 100 m of significant stands of bushland.

Under Part 3A provisions, consultation must be made with the RFS for applications made on bushfire prone land. The RFS typically requires an assessment of the development be prepared following 'Planning for Bushfire Protection' (RFS 2006) hereafter referred to as PBP. Such an assessment is to specify and detail an accurate APZ based on the known retention and management of bushland along with a compliant access design and utility installation including water supply for fire fighting.

5.2 Bushfire Protection Measures

This section demonstrates how the Concept Plan complies with the Acceptable Solutions of PBP, hence satisfying the DGR No. 11 Bushfire: "*Demonstrate compliance with the relevant provisions of Planning for Bushfire Protection (PBP) 2006*". The bushfire protection measures are discussed below and include the provision of Asset Protection Zones (APZ), access, building construction standards and services.

5.2.1 Asset Protection Zones

PBP identifies three groups or types of development, each requiring a different level of bushfire protection, hence requiring a different method of assessment and application of Asset Protection Zones (APZ):

1. APZ for residential development and subdivision can be based on the Acceptable Solutions contained within Appendix 2, Table A2.4 of PBP;
2. APZ for Special Fire Protection Purpose Development (SFPP) can be based on the Acceptable Solutions within Appendix 2, Table A2.6 of PBP; and
3. APZ for Class 5 to 8 and 10 buildings (such as commercial and industrial development) is not specified within PBP, however, aims and objectives of PBP to be satisfied which includes an appropriate separation from the bushfire hazard, defendable space and adequate access.

As the study area is for predominantly residential housing this assessment focuses on the bushfire protection standard for residential subdivision within PBP, however, the detail necessary for the planning of SFPP developments (such as schools and retirement villages) and other developments (such as shopping centres) is also included.

Residential development can mean the subdivision of land for future housing and may include multi-housing developments such as townhouses. This type of development must comply with the acceptable solutions or performance criteria of PBP.

Development applications for single dwellings and additions (commonly referred to as infill development) may not always be able to achieve the acceptable solutions or performance criteria and bushfire protection alternatives need to be considered.

As the Concept Plan consists primarily of a redevelopment of residential housing it is recommended that the acceptable solutions for residential subdivision be achieved (PBP Appendix 2, Table A2.4). Table 2 calculates the APZ for possible bushland-development interface areas.

The proposed retention or enhancement of vegetation north of the shopping centre and within the Smiths Creek riparian corridor, would require an APZ between the corridor and adjacent development. The size of the APZ could vary based on the width and continuity of the bushland within the corridor.

As outlined in Table 2, an APZ for the riparian corridor will be dependant if the corridor, or discontinuous and separated sections of the corridor, was less than 50 m in width allowing it to be categorised as 'low hazard' vegetation using the provisions within PBP (RFS 2006; pg 52).

Unless managed accordingly, smaller internal bushland parks or remnants may also require an APZ depending on their size, width and proximity to the bushland corridors. Generally, remnants less than 1 hectare or corridors less than 50 m in width could be categorised as 'low hazard' vegetation and may attract a smaller APZ, if any at all.

Special Fire Protection Purpose (SFPP) developments require a higher standard of bushfire protection due to the vulnerability of the occupants and the potential need for assisted evacuation. The RF Act and *Rural Fires Regulation 2008* identify SFPP developments to include:

- School;
- Child care centre;
- Hospital;
- Hotel, motel or other tourist accommodation;
- Building for mentally incapacitated persons;
- Housing for older people (SEPP Seniors Living) or disability (SEPP 5);

- Group homes (SEPP 9);
- Retirement village;
- Estates under SEPP 36;
- Employment areas solely for employees with disabilities;
- Respite care centres or similar; and
- Accommodation associated with an educational institution.

These types of development must comply with the acceptable solutions or performance criteria of PBP. The acceptable solution (PBP Appendix 2, Table A2.6) for applying an APZ to SFPP development is outlined in Table 4.

BCA Class 5, 6, 7, 8 and 10 buildings (which include offices, factories, warehouses and other commercial or industrial facilities) do not have specific bushfire performance requirements under the BCA and as such building construction standards under AS 3959 'Construction of Buildings in Bushfire Prone Areas' (Standards Australia 2009) do not apply as a set of deemed to satisfy provisions. The general fire safety constructions provisions within the BCA are taken as acceptable solutions, but the aim and objectives of PBP apply in relation to other matters such as access, water and services, emergency planning, and landscaping/vegetation management.

The objectives of PBP are:

a) *Afford occupants of any building adequate protection from exposure to bushfire*;

b) *Provide for defendable space to be located around buildings;*

c) *Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition*;

d) *Ensure that safe operation access and egress for emergency service personnel and residents is available;*

e) *Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the asset protection zone (APZ)*; and,

f) *Ensure that utility services are adequate to meet the needs of firefighters (and others assisting in bushfire fighting.*

To satisfy the above objectives, an acceptable solution would be to provide an Asset Protection Zone as for residential development to prevent flame contact and ignition of external building materials (see objective c). An alternative option, and one more reliant on a detailed assessment of the bushfire attack at a specific location and for a specific building, is to provide an APZ of a size where it acts as 'defendable space' only. PBP defines 'defendable space' as "*an area within the asset protection zone that provides an environment in which a person can undertake property protection after the passage of a bushfire within some level of safety*". This option relies on the high standard of construction (with respect to bushfire protection) inherent within commercial and industrial buildings common to employment lands, and is appropriate for the style of the development (*ie* not a dwelling or SFPP development). A minimum defendable space of 10 m is recommended and is to consist of a perimeter road compliant with the acceptable solutions listed in Section 5.2.4 of this report.

Assessment of the Concept Plan concludes that it can accommodate the APZs as required by PBP and listed in Table 4 below. All APZs will be located outside of significant vegetation to be retained as assessed in the Ecological Assessment.

Table 4 APZ calculation, location and dimensions for the study area

Location description	Slope class of most influence[1]	Predominant vegetation community[2]	Residential APZ[3]	SFPP APZ[4]
Eastern bushland interface	Downslope 0 - 5°	Forest	25 m (10 m OPA)	70 m (20 m OPA)
Dalkeith Place in south-east corner of study area	Downslope 5 - 10°	Forest	35 m (15 m OPA)	50 m (25 m OPA)
Smiths Creek riparian bushland corridor if wider than 50 m	Downslope 0 - 5°	Woodland (Grassy)	15 m (OPA not allowed)	50 m (OPA not allowed)
Smiths Creek riparian bushland corridor if narrower than 50 m	Downslope 0 - 5°	Low Hazard vegetation (woodland)	10 m (OPA not allowed)	40 m (OPA not allowed)
Small areas of vegetation separated from the eastern interface and Smiths Creek corridor (< 1 hectare in size or a corridor narrower than 50 m)	Varies, but within 0 - 5°	Low Hazard vegetation (woodland)	10 m (OPA not allowed)	40 m (OPA not allowed)

[1] Slope class most significantly influencing fire behaviour where the vegetation (bushfire hazard) is found over 100 m from the development boundary.

[2] Predominant vegetation is the most predominant and problematic vegetation over 140 m from the development boundary.

[3] PBP required setback for residential subdivision.

[4] PBP required setback for Special Fire Protection Purpose (SFPP) development.

5.2.2 APZ Management

The APZ is to be measured from the edge of the unmanaged bushland to the most external building point of a building and the APZ can contain managed vegetation and can be utilised as areas of public open space, recreational areas such as sportsgrounds, access ways such as roads, and ancillary parts of development such as yards and car parks.

Appropriate landscaping and vegetation and fuel management is started at the planning phase and carried through construction to occupation of dwellings and future maintenance. Landscaping within the APZ may differ between the Outer Protection Area (OPA) and Inner Protection Area (IPA). The OPA is a relatively smaller portion of the total APZ and extends from the bushfire source towards the IPA, which is adjacent the building. The purpose of the OPA is to reduce the rate of spread of fire, and reduce the likelihood of crown fire whilst providing a slightly denser tree canopy than the IPA to filter embers. The IPA offers more protection for defendable space and managing heat intensities at the building. The dimension of the OPA depends on the type of development and effective slope. These dimensions are indicated in Table 4.

The APZ, including differences in OPA and IPA management, should be landscaped and managed in the following manner:

- No part of a building is to be within the APZ.
- Mature canopy trees may be within the OPA providing crowns and canopies (which may include small clumps of crowns or a single grove of trees) do not overlap and have an overall canopy cover of less than 30%.

- Mature canopy trees may be within the IPA providing crowns and canopies (*eg* a small clumps of crowns or a single grove of trees) are separated and have an overall canopy cover of less than 15%.
- Understorey saplings, shrubs and groundcovers within both the OPA and IPA are to be managed in the following manner:
    - The saplings provide a sparse scatter of individuals useful for the long-term replacement of canopy species typically retained within the APZ;
    - The saplings and shrubs are well spread out and do not form a contiguous pathway from the bushfire source to a dwelling;
    - A minimal ground fuel is to be maintained to include either mown/slashed grass, mulch, managed groundcovers, organic matter, bare or sealed ground, providing the final groundcover does not exceed 4 tonnes per hectare of fine fuel (*ie* material less than 6 millimetres in diameter). The OPA may have up to 8 tonnes per hectare of fine fuel;
    - Landscaped and garden areas with higher fuel loads can be within the APZ providing they are within well-defined and managed garden beds that do not provide a continuous pathway of fuels from the bushfire source to a dwelling.

5.2.3 Perimeter access within the APZ

All bushland/development interface areas associated with new development that require an APZ are to contain a perimeter access road linked to the internal road network at regular intervals. These roads should be in the form of public perimeter roads designed and constructed in compliance with the specifications listed in Section 5.2.4 of this report.

Assessment of the Concept Plan concludes that the design has either allowed for a public perimeter road or can accommodate such a road within the design. For example, in the northeast corner of the study area the options for ensuring perimeter access can be provided between the bushfire hazard and the development at this location by either:

- Providing an eastern interface public perimeter road linking to Peppin Crescent, or
- Providing a high standard fire trail link in lieu of a public road for this relatively short section that provides an emergency link only between Peppin Crescent and Georges River Road. This fire trail could act as part of a bicycle/walk track. To ensure continuous management, a fire trail should be under one ownership and therefore Council would be the preferred owner/manager in this instance.

5.2.4 Access

The design and construction of public roads within the study area are recommended to meet the accepted provisions within PBP (RFS 2006; pg 21), as listed below. The access design and layout in the Concept Plan complies with these requirements. The performance criterion of the road system is to allow safe access for firefighters while residents are evacuating the area.

- Public roads are two-wheel drive, all weather roads;
- Urban perimeter roads are two-way, that is, at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb), allowing traffic to pass in opposite directions. Roads that are not perimeter roads can comply with the road widths within Table 5 below;
- The perimeter road is linked to the internal road system at an interval of no greater than 500 metres in urban areas;
- Traffic management devices are constructed to facilitate access by emergency services vehicles;
- Public roads have a cross fall not exceeding 3 degrees;
- Public roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer

radius turning circle, and are clearly sign posted as a dead end and direct traffic away from the hazard;

- Curves of roads (other than perimeter roads) are a minimum inner radius of six metres and minimal in number, to allow for rapid access and egress;
- The minimum distance between inner and outer curves is 6 metres;
- Maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient;
- There is a minimum vertical clearance to a height of 4 metres above the road at all times;
- The capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes or 9 tonnes per axle for all other areas). Bridges clearly indicated load rating;
- Public roads greater than 6.5 metres wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water for fire suppression;
- Public roads between 6.5 metres and 8 metres wide are No Parking on one side with the services (hydrants) located on this side to ensure accessibility to reticulated water for fire suppression;
- Public roads up to 6.5 metres wide provide parking within parking bays and located services outside of the parking bays to ensure accessibility to reticulated water for fire suppression;
- One way only public access roads are no less than 3.5 metres wide and provide parking within parking bays and located services outside of the parking bays to ensure accessibility to reticulated water for fire suppression;
- Parking bays are a minimum of 2.6 metres wide from kerb to kerb edge to road pavement. No services or hydrants are located within the parking bays.

Table 5 Minimum road widths for roads that are not perimeter roads

Curve radius (inside edge)	Swept path width	Single lane width	Two way width
< 40 m	3.5 m	4.5 m	8.0 m
40 – 69 m	3.0 m	3.9 m	7.5 m
70 – 100 m	2.7 m	3.6 m	6.9 m
> 100 m	2.5 m	3.5 m	6.5 m

5.2.5 Building Construction Standards

The building construction standard for the redevelopment and new development of dwellings within the study area is based on the separation distance between the dwelling and the bushfire hazard, the vegetation type and slopes, as determined for the APZ (see Table 4). Using Table 2.4.2 within AS 3959-2009 'Construction of buildings in bushfire prone areas' (Standards Australia 2009), this information results in the determination of the Bushfire Attack Level (BAL) potentially received by a building within 100 m of a bushfire hazard (*eg* eastern interface or Smiths Creek riparian corridor). The BAL relates specifically to a level of building construction standard found in Sections 3 to 9 of AS3959-2009.

The assessment of building construction standard is undertaken at the development application stage for a particular dwelling as aspects of the dwelling and its location with respect to the bushfire hazard and surrounding dwellings can alter the required standard. The information on building construction standards in Table 6 below provides as much detail as possible at this stage of the planning process.

Table 6 Zones affected by construction standards under AS3959-2009 in the study area

Location description	BAL-40	BAL-29	BAL-19	BAL-12.5	BAL-Low No requirement
Eastern bushland interface	20 to <27 m from the bushfire source	27 to <37 m from the bushfire source	37 to <50 m from the bushfire source	50 to 100 m from the bushfire source	> 100 m from the bushfire source
Dalkeith Place in south-east corner of study area	26 to <33 m from the bushfire source	33 to <46 m from the bushfire source	46 to <61 m from the bushfire source	61 to 100 m from the bushfire source	> 100 m from the bushfire source
Smiths Creek riparian corridor if wider than 50 m	13 to <17 m from the bushfire source	17 to <25 m from the bushfire source	25 to <35 m from the bushfire source	35 to 100 m from the bushfire source	> 100 m from the bushfire source
Smiths Creek riparian corridor if narrower than 50 m	8 to <11 m from the bushfire source	11 to <17 m from the bushfire source	17 to <24 m from the bushfire source	24 to 100 m from the bushfire source	> 100 m from the bushfire source
Small areas of vegetation separated from the eastern interface and Smiths Creek corridor (< 1 hectare in size or a corridor narrower than 50 m)	8 to <11 m from the bushfire source	11 to <17 m from the bushfire source	17 to <24 m from the bushfire source	24 to 100 m from the bushfire source	> 100 m from the bushfire source

5.2.6 Water Supply

Reticulated water (*eg* hydrant spacing, sizing and pressures) is to be supplied throughout the redevelopment of new areas to comply with AS 2419-2005 'Fire hydrant installations – System design, installation and commissioning'. Hydrants are not to be located within any road carriageway and the provisions of parking and hydrant locations in the public road access specifications in Section 5.2.4 above are to be met.

5.2.7 Electricity

Where practicable, electrical transmission lines are to be underground. If above ground, they are to be installed with short pole spacing (*eg* 30 metres) and no part of a tree is closer to a powerline than the distance set out in accordance with the specifications in 'Vegetation Safety Clearances' issued by Energy Australia (NS179, April 2002).

5.2.8 Gas

Reticulated or bottled gas is installed and maintained in accordance with AS/NZS1596:2008 'The storage and handling of LP gas' and the requirements of relevant authorities.

6 SUMMARY & CONCLUSIONS

6.1 Ecology

6.1.1 TSC Act

Based upon the considerations detailed above, in Appendix 1 and in Appendix 4, development in accordance with the Concept Plan would not be likely to significantly affect any threatened species or populations listed on the schedules of the NSW TSC Act.

Having regard to the critically endangered status of Cumberland Plain Woodland, and giving due consideration to the seven factors listed under s.5A of the EP&A Act, the impact upon this community from development in accordance with the Concept Plan could be significant.

Similarly, due to the proportion of the local occurrence of Shale Sandstone Transition Forest that would be removed from the site, the impact upon this community from development in accordance with the Concept Plan could be significant.

However, giving consideration to the proposed mitigation measures and off-sets set out in Chapter 4.6 of this report, development in accordance with the Concept Plan as a whole, would not be likely to significantly affect either of these ecological communities

6.1.2 EPBC Act

The Concept Plan as a whole, including the proposed mitigation measures and off-sets set out in Chapter 4.6 of this report, would not be likely to impose a significant impact upon any matter of National Environmental Significance.

However, given the scale of the project, and the variety of threatened species and ecological communities present, it is recommended that the project be referred to the Commonwealth Minister for Environment and Heritage under the EPBC Act, for certainty.

6.1.3 SEPP 44

Some patches of vegetation within the subject site are likely to constitute 'potential koala habitat', based on the tree species present.

The site does not constitute 'core koala habitat', based on lack of evidence of a resident population of Koalas.

There is no requirement under SEPP 44 to prepare a Koala Plan of Management.

6.1.4 Key Thresholds

The Airds Bradbury Renewal Project has been assessed against each of the four Key Thresholds set out in Step 5 of the *Draft Guidelines for Threatened Species Assessment* (DPI & DEC 2005).

Threshold 1

"w*hether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values*."

The Airds Bradbury Renewal Project would maintain or improve specific biodiversity values in the study area, as set out in Table 7 below.

Table 7 Impact on Biodiversity Values.

Value	Impact	Outcome
Cumberland Plain Woodland	Loss of 1.21ha (comprised of several very small areas) Retention of 3.19ha (comprised of one 3ha patch, and a separate 0.19ha patch) Enhancement of structure and ecological function of main 3ha patch through weed control and revegetation 4 trees/shrubs planted per 1 tree/shrub removed	Improve Value
Shale Sandstone Transition Forest	Loss of 2.41ha of very poor condition SSTF, with very low regeneration potential Loss of 2ha of poor to moderate condition SSTF, with some limited regeneration potential Retention of 3.73ha of SSTF Revegetation of 17.74 ha of SSTF (being revegetation of 4ha of SSTF per 1ha cleared) Revegetation to occur along the Smiths Creek corridor, and adjacent to the site within the Georges River Riverside Reserve	Maintain Value
Koalas and Koala habitat	Loss of 4 ha of occasional habitat Retention of 6.92ha of potential habitat Revegetation of 17.74ha of land Improvement of connectivity and habitat quality along Smiths Creek Increase in extent of habitat within the Georges River Riverside Reserve.	Maintain Value in short term Improve Value in medium and long term
Microchiropteran bat habitat	Loss of 5.62ha of potential habitat Retention of 6.92ha of potential habitat Revegetation of 17.74ha of land, plus additional planting of trees and shrubs within areas of CPW	Maintain Value in short term Improve Value in medium and long term

Threshold 2

"*whether or not the proposal is likely to reduce the long term viability of a local population of the species, population or ecological community*."

Development in accordance with the Concept Plan would require removal of several very small areas of CPW. These areas are of negligible value with regard to the long term viability of the main patch of CPW. The long term viability of the main patch of CPW would be enhanced through improvement of the vegetation structure and its ecological function. The long term viability would also be enhanced through weed control works and rationalisation of the network of existing tracks.

Development in accordance with the Concept Plan would require removal of several areas of very poor condition SSTF which are not likely to be viable, and removal of several areas of poor to moderate condition vegetation with poor viability. These areas would be replaced by revegetation of SSTF on nearby land, at a ratio of 4ha planted per 1ha cleared. The planted areas would be designed to produce a structure and floristic diversity characteristic of SSTF. The vegetation would be maintained for a minimum of 2 years, to ensure the new plantings have established, and to promote

establishment of a viable vegetation community. It is likely that the long term viability of SSTF in the study area would be improved.

There are no Koalas resident within the study area. Dispersing young Koalas are occasionally recorded in the suburb of Airds. The Concept Plan has been designed having regard to maintaining access routes for Koalas into Airds, and to facilitate Koala movements through Airds. It is not likely that development in accordance with the Concept Plan would reduce the long term viability of a local population of the Koala.

Development in accordance with the Concept Plan would result in loss of some areas of potential habitat for some threatened microchiropteran bat species. However, the site does not contain any resources or features that are unique or scarce within the locality, nor any features likely to be of significance for breeding. Extensive tracts of intact habitat occur to the east of the site, providing habitat for microchiropteran bats. Microchiropteran bats are known to change roost sites regularly, and would not be likely to be dependent upon any particular tree within the site.

Development in accordance with the Concept Plan would not be likely to reduce the long term viability of any local population of threatened microchiropteran bat species.

Threshold 3

"*whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community, or place it at risk of extinction*."

Local occurrences of both CPW and SSTF would be retained within the Concept Plan, and enhanced through additional planting, weed control, rationalisation of existing tracks *etc*. Development in accordance with the Concept Plan would not accelerate the extinction of either community, nor would place either community at risk of extinction.

A viable and actively growing population of Koalas is known to occur in the Georges River area. Development in accordance with the Concept Plan would not affect this population, nor accelerate the extinction of the species, nor place the species at risk of extinction.

Threatened microchiropteran bat species known and likely to occur within the site are also known to occur in the extensive vegetated areas conserved to the east of the site. The site does not contain any unique features or values for such species. Development in accordance with the Concept Plan would not accelerate the extinction of any microchiropteran bat species, nor place any microchiropteran bat species at risk of extinction.

Threshold 4

"*whether or not the proposal will adversely affect critical habitat*."

The Airds Bradbury Renewal Project would not affect any area of declared "*critical habitat"*.

6.2 Bushfire

The assessment of bushfire protection for the Airds Bradbury Renewal Project concludes that the study area is suitable and capable to be developed as proposed in the Concept Plan whilst accommodating the minimum bushfire protection measures as required by NSW legislation and policy, namely 'Planning for Bushfire Protection 2006' (PBP).

The bushfire hazard to the east within the study area and within the adjacent Georges River Riverside Reserve presents a serious threat to the study area and this bushland-development interface will require an Asset Protection Zone (APZ) recommended to comply with PBP and would range from 25 m to 35 m for residential development.

Any retention or enhancement of the Smiths Creek bushland and riparian corridor may create a bushfire hazard that will require an APZ ranging in width from 10 m to 15 m for residential development depending on the width and continuity of the corridor. Similarly, the retention or creation of smaller areas of vegetation within parks may also require an APZ depending on the size of the vegetation.

Areas requiring an APZ will also require a perimeter access road to be linked to an internal road system also capable of allowing safe access for firefighters while residents are evacuating the area. The road system is to be equipped with adequate water supply and hydrant locations.

As required by the DGRs, it is concluded that the Concept Plan can comply with 'Planning for Bushfire Protection 2006'.

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AIRDS BRADBURY RENEWAL PROJECT

ECOLOGICAL AND BUSHFIRE ASSESSMENT

APPENDIX 1

Threatened fauna species known from the locality

March 2011

APPENDIX 1

Threatened fauna species previously recorded within the subject site and within 10km of the site since 1980 (previous surveys; DECCW Wildlife Atlas, December 2008 and January 2009; Bionet database, March 2010).

Species	**Habits/Requirements/Records in the locality**	**Occurrence in the study area**
BIRDS		
Black-necked Stork *Ephippiorhynchus asiaticus* E (TSC)	Usually inhabits swamps associated with river systems and large permanent pools (Blakers *et al* 1984). Inhabits tropical to warm temperate wetlands, lagoons, swamps, mud-flats and irrigated cropland (Lindsey 1992). Feeds in shallow water for fish and frogs (Blakers *et al* 1984). Nests high in a tree in a secluded swamp (Lindsey 1992). 1 record in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Black-necked Stork would not be likely to occur within the subject site.
Bush Stone-curlew *Burhinus grallarius* E (TSC)	Distribution has contracted to isolated areas on the central and mid-north coast of NSW, and the western slopes and plains of the Great Dividing Range and the Riverina district of central NSW (NPWS 1999). Inhabits lightly timbered open forest and woodland areas with a grassy understorey (NPWS 1999; Blaker *et al* 1984). Preferred habitat is often associated with casuarina, eucalypts, acacia or epolycarya. Will also use dry open grassland and cropland with cover nearby (NPWS 1999). Nests in a shallow scrape on the ground (Lindsey 1992), near dead timber, usually under trees in open woodland with a short grassy understorey (NPWS 1999). Nocturnal, especially active on moonlit nights (NPWS 1999). Pairs probably occupy 10-20ha when breeding. Small flocks may roam over 100km^2 in the non-breeding season (Blakers *et al* 1984). 1 record in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Bush Stone-curlew would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Blue-billed Duck *Oxyura australis* V (TSC)	Inhabits temperate wetlands of southeastern and southwestern Australia. Prefers large, deep, permanent freshwater lakes, lagoons and swamps, especially with extensive beds of Cumbungi *Typha* sp (Lindsey 1992; NPWS 1999). Has been observed on large rivers, in sewage ponds and in saline water bodies during non-breeding seasons (NPWS 1999). The Blue-billed Duck breeds mainly in the lower Murray-Darling basin, with young birds migrating to non-breeding areas on the Murray River system and coastal lakes to moult (NPWS 1999). It is a completely aquatic species and almost never comes ashore (Lindsey 1992; NPWS 1999). Feeds mainly on aquatic macroinvertebrates. 1 record in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Blue-billed Duck would not be likely to occur within the subject site.
Freckled Duck *Stictonetta naevosa* V (TSC)	Inhabits a variety of plankton-rich wetland types, including swamps heavily vegetated with Cumbungi, Lignum, Canegrass or Ti-tree (in coastal areas), large open lakes and their shores, creeks, farm dams, sewage ponds and floodwaters (NPWS 1999). A typically gregarious species which regularly forms congregations of 10-100 birds. Found during nonbreeding periods in both small and large groups on permanent open water bodies, resting on fallen trees, sand spits or on flattened down platforms of Cumbungi in dense cover over deep water (NPWS 1999). Feeds at wetland edges or in shallow waters at dusk on algae, seeds of aquatic grasses and sedges, small invertebrates, small fish and the vegetative parts of aquatic plants (NPWS 1999). 1 record in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Freckled Duck would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Square-tailed Kite *Lophoictinia isura* V (TSC)	Has a widespread distribution across virtually all of mainland Australia, excepting waterless desert (NPWS 1999). Typically inhabits tropical and temperate coastal forests and woodlands, and also inland along timbered watercourses (NPWS 1999). Appears to migrate seasonally, south in summer, north in winter (Blakers *et al* 1984). In NSW, it is often associated with forests dominated by *Eucalyptus longifloria*, *Corymbia maculata* or *E elata, E smithii*. Also sighted within forests containing other eucalypts, *Angophora* spp and *Callitris* spp with a shrubby understorey and Box-Ironbark woodland (NPWS 1999). Feeds on passerine birds, especially honeyeaters, nestling birds, rabbits, reptiles and carrion (NPWS 1999; Lindsey 1992). Nests is a substantial structure of sticks, usually constructed in a fork or on a large horizontal limb of *Angophora* spp or *Eucalyptus* spp approx 15-20m above the ground, along or near watercourses (Lindsey 1992; NPWS 1999). 1 record in the locality since 1980.	The subject site theoretically contains foraging habitat for this species. However, the site contains a low diversity and abundance of prey species, and is not likely to be an important resource for this species, particularly considering the extent of intact habitat immediately to the east of the site, in the Georges River area. The Square-tailed Kite could theoretically occur within the subject site on rare occasions, but would not be likely to be affected by minor losses of vegetation associated with the Preferred Masterplan Option.
Spotted Harrier *Circus assimilis* V(TSC)	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population (DECCW Profile). Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. Most commonly found in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (DECCW Profile). Preys on terrestrial mammals (eg bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion (DECCW Profile). Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months (DECCW Profile). Threats include clearing and degradation of foraging and breeding habitat, particularly that which affects prey densities, secondary poisoning from rodenticides and secondary poisoning from rabbit baiting (DECCW Profile). 1 record in the locality since 1980.	The subject site does not contain likely habitat for this species. The Spotted Harrier would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Little Eagle *Hieraaetus morphnoides* V (TSC)	Distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. DECCW Profile. Occurs in habitats rich in prey, within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Requires a tall living tree for nesting, within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Young fledge in early summer. Feeds on birds, reptiles and mammals, occasionally large insects and carrion. Formerly heavily dependent on rabbits. DECCW Profile. Most of its former native mammalian prey species in inland NSW are extinct (terrestrial mammals of rabbit size or smaller, *e.g.* large rodents, bandicoots, bettongs, juvenile hare-wallabies and nailtail wallabies). Main threats are inferred to be clearing and degradation of its foraging and breeding habitat. 16 records in the locality since 1980.	The subject site does not contain likely habitat for this species. It is theoretically possible that the Little Eagle could occur on the subject site on rare occasions, but not likely that this species would be affected by the Preferred Masterplan Option.
Gang Gang Cockatoo *Callocephalon fimbriatum* V (TSC) E population (TSC)	Inhabits tall montane forests and woodlands in summer, particularly heavily timbered mature wet sclerophyll forests. Also occurs in sub-alpine Snow Gum woodland and occasionally in temperate rainforests. Undertakes nomadic and seasonal movements, and in winter tends to occur at lower altitudes in drier, more open eucalypt forest and woodland, particularly Box-Ironbark associations, and in dry forest in coastal areas (NSW Scientific Committee). Feeds on green acacia seeds, eucalypt seeds, fruits and berries, including seeds, fruits and berries of introduced plant species (Lindsey 1992; Blakers *et al* 1984). Tends to exhaust one food supply before moving to another (Blakers *et al* 1984). Nests in hollows in large old trees, usually close to water. Shows strong nest site fidelity. Breeding occurs mainly in tall mature wet sclerophyll forests with a dense understorey (NSW Scientific Committee). 9 records in the locality since 1980.	The subject site does not contain likely habitat for this species. No evidence of this species (*eg* chewed cones/fruits) has been recorded during previous or current field surveys. The Gang Gang Cockatoo would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Glossy Black Cockatoo *Calyptorhynchus lathami* V (TSC)	Inhabits drier eucalypt forest and woodland, characteristically on sites with low soil nutrient status (Blakers *et al* 1984; NPWS 1999; DEC 2004a). Prefers intact landscapes (NPWS 1999; DEC 2004a). Feeds almost exclusively on seeds of *Allocasuarina* spp - predominantly *A littoralis* and *A torulosa* (Lindsey 1992; Blakers *et al* 1984; NPWS 1999). Inland birds use a more diverse range of species, including *A cristata* (Blakers *et al* 1984). In the central west of NSW they also eat the seeds of Cypress Pine (DEC 2004a). Birds favour individual trees which produce seeds with high nutrient content, and may sample a few trees before selecting one to feed in (DEC 2004a). Lives in loose groups which occupy an area permanently (Blakers *et al* 1984) Nests in a large tree hollow (Lindsey 1992; NPWS 1999). 5 records in the locality since 1980.	The subject site does not contain suitable habitat for this species. No evidence of this species (*eg* chewed cones) has been recorded during previous or current field surveys. The Glossy Black Cockatoo would not be likely to occur within the subject site.
Swift Parrot *Lathamus discolor* E (TSC) E (EPBC)	Breeds only in Tasmania, (Lindsey 1992, Blakers *et al* 1984; NSW Scientific Committee). Occurs in forests and woodlands of NSW from May to August (NSW Scientific Committee). Forages in the upper tree canopy for nectar, pollen and lerps (Blakers *et al* 1984). Lives in small flocks which appear in areas where eucalypts are flowering in profusion (Blakers *et al* 1984). Dependent on flowering resources across a wide range of habitats in its wintering grounds of NSW (NSW Scientific Committee). 2 records in the locality since 1980.	The subject site theoretically contains a winter foraging resource for this species. However, the site contains a low diversity and abundance of eucalypt species, and is not likely to be an important resource for the Swift Parrot, particularly considering the extent of intact habitat immediately to the east of the site, in the Georges River area. The Swift Parrot could theoretically occur within the subject site on rare occasions when the eucalypts present are in flower, but would not be likely to be affected by minor losses of vegetation associated with the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Little Lorikeet *Glossopsitta pusilla* V (TSC)	Mostly occurs in dry, open eucalypt forests and woodlands, from just north of Cairns, around the east coast of Australia, to Adelaide. In NSW they occur in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (NSW Scientific Committee). Occurs in both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. In a SE Qld study, they were more likely to occupy forest sites with relatively short to intermediate logging rotations (15–23 years) and sites that have had short intervals (2.5– 4 years) between fires (NSW Scientific Committee). Feeds primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on melaleucas and mistletoes. On the western slopes and tablelands White Box Eucalyptus albens and Yellow Box E. melliodora are particularly important food sources. They are also reported as feeding on fruits, particularly those of mistletoes (NSW Scientific Committee). Apparently nomadic, related to food availability (NSW Scientific Committee). 17 records in the locality since 1980.	The subject site theoretically contains a foraging resource for this species. However, there is a low diversity and abundance of eucalypt species, and the site is not likely to be an important resource for the Little Lorikeet, particularly considering the extent of intact habitat immediately to the east of the site, in the Georges River area. The Little Lorikeet could occur within the subject site on rare occasions when the eucalypts present are in flower, but would not be likely to be affected by minor losses of vegetation associated with the Preferred Masterplan Option.
Speckled Warbler *Pyrrholaemus sagittatus* V (TSC)	Inhabits woodland with a grassy understorey, often on rocky ridges or in gullies. Mainly recorded from the hills and tablelands of the Great Dividing Range (Blakers *et al* 1984; NSW Scientific Committee). A sedentary species, apparently social, with breeding territories approx 10 ha in size. Forages mainly on the ground for seeds and insects, seldom wandering far from the shelter of bushes and shrubs (Blakers *et al* 1984; Lindsey 1992). Preferred foraging habitat is areas with a combination of open grassy patches, leaf litter and shrub cover (NSW Scientific Committee). Nests on the ground in grass tussocks, dense litter and fallen branches (NSW Scientific Committee). 6 records in the locality since 1980.	The subject site contains potential habitat for this species. The Speckled Warbler is a sedentary species that has not been recorded within the relatively isolated patches of woodland within the site, during numerous previous fauna surveys conducted in different seasons and over a period of 8 years. The Speckled Warbler does not appear to occur within the subject site, and would not be likely to be affected by the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Powerful Owl *Ninox strenua* V (TSC)	Inhabits tall moist productive eucalypt forests of the eastern tableland edge, and the mosaic of wet and dry sclerophyll forests occurring on undulating, gentle terrain near the coast. Ideally with a tall shrub layer and/or abundant hollows supporting a high density of arboreal marsupials (DEC 2005a; Blakers *et al* 1984; Lindsey 1992). A nocturnal sedentary species which lives alone or in pairs, occupies permanent territories up to 1500 ha in size which contain several roost sites (Blakers *et al* 1984; Lindsey 1992; DEC 2005a). Roosts by day in dense foliage of mid-canopy trees (including *Allocasuarina* spp, rainforest species, Turpentine and eucalypts), often amongst groves of up to 2ha of similar-sized trees in the height range of 3-15m (DEC 2005a), in sheltered gullies, often along streams and wide creek flats between ridges covered with eucalypt forest (DEC 2005a; Blakers *et al* 1984). Prefers to forage in moist unlogged forest in gully systems, but also forages in dry and regrowth forest. Preys on arboreal mammals (80% of diet), birds (18%) and insects and some terrestrial mammals (2%) (Blakers *et al* 1984). The Common Ringtail Possum is a primary prey species in lowland areas, and the Greater Glider in highland areas (DEC 2005a). Nests in a large tree-hollow (greater than 45cm wide and 100cm deep), usually high (at least 20m from the ground) in a very large eucalypt (with a DBH of at least 80cm) (Lindsey 1992; DEC 2005a). Nesting sites are typically in unlogged unburnt gullies and lower slopes, within 100m of streams, and surrounding by trees or tall shrubs (DEC 2005a). 23 records in the locality since 1980.	The subject site theoretically contains foraging habitat for the Powerful Owl, although it is of very poor quality, lacking a shrub layer and abundant hollows. The subject site contains a very low diversity and abundance of prey species, and is not likely to be an important resource for this species, particularly considering the extent of intact habitat immediately to the east of the site, in the Georges River area. The Powerful Owl could theoretically occur within the site on rare occasions, but would not be likely to be affected by minor losses of vegetation associated with the Preferred Masterplan Option.
Brown Treecreeper *Climacteris picumnus victoriae* V (TSC)	Inhabits a variety of drier vegetation types across eastern Australia, commonly eucalypt woodland, sometimes adjacent forest where there is dead timber (Lindsey 1992; Blakers *et al* 1984). Mainly occurs in the central-west of NSW. Prefers open woodland lacking a dense understorey (NSW Scientific Committee). A sedentary species that lives in small groups and occupies permanent home territories of about 5-10ha (Blakers *et al* 1984; Lindsey 1992). Forages on tree trunks and amongst leaf litter for insects, spending approx half of its time on the ground (NSW Scientific Committee; Blakers *et al* 1984). Nests in a tree-hollow (Lindsey 1992). 5 records in the locality since 1980.	The subject site contains potential habitat for this species. The Brown Treecreeper is a sedentary species that has not been recorded within the relatively isolated patches of woodland within the site, during numerous previous fauna surveys conducted in different seasons and over a period of 8 years. The Brown Treecreeper does not appear to occur within the subject site, and would not be likely to be affected by the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Hooded Robin *Melanodryas cucullata cucullata* V (TSC)	Occurs throughout SE Australia, although mainly west of the Great Dividing Range, in a range of drier eucalypt woodlands, acacia shrublands and open forests, often in or near clearings (Blakers *et al* 1984; Lindsey 1992). Possibly seasonally migratory in some areas (Blakers *et al* 1984). Lives in small family groups within large home ranges (NSW Scientific Committee). Forages mainly on open ground by pouncing from a perch. Forages in areas with a mix of bare ground, ground cover and litter (Blakers *et al* 1984; NSW Scientific Committee). Nests in a cup of grass in a fork or small tree hollow usually within a few metres of the ground (Lindsey 1992). 2 records in the locality since 1980.	The subject site contains potential habitat for this species. The Hooded Robin has not been recorded within the relatively isolated patches of woodland within the site, during numerous previous fauna surveys conducted in different seasons and over a period of 8 years. The Hooded Robin does not appear to occur within the site, and would not be likely to be affected by the Preferred Masterplan Option.
Scarlet Robin *Petroica boodang* V (TSC)	Found in south-eastern Australia and south-west Western Australia. In NSW, it occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Nest is an open cup of plant fibres and cobwebs in the fork of tree (often a dead branch in a live tree, or in a dead tree or shrub), usually more than 2 m above the ground. It is sensitive to habitat degradation and overgrazing. 9 records in the locality (DECCW Atlas).	The subject site does not contain suitable habitat for this species. The Scarlet Robin would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Flame Robin *Petroica phoenica* V (TSC)	Found across south-eastern Australia. In NSW, it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains (Higgins and Peter 2002). There may be two disjunct breeding populations in NSW, on the Northern Tablelands and the Central–Southern Tablelands. (DECCW Profile). Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Nest is an open cup nest of plant fibres and cobweb, often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank (DECCW Profile). Key threats are clearing and degradation of breeding habitat, and degradation of wintering habitat. 2 records in the locality (DECCW Atlas).	The subject site does not contain suitable habitat for this species. The Flame Robin would not be likely to occur within the subject site.
Diamond Firetail *Stagonopleura guttata* V (TSC)	Inhabits eucalypt woodland, forests and mallee where there is a grassy understorey, including agricultural land, mainly inland of the Great Dividing Range (Lindsey 1992; Blakers *et al* 1984; NSW Scientific Committee). Generally sedentary, lives in pairs or small groups, consolidating into flocks during winter (Lindsey 1992; Blakers *et al* 1984; NSW Scientific Committee). Forages on the ground for grass seeds, other plant material and insects (NSW Scientific Committee; Lindsey 1992; Blakers *et al* 1984). Nests in a bulky flask-shaped structure with a side entrance approached by a woven tunnel, usually placed in dense foliage in a bush or mistletoe clump, several metres from the ground (Lindsey 1992). 1 record in the locality since 1980.	The subject site is outside of the usual range of this species, but does contain some potential habitat. The Diamond Firetail is generally a sedentary species that has not been recorded within the relatively isolated patches of woodland within the site, during numerous previous fauna surveys conducted in different seasons and over a period of 8 years. The Diamond Firetail does not appear to occur within the subject site, and would not be likely to be affected by the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Black-chinned Honeyeater *Melithreptus gularis gularis* V (TSC)	Inhabits mainly eucalypt forest and woodland, paperbark woodland, acacia scrub and spinifex, particularly where there are patches of flowering shrubs, across northern and eastern Australia (Lindsey 1992; Blakers *et al* 1984). In NSW, it occurs generally inland of the Great Dividing Range, mainly in eucalypt woodlands containing Box-Ironbark associations and River Red Gum (Blakers *et al* 1984; NSW Scientific Committee). A sedentary species which lives in small groups which maintain permanent, extensive territories. It is an active bird, forever on the move, and forages high in the tree canopy (Lindsey 1992). Feeds on nectar, honeydew and insects (Blakers *et al* 1984). Occurs mainly in larger remnants, reportedly affected by competition for food and by nest predation in smaller remnants (NSW Scientific Committee). 3 records in the locality since 1980.	The subject site is outside of the usual range of this species, and does not contain large remnants of native woodland. The Black-chinned Honeyeater is a sedentary species that has not been recorded within the relatively isolated patches of woodland within the site, during numerous previous fauna surveys conducted in different seasons and over a period of 8 years. The Black-chinned Honeyeater does not appear to occur within the subject site, and would not be likely to be affected by the Preferred Masterplan Option.
Regent Honeyeater *Xanthomyza phrygia* E (TSC) E (EPBC)	Semi-nomadic, usually recorded on western slopes of the Great Dividing Range, in open eucalypt forest and woodland. Usually recorded in box-ironbark associations, also wet lowland coastal forests. Forages in the upper canopy of flowering eucalypts for nectar, fruits and insects (NPWS 1999; Lindsey 1992; Blakers *et al* 1984). Nectar taken from approximately 16 species of eucalypt (NPWS 1999). A noisy, aggressive and conspicuous species, gregarious when not breeding. Observed bathing in roadside puddles. Nests in the fork of a tree 1-20m above the ground (Lindsey 1992). Specific requirements in mature Ironbark and Red-Yellow Box communities (NPWS 2003). 1 record in the locality since 1980.	The subject site is outside of the usual range of the Regent Honeyeater, and does not contain preferred habitat, but does theoretically provide an occasional foraging resource for this species. The subject site contains a low diversity and abundance of eucalypt species, and is not likely to be an important resource for the Regent Honeyeater, particularly considering the extent of intact habitat immediately to the east of the site, in the Georges River area. The Regent Honeyeater could theoretically occur within the subject site on rare occasions when the eucalypts present are in flower, but would not be likely to be affected by minor losses of vegetation associated with the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Varied Sittella *Daphoenositta chrysoptera* V (TSC)	Inhabits eucalypt forests and woodlands, mallee and *Acacia* woodland. Occurs throughout most of mainland Australia, except the treeless deserts and open grasslands (NSW Scientific Committee). A sedentary species. Feeds on arthropods gleaned from crevices in rough or decorticating bark, and from dead twigs, branches or dead trees. Builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (NSW Scientific Committee). Population viability is sensitive to habitat isolation, reduced patch size and habitat simplification, including reductions in tree species diversity, tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter (NSW Scientific Committee). Adversely affected by the dominance of Noisy Miners in woodland patches. Current threats include habitat degradation through small-scale clearing for fencelines and road verges, rural tree decline, loss of paddock trees and connectivity, 'tidying up' on farms, and firewood collection. 55 records in the locality since 1980.	The subject site does not contain likely habitat for this species. Vegetation present is highly degraded and simplified and consists of small isolated patches. The Varied Sittella is a sedentary species that has not been recorded within the relatively isolated patches of woodland within the site, during numerous previous fauna surveys conducted in different seasons and over a period of 8 years. The Varied Sittella does not appear to occur within the subject site, and would not be likely to be affected by the Preferred Masterplan Option.
REPTILES		
Rosenberg's Goanna *Varanus rosenbergi* V (TSC)	Occurs in heath, open forest and woodland, on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions, and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River (DEC Profile). Individuals require large areas of habitat, and shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens (DEC Profile). Feeds on carrion, birds, eggs, reptiles and small mammals (DEC Profile). Nests in termite mounds, and these are a critical habitat component (DEC Profile). Is generally slow moving, and on the tablelands is likely only to be seen on the hottest days. Runs along the ground when pursued (as opposed to the Lace Monitor, which climbs trees) (DEC Profile). 4 records in the locality since 1980.	The subject site does not contain suitable habitat for this species. Rosenberg's Goanna would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Broad-headed Snake *Hoplocephalus bungaroides* E (TSC) V (EPBC)	Restricted to sandstone ranges within the Sydney basin, and areas within a radius of approximately 200km of Sydney (NPWS 1999; DEH 2006). Distribution appears to be in four key areas, the Blue Mountains, Southern Sydney, an area NW of the Cumberland Plain, and the Nowra hinterland (NPWS 1999). Prefers habitats centered on the Triassic sandstone of the Sydney basin. Sites are typified by exposed sandstone outcrops and benching in areas of open woodland and/or heath (NPWS 1999). Refuge sites are predominantly west to north west in aspect, never east (NPWS 1999; DEH 2006). Some individuals near Bathurst occur in forest growing on shale or conglomerate slopes and bluffs (DEH 2006). The Broad-headed Snake shelters in tree-hollows during summer (preferring large trees, dead trees and trees with multiple hollows – DEH 2006), and beneath close-fitting exfoliating sheets of sandstone rock during the cooler months (NPWS 1999; Cogger 1995). A nocturnal species which preys mainly on lizards and geckoes (NPWS 1999; Cogger 1995). Snakes are more common away from the disturbance of access routes (DEH 2006). Canopy tree species at known sites include Yellow Bloodwood *Corymbia eximia*, Red Bloodwood *Corymbia gummifera*, Silver-top Ash *Eucalyptus sieberi*, Grey Gum *Eucalyptus punctata* and Sydney Peppermint *Eucalyptus piperita* (NPWS 1999). Snakes occupy discrete home ranges. Adults show strong site fidelity, and juveniles do not disperse long distances (DEH 2006). 6 records in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Broad-headed Snake would not be likely to occur within the subject site.
AMPHIBIANS		
Red-crowned Toadlet *Pseudophryne australis* V (TSC)	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones, within the Sydney Basin (Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains) (DEC Profile). Inhabits periodically wet drainage lines below sandstone ridges, that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter (DEC Profile). Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters (DEC Profile). 28 records in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Red-crowned Toadlet would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Green & Golden Bell Frog *Litoria aurea* E (TSC) E (EPBC)	Has been recorded in a wide variety of both ephemeral and permanent water bodies, including marshes, dams and stream-sides (NPWS 2005; NPWS 1999). Apparently prefers unshaded water with plenty of emergent vegetation, particularly bullrushes *Typha* spp or spikerushes *Eleocharis* spp (NPWS 2005, NPWS 1999, Robinson 1998; Cogger 1996), with nearby grassy areas and diurnal sheltering sites such as rocks or tussocky vegetation (NPWS 1999). Does not usually occur in conjunction with the predatory fish Plague Minnow *Gambusia holbrooki* (NPWS 1999). Once abundant along the whole coast of NSW and extending up into tableland areas, most surviving populations are now coastal (NPWS 1999). No records in the locality since 1980.	The Green & Golden Bell Frog is not listed as occurring within the locality on either the DECCW Atlas or Bionet database, but is discussed in terms of potential habitat in AMBS (2001). Targeted searches and call playback were conducted for this species during the recent 2009 survey. The existing dam was found to be infested with Plague Minnow, which would greatly reduce its value for the Green & Golden Bell Frog, and would probably prevent successful breeding. It appears that the Green & Golden Bell Frog does not occur on the subject site.
Littlejohn's Tree Frog *Litoria littlejohni* V (TSC) V (EPBC)	Occurs on the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. The majority of records are from within the Sydney Basin Bioregion with only scattered records south to the Victorian border. This species has not been recorded in southern NSW within the last decade. Records are isolated and tend to be at high altitude (DECCW Profile). Breeds in the upper reaches of permanent streams and in perched swamps. Breeding is triggered by heavy rain and can potentially occur all year, but is usually from late summer to early spring when conditions are favourable. Males call from low vegetation close to slow flowing pools. Eggs and tadpoles are mostly found in still or slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools. Eggs are laid in loose gelatinous masses attached to small submerged twigs. Egg masses of this species are clearly visible, and are reported as being a more effective survey method for this species than observations of individuals, or call surveys (EPBC Profile). Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground. 2 records in the locality since 1980.	The subject site does not contain likely habitat for this species. Littlejohn's Tree Frog would not be likely to occur on the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Giant Burrowing Frog *Heleioporus australiacus* V (TSC) V (EPBC)	In the Sydney area there is a marked preference for sandstone ridgetop habitat and broader upland valleys. In these locations the frog is associated with small headwater creeklines and along slow flowing to intermittent creeklines. The vegetation is typically woodland, open woodland and heath, and may be associated with 'hanging swamp' seepage lines and where small pools form from the collected water. They have also been observed occupying artificial ponded structures such as fire dams, gravel 'borrows', detention basins and box drains that have naturalised over time and are still surrounded by other undisturbed habitat (DEC Profile). Limited observations on this species suggest an ability to range widely, frequently being observed on roads at considerable distance from suitable riparian breeding, or other moist habitat (DEC Profile). 26 records in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Giant Burrowing Frog would not be likely to occur within the subject site.
MAMMALS		
Spotted-tailed Quoll *Dasyurus maculatus* V (TSC) E (EPBC)	Variety of habitats including sclerophyll forest and woodlands, coastal heathlands and rainforest (NPWS 1999; Edgar & Belcher 1995). Occasionally sighted in open country, grazing lands, rocky outcrops and other treeless areas (NPWS 1999). Usually nocturnal, partly arboreal (Edgar & Belcher 1995; NPWS 1999). Apparently defines its territory with 'latrines' (Edgar & Belcher 1995). Requires suitable den sites (*eg* hollow logs, tree-hollows, rock crevices or caves), an abundance of food (small terrestrial birds and mammals, up to the size of small wallabies), and relatively large areas of intact vegetation for foraging (NPWS 1999; Edgar & Belcher 1995). Uses numerous den sites within its home range, which is estimated to be between 800ha and 20km^2 (NPWS 1999). A highly mobile species recorded travelling several kilometres overnight (NPWS 1999). 6 records in the locality since 1980.	The subject site does not contain suitable habitat for this species, nor a suitable prey resource. The Spotted-tailed Quoll would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Koala *Phascolarctos cinereus* V (TSC)	In NSW the Koala occurs mainly on the north coast and central coast, extending west of the Great Dividing Range along inland rivers (NPWS 1999). Koalas inhabit eucalypt forest and woodland, and are influenced in distribution by size and species of tree present, soil nutrients, climate, rainfall, and size and disturbance history of habitat patches (NPWS 1999). Although solitary in appearance, Koalas live in complex groups with individuals having overlapping territories (NPWS 1999). Koalas are relatively sedentary, and spend the majority of their time resting in the forks of trees (NPWS 1999; Martin & Handasyde 1995). Koalas are generally most active at dusk (NPWS 1999). Koalas feed almost exclusively on the leaves of a wide range of eucalypts, although within any one area Koalas will prefer only a small number of species (NPWS 1999; Martin & Handasyde 1995). 943 records in the locality since 1980.	There is a large, viable, and apparently increasing Koala population in the Georges River area. Animals appear to be dispersing randomly in a search for new habitat, and are venturing into the suburb of Airds. However, whilst potential habitat for Koalas does occur within the Airds Bradbury site, the habitat has not been adequate to entice Koalas to stay. It is probable that anthropogenic disturbances associated with the Airds residential area would deter Koalas from using otherwise suitable habitat. It is unlikely that the subject site provides an important resource for Koalas, or is of significance with regard to the long term survival of Koalas in the Georges River area. Refer to Chapter 3.3.2 of the main report for further discussion of Koalas.
Eastern Pygmy-possum *Cercartetus nanus* V (TSC)	Inhabits rainforest, sclerophyll forest, and tree heath in coastal areas and at higher elevations in NSW (Strahan 1995; NSW Scientific Committee). The Eastern Pygmy-possum is an agile climber, and feeds mainly on pollen and nectar from banksias, eucalypts and understorey plants, and also insects (NSW Scientific Committee; Strahan 1995). Trapping is most successful in areas of flowering banksias (NSW Scientific Committee). A nocturnal species which shelters and nests in very small spaces during the day, in tree hollows, disused bird nests, shredded bark in the forks of tea-trees *etc* (Strahan 1995). 8 records in the locality since 1980.	The subject site does not contain suitable habitat for this species, nor a suitable foraging resource. The Eastern Pygmy-possum would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Squirrel Glider *Petaurus norfolcensis* V (TSC)	Inhabits dry sclerophyll forest and woodland with an abundant supply of hollow-bearing trees and a mix of eucalypts, acacias and banksias (NPWS 1999). Within a suitable vegetation community, at least one flora species should flower heavily during winter, and one or more eucalypts should be smooth-barked (NPWS 1999). Potential habitat in NSW includes Box-Ironbark forests and woodlands in the west, River Red Gum Forests of the Murray Valley and eucalypt forests in the northeast (NPWS 1999). The Squirrel Glider is nocturnal, shelters in leaf-lined tree hollows, and feeds primarily on nectar, pollen, flowers, acacia gum and insects (NPWS 1999; Suckling 1995). Squirrel Gliders can glide for up to 50m, and occupy home ranges estimated as between 0.65 and 8.55ha (NPWS 1999). 3 records in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Squirrel Glider would not be likely to occur within the subject site.
Yellow-bellied Glider *Petaurus australis* V (TSC)	Inhabits tall mature forests in areas of high rainfall along the east coast of Australia (Menkhorst & Knight 2001). Prefers areas where year-round food resources are available from a mixture of eucalypt species (NPWS 1999). Plant and Insect exudates make up the bulk of its diet (Russell 1995). Makes characteristic triangular or V-shaped incisions in tree trunks to obtain sap (NPWS 1999; Menkhorst & Knight 2001). Nocturnal, it rests by day in a den in a hollow branch. Usually occurs in very low densities. Its home range is in the order of 30-65ha (NPWS 1999; Russell 1995). 3 records in the locality since 1980.	The subject site does not contain suitable habitat for this species. The Yellow-bellied Glider would not be likely to occur within the subject site.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Grey-headed Flying-fox *Pteropus poliocephalus* V (TSC) V (EPBC)	Occurs in rainforest, tall sclerophyll forests and woodlands, heaths and swamps along the east coast of Australia from Bundaberg to Melbourne, generally to the east of the Great Dividing Range (NPWS 2001). Also recorded in urban gardens and cultivated fruit crops (NPWS 2001). Forages on pollen, nectar and fruits of native trees (in particular *Melaleuca, Eucalyptus* and *Banksia*), and is an important pollinator and seed-disperser of native trees (NPWS 2001). Partly migratory in response to food availability. Roosts in large congregations or 'camps' during the day (NPWS 2001; Strahan 1995), which are generally located within 20km of a regular food source, in stands of riparian rainforest paperbark or casuarina forest (NPWS 2001). Camp site fidelity is high. 41 records in the locality since 1980.	The Grey-headed Flying-fox is a wide-ranging species which has been recorded flying across the subject site on several occasions (AMBS 2001 and Hayes Env 2009). The subject site theoretically contains potential habitat for this species, although no sign of a 'camp' or primary roost site has been recorded. The Grey-headed Flying Fox could potentially forage within the subject site on occasions, but would not be likely to be affected by minor losses of vegetation associated with the Preferred Masterplan Option.
Large-eared Pied Bat *Chalinolobus dwyeri* V (TSC) V (EPBC)	Inhabits dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range, from Queensland to Bungonia. Has also been recorded occasionally in sub-alpine woodlands above 1500m, and at the edge of rainforest and moist eucalypt forest (Hoye & Dwyer 1995). First recorded in a dis-used mine tunnel near Copeton, NSW in early 1960's. Probably forages for insects below the forest canopy (Hoye & Dwyer 1995). Roosts by day in tree-hollows, caves and dis-used mine-tunnels (DEC NRMAS-7 2004; Hoye & Dwyer 1995). In caves it often selects positions close to the entrance in the 'twilight zone'. Appears to hibernate during winter (Hoye & Dwyer 1995). 5 records in the locality since 1980.	The subject site contains potential foraging habitat for this species, but does not contain caves or important roost sites. The Large-eared Pied Bat could utilise the site for foraging on occasions, but, given the extensive tracts of intact habitat on reserved lands to the east, would not be likely to be affected by relatively minor losses of vegetation associated with the Preferred Masterplan Option.
Eastern False Pipistrelle *Falsistrellus tasmaniensis* V (TSC)	Thought to forage above the forest canopy, in open woodland or over water. Occurs along the Great Dividing Range of SE Australia, and east to the coast. Is more common at cooler elevations (Phillips 1995). Has been recorded roosting in tree hollows (Phillips 1995). Occasionally found in caves (DEC NRMAS-7 2004). Apparently hibernates during winter, and may sexually segregate for part of the year (Phillips 1995). 8 records in the locality since 1980.	The subject site contains potential foraging and roosting habitat for this species. The Eastern False Pipistrelle could occur within the site, and may be affected by the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Eastern Bent-wing Bat *Miniopterus schreibersii oceanenis* V (TSC)	Typically inhabits well-timbered valleys where it forages above the tree canopy (Dwyer 1995b). Roosts in caves, old mines, stormwater channels and comparable structures (DEC NRMAS-7 2004; Dwyer 1995b). In SE Australia it seeks cold roosts through winter to allow hibernation. Depends upon specific mass nursery sites in Spring to rear its young (Dwyer 1995b), thus prone to mass damage from catastrophic events (DEC NRMAS-7 2004). 16 records in the locality since 1980.	The subject site contains potential foraging habitat for this species, but does not contain caves or important roost sites. The Eastern Bent-wing Bat could utilise the site for foraging on occasions, but, given the extensive tracts of intact habitat on reserved lands to the east, would not be likely to be affected by relatively minor losses of vegetation associated with the Preferred Masterplan Option.
Little Bent-wing Bat *Miniopterus australis* V (TSC)	Forages beneath the tree canopy of well-timbered habitats including rainforest, *Melaleuca* swamps and dry sclerophyll forests (Dwyer 1995a). Roosts in caves and old mines, depends upon specific nursery sites to rear its young (Dwyer 1995a), thus prone to mass damage from catastrophic events (DEC NRMAS-7 2004). Not listed on either the DECCW Atlas or Bionet database, but possibly recorded in the study area by Anabat detection.	The subject site contains potential foraging habitat for this species, but does not contain caves or important roost sites. The Little Bent-wing Bat could utilise the site for foraging on occasions, but, given the extensive tracts of intact habitat on reserved lands to the east, would not be likely to be affected by relatively minor losses of vegetation associated with the Preferred Masterplan Option.
Large-footed Myotis *Myotis adversus* V (TSC)	Occurs in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers (DEC Profile). Generally roosts in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (DEC Profile). Colonies never occur far from bodies of water, ranging from rainforest streams to large lakes and reservoirs (Richards 1995b). Forage over streams and pools catching insects and small fish by raking their feet across the water surface (DEC Profile; Richards 1995b). Males roost alone and defend territories when not breeding. Torpid in winter in roosts separate to maternity sites (Richards 1995b). 304 records in the locality since 1980.	The subject site contains potential foraging habitat for this species, but does not contain caves or The Large-footed Myotis could utilise the existing dam in the subject site for foraging on occasions. The site does not contain caves or likely important roost sites. The dam is to be retained. The Large-footed Myotis would not be likely to be affected by the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
Eastern Freetail Bat *Mormopterus norfolkensis* V (TSC)	Usually recorded in dry eucalypt forest and woodland east of the Great Dividing Range, but has also been recorded in rainforest and wet sclerophyll forest (Allison & Hoye 1995). Apparently solitary. Predominantly tree-dwelling, but has been recorded roosting in the roof of a hut (Allison & Hoye 1995). 13 records in the locality since 1980.	The subject site contains potential foraging and roosting habitat for this species. The Eastern Freetail Bat could occur within the site, and may be affected by the Preferred Masterplan Option
Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris* V (TSC)	Occurs throughout eastern and northern Australia, foraging above the canopy in eucalypt forests, and closer to the ground in mallee or open country (Richards 1995a). Usually solitary, occasionally occurring in colonies of less than 10 individuals (Richards 1995a). Roosts in tree hollows (Richards 1995a), occasionally in caves (DEC NRMAS-7 2004), and has been found in the abandoned nests of Sugar Gliders (Richards 1995a). Possibly migratory in southern Australia (Richards 1995a). 2 records in the locality since 1980.	The subject site contains potential foraging and roosting habitat for this species. The Yellow-bellied Sheath-tail Bat could occur within the site, and may be affected by the Preferred Masterplan Option.
Greater Broad-nosed Bat *Scoteanax rueppellii* V (TSC)	Inhabits gullies and river systems draining the Great Dividing Range, occurs in a variety of woodland and forest habitats, from open eucalypt woodland to rainforest. Open woodlands suit its direct flight pattern, in denser rainforests it favours creekline corridors for foraging (Hoye & Richards 1995). Usually roosts in tree-hollows, but has been found in old buildings (Hoye & Richards 1995). 17 records in the locality since 1980.	The subject site contains potential foraging and roosting habitat for this species. The Greater Broad-nosed Bat could occur within the site, and may be affected by the Preferred Masterplan Option.

Species	Habits/Requirements/Records in the locality	Occurrence in the study area
INVERTEBRATES		
Cumberland Plain Land Snail *Meridolum corneovirens* E (TSC)	Appears to be restricted to the Cumberland Plain and Castlereagh Woodlands of Western Sydney, and also along the fringes of River-flat Forest (NPWS 1999). Typically occurs in moist loose soil under logs and other debris, amongst leaf and bark accumulations around the base of trees, and sometimes under grass clumps (NPWS 1999). Apparently burrows deeply into soil during dry conditions (R Hayes *pers obs*). 56 records in the locality since 1980.	The Cumberland Plain Land Snail has been previously recorded in the patch of Cumberland Plain Woodland to the north of the Airds shopping centre within the subject site. Recent surveys failed to find any live individuals of this species, but did find empty shells (note that shells have been reported as persisting for up to 50 years in areas where live snails have become extinct). Given the high levels of ground disturbance within the area of habitat for this species, including mowing, burning, trampling, and removal of logs, and that these disturbances have continued throughout a period of sustained drought, it seems likely that the population of Cumberland Plain Land Snail previously recorded within the study area has become extinct.

AIRDS BRADBURY RENEWAL PROJECT

ECOLOGICAL AND BUSHFIRE ASSESSMENT

APPENDIX 2

Inventory of flora species recorded

March 2011

APPENDIX 2 Flora species recorded in the Airds/Bradbury study area during the January 2009 survey (Hayes Env).

KEY	
Status	
*	Exotic weed species (including native horticultural and non-endemic species)
N	Noxious Weed (class#) listed on the *NSW Noxious Weeds Act 1993* for the Campbelltown LGA
Record	
A	Dean Park
B	Smiths Creek
C	Greengate Reserve
D	Existing Dam

Status	SCIENTIFIC NAME	COMMON NAME	A	B	C	D
	Acanthaceae					
	Brunoniella australis	Blue Trumpet	●			
	Adiantaceae					
	Cheilanthes sieberi	Mulga Fern	●	●	●	
	Alismataceae					
*	*Alisma plantago-aquatica*	Water Plantain				●
	Anthericaceae					
	Caesia parviflora var. *parviflora*			●	●	
	Thysanotus juncifolius				●	
	Tricoryne elatior	Yellow Autumn-lily	●			
	Apiaceae					
	Apium prostratum	Sea Celery	●			●
	Centella asiatica	Pennywort				●
*	*Foeniculum vulgare*	Fennel	●	●		●
	Platysace ericoides				●	
	Asclepiadaceae					
*	*Araujia sericifera*	Moth Vine	●	●		●
	Asparagaceae					
*	*Protasparagus aethiopicus*	Asparagus Fern	●			
*	*Asparagus officinalis*	Asparagus		●		
	Asteraceae					
*	*Bidens pilosa*	Cobbler's Pegs	●	●		●
	Calotis lappulacea	Yellow Burr-daisy	●			
	Chrysocephalum apiculatum	Common Everlasting	●	●		
*	*Cirsium vulgare*	Spear Thistle	●	●	●	●
*	*Conyza sp.*		●	●		●
	Euchiton sphaericus		●	●	●	●
*	*Hypochaeris radicata*	Catsear	●	●	●	●
*	*Lactuca serriola*	Prickly Lettuce				●
	Ozothamnus diosmifolius	White Dogwood			●	
	Senecio diaschides				●	
*	*Senecio madagascariensis*	Fireweed	●	●		●
*	*Sonchus oleraceus*	Common Sowthistle				●
	Vernonia cinerea var. *cinerea*		●			
	Vittadinia cuneata	Fuzzweed	●			
	Vittadinia sulcata		●			

Status	SCIENTIFIC NAME	COMMON NAME	A	B	C	D
	Bignoniaceae					
*	*Jacaranda mimosifolia*	Jacaranda		●		
	Campanulaceae					
	Wahlenbergia gracilis	Sprawling or Australian Bluebell	●		●	
	Casuarinaceae					
	Allocasuarina littoralis	Black Sheoak			●	
	Allocasuarina torulosa	Forest Oak			●	
	Chenopodiaceae					
	Atriplex semibaccata	Creeping Saltbush	●			
	Einadia hastata	Berry Saltbush	●	●	●	●
	Enchylaena tomentosa	Ruby Saltbush	●			
	Clusiaceae					
N (4)	*Hypericum perforatum*	St. Johns Wort	●			
	Commelinaceae					
	Commelina cyanea	Native Wandering Jew		●		
	Convolvulaceae					
	Convolvulus erubescens		●			
	Dichondra repens	Kidney Weed	●	●		●
	Cyatheaceae					
	Cyathea cooperi	Straw Treefern			●	
	Cyperaceae					
	Bolboschoenus fluviatilis					●
*	*Cyperus brevifolius*		●			●
*	*Cyperus eragrostis*	Umbrella Sedge			●	●
	Eleocharis sphacelata	Tall Spike Rush				●
	Isolepis inundata					●
	Lepidosperma filiforme				●	
	Lepidosperma laterale				●	
	Epacridaceae					
	Leucopogon juniperinus				●	
	Euphorbiaceae					
	Breynia oblongifolia	Coffee Bush		●	●	
	Phyllanthus hirtellus	Thyme Spurge			●	
	Poranthera microphylla				●	
	Fabaceae (Faboideae)					
	Daviesia ulicifolia	Gorse Bitter Pea		●	●	
	Desmodium varians	Slender Tick-trefoil		●		
	Dillwynia sieberi			●		
	Glycine clandestina				●	
	Glycine tabacina		●	●		
	Gompholobium minus	Dwarf Wedge Pea			●	
	Hardenbergia violacea	False Sarsaparilla	●	●	●	
	Indigofera australis		●		●	
*	*Lotus uliginosus*	Birds-foot Trefoil				●
	Podolobium scandens	Netted Shaggy Pea			●	
	Pultenaea elliptica		●			
*	*Trifolium repens*	White Clover		●		●
	Fabaceae (Mimosoideae)					
	Acacia decurrens	Black Wattle	●	●		●

Status	SCIENTIFIC NAME	COMMON NAME	A	B	C	D
	Acacia falcata		●			
	Acacia implexa	Hickory Wattle	●	●		
	Acacia longifolia	Sydney Golden Wattle			●	
	Acacia parramattensis	Parramatta Wattle	●		●	
*	*Acacia saligna*	Golden Wreath Wattle		●		
	Acacia terminalis	Sunshine Wattle			●	
	Acacia ulicifolia	Prickly Moses		●	●	
	Gentianaceae					
*	*Centaurium tenuiflorum*		●	●		●
	Geraniaceae					
	Geranium homeanum				●	
	Goodeniaceae					
	Dampiera purpurea				●	
	Goodenia hederacea ssp. *hederacea*		●		●	
	Haemodoraceae					
	Haemodorum planifolium				●	
	Haloragaceae					
	Gonocarpus tetragynus				●	
*	*Myriophyllum aquaticum*	Parrots Feathers				●
	Hypoxidaceae					
	Hypoxis glabella			●		
	Hypoxis hygrometrica var. *hygrometrica*		●			
	Juncaceae					
	Juncus usitatus		●		●	●
	Lauraceae					
	Cassytha glabella				●	
	Lobeliaceae					
	Pratia purpurascens	Whiteroot			●	
	Lomandraceae					
	Lomandra filiformis		●		●	
	Lomandra longifolia	Spiny-headed Mat-rush			●	
	Lomandra multiflora		●	●	●	
	Lomandra obliqua				●	
	Malvaceae					
*	*Modiola caroliniana*	Red-flowered Mallow				●
*	*Pavonia hastata*			●		
*	*Sida rhombifolia*	Paddy's Lucerne	●	●	●	●
	Myrsinaceae					
	Rapanea variabilis	Muttonwood			●	
	Myrtaceae					
	Angophora bakeri	Narrow-leaved Apple		●	●	
	Angophora costata	Sydney Red/Rusty Gum			●	
	Corymbia gummifera	Red Bloodwood			●	
	Eucalyptus acmenioides				●	
	Eucalyptus crebra	Narrow-leaved Ironbark	●	●	●	
	Eucalyptus eugenioides	Thin-leaved Stringybark	●	●		
	Eucalyptus fibrosa	Red Ironbark	●			
	Eucalyptus moluccana	Grey Box	●			
	Eucalyptus punctata	Grey Gum			●	
	Eucalyptus tereticornis	Forest Red Gum	●	●		

Status	SCIENTIFIC NAME	COMMON NAME	A	B	C	D
	Kunzea capitata	Tick Bush			●	
	Syncarpia glomulifera	Turpentine			●	
	Nandinaceae					
	Nandina domestica			●		
	Oleaceae					
N (4)	*Ligustrum lucidum*	Large-leaved Privet	●	●		
N (4)	*Ligustrum sinense*	Small-leaved Privet	●	●	●	
	Notelaea longifolia	Large Mock-olive	●		●	
	Onagraceae					
	Ludwigia peploides					●
N (3)	*Ludwigia peruviana*					●
	Orchidaceae					
	Dipodium punctatum				●	
	Oxalidaceae					
	Oxalis perennans		●		●	●
	Phormiaceae					
	Dianella caerulea var. *caerulea*				●	
	Dianella longifolia var. *longifolia*		●			
	Dianella revoluta				●	
	Stypandra glauca	Nodding Blue Lily		●	●	
	Pittosporaceae					
	Billardiera scandens	Appleberry			●	
	Bursaria spinosa	Native Blackthorn	●	●	●	●
	Plantaginaceae					
*	*Plantago lanceolata*	Lamb's Tongues	●	●		●
	Poaceae					
	Agrostis avenacea	Blown Grass				●
*	*Aira cupaniana*	Silvery Hairgrass			●	
*	*Andropogon virginicus*	Whisky Grass		●		
	Anisopogon avenaceus	Oat Speargrass			●	
	Aristida ramosa		●		●	
	Aristida vagans	Threeawn Speargrass	●			
	Austrodanthonia sp.		●		●	
	Austrodanthonia tenuior		●			
*	*Avena barbata*	Bearded Oats				●
	Bothriochloa macra	Red Grass	●			●
*	*Briza maxima*	Quaking Grass	●	●	●	●
*	*Briza minor*	Shivery Grass	●	●		
*	*Briza subaristata*		●	●		●
*	*Bromus catharticus*			●		
*	*Bromus molliformis*					●
*	*Chloris gayana*	Rhodes Grass		●		
	Chloris truncata	Windmill Grass		●		
	Cymbopogon refractus	Barbed Wire Grass	●	●		
	Cynodon dactylon	Common Couch		●		●
	Dichelachne crinita	Longhair Plumegrass			●	
	Dichelachne micrantha		●	●		●
	Digitaria ramularis				●	
	Echinopogon caespitosus		●		●	
	Entolasia marginata	Bordered Panic			●	
	Entolasia stricta	Wiry Panic			●	

Status	SCIENTIFIC NAME	COMMON NAME	A	B	C	D
*	*Eragrostis curvula*	African Lovegrass	●	●		●
	Eragrostis leptostachya		●			
	Imperata cylindrica	Bladey Grass			●	
	Microlaena stipoides		●			
N (4)	*Nassella neesiana*	Chilean Needle Grass	●			
	Panicum simile	Two-colour Panic			●	
*	*Paspalum dilatatum*	Paspalum	●	●	●	●
*	*Pennisetum clandestinum*	Kikuyu Grass	●	●		●
	Poa labillardierei var. *labillardierei*	Tussock			●	
*	*Setaria gracilis*	Slender Pigeon Grass	●		●	●
*	*Sporobolus africanus*	Parramatta Grass				●
	Sporobolus elongatus	Slender Rat's Tail Grass	●			
	Themeda australis	Kangaroo Grass	●	●	●	●
	Vulpia megalura			●	●	●
	Polygonaceae					
	Persicaria decipiens	Slender Knotweed				●
*	*Rumex acetosella*					●
	Pontederiaceae					
N (3)	*Eichhornia crassipes*	Water Hyacinth				●
	Primulaceae					
*	*Anagallis arvensis*	Scarlet/Blue Pimpernel		●		●
	Proteaceae					
	Lomatia silaifolia	Crinkle Bush			●	
	Persoonia pinifolia	Pine-leaved Geebung			●	
	Rhamnaceae					
	Pomaderris lanigera				●	
	Pomaderris ligustrina ssp. *ligustrina*				●	
	Rosaceae					
N (4)	*Rubus fruiticosus*	Blackberry complex	●		●	
	Rubiaceae					
	Opercularia diphylla		●			
	Pomax umbellata				●	
	Salicaceae					
N (5)	*Salix babylonica*	Weeping Willow				●
	Santalaceae					
	Exocarpos cupressiformis	Native Cherry	●	●	●	
	Sapindaceae					
	Dodonaea triquetra				●	
	Scrophulariaceae					
	Veronica plebeia	Trailing Speedwell		●	●	
	Smilacaceae					
	Smilax australis	Sarsaparilla			●	
	Solanaceae					
*	*Solanum nigrum*	Black-berry Nightshade	●	●		●
	Solanum pungetium	Eastern Nightshade			●	
	Stylidiaceae					
	Stylidium graminifolium	Grass Triggerplant			●	
	Thymelaeaceae					
	Pimelea linifolia				●	

Status	SCIENTIFIC NAME	COMMON NAME	A	B	C	D
	Verbenaceae					
N (4)	*Lantana camara*	Lantana		•		
*	*Verbena bonariensis*	Purpletop	•	•	•	•
	Xanthorrhoeaceae					
	Xanthorrhoea media				•	
	Number of natives		**52**	**32**	**82**	**20**
	number of exotics		**26**	**31**	**12**	**35**
	Total number of species		**78**	**63**	**94**	**55**

Class 4 Noxious Weed – The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed

Class 5 Noxious Weed – The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with, including 'an occupier of land on which there is a notifiable weed must notify the local control authority [Hawkesbury River County Council] for the land of that fact within 24 hours of becoming aware that the notifiable weed is on the land'.

AIRDS BRADBURY RENEWAL PROJECT

ECOLOGICAL AND BUSHFIRE ASSESSMENT

APPENDIX 3

Fauna species recorded within the study area

March 2011

APPENDIX 3 Fauna species recorded within the Airds/Bradbury study area (AMBS 2001 & 2002; Hayes Env 2009).

KEY	
Status	
*	Introduced species
M	Migratory species listed under the Commonwealth EPBC Act
E (TSC)	Endangered species listed on the NSW TSC Act
V (TSC)	Vulnerable species listed on the NSW TSC Act
E (EPBC)	Endangered species listed on the Commonwealth EPBC Act
V (EPBC)	Vulnerable species listed on the Commonwealth EPBC Act
Record	
A	Species recorded during AMBS (2001 & 2002)
B	Species recorded during Hayes Env (2009)
a	anecdotal residents record – not confirmed

Status	COMMON NAME	SCIENTIFIC NAME	A	B
	BIRDS			
	Anatidae			
M	Pacific Black Duck	*Anas superciliosa*	✓	
M	Chestnut Teal	*Anas castanea*	✓	
M	Australian Wood Duck	*Chenonetta jubata*	✓	✓
	Podicepedidae			
	Australasian Grebe	*Tachybaptus novaehollandiae*	✓	
	Columbidae			
*	Rock Dove	*Columba livia*	✓	✓
	Peaceful Dove	*Geopelia placida*		✓
	Crested Pigeon	*Ocyphaps lophotes*	✓	✓
*	Spotted Turtledove	*Streptopelia chinensis*	✓	✓
	Phalacrocoracidae			
	Little Pied Cormorant	*Phalacrocorax melanoleucos*	✓	
	Ardeidae			
	White-faced Heron	*Egretta novaehollandiae*	✓	
	Rallidae			
	Purple Swamphen	*Porphyrio porphyrio*	✓	✓
	Charadriidae			
M	Masked Lapwing	*Vanellus miles*	✓	
	Cacatuidae			
	Galah	*Cacatua roseicapilla*	✓	✓
	Sulphur-crested Cockatoo	*Cacatua galerita*	✓	✓
	Long-billed Corella	*Cacatua tenuirostris*	✓	
	Psittacidae			
	Eastern Rosella	*Platycercus eximius*	✓	✓
	Red-rumped Parrot	*Psephotus haematonotus*	✓	✓
	Scaly-breasted Lorikeet	*Trichglossus chlorolepidotus*	✓	
	Rainbow Lorikeet	*Trichoglossus haematodus*	✓	✓
	Halcyonidae			
	Laughing Kookaburra	*Dacelo novaeguineae*	✓	✓
	Climacteridae			
	White-throated Treecreeper	*Cormobates leucophaeus*		✓
	Maluridae			
	Superb Fairy-wren	*Malurus cyaneus*	✓	✓

Status	COMMON NAME	SCIENTIFIC NAME	A	B
	Acanthizidae			
	Yellow Thornbill	*Acanthiza nana*		✓
	Buff-rumped Thornbill	*Acanthiza reguloides*	✓	
	Weebill	*Smicrornis brevirostris*	✓	
	Pardalotidae			
	Spotted Pardalote	*Pardalotus punctatus*	✓	
	Meliphagidae			
	Red Wattlebird	*Anthochaera carunculata*	✓	
	Little Wattlebird	*Anthochaera chrysoptera*	✓	
	Noisy Miner	*Manorina melanocephala*	✓	✓
	Noisy Friarbird	*Philemon corniculatus*	✓	
	Little Friarbird	*Philemon citreogularis*		✓
	Campephagidae			
	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	✓	✓
	Pachycephalidae			
	Whistler	*Pachycephala* sp	✓	
	Artamidae			
	Pied Butcherbird	*Cracticus nigrogularis*		✓
	Grey Butcherbird	*Cracticus torquatus*	✓	✓
	Australian Magpie	*Gymnorhina tibicen*	✓	✓
	Pied Currawong	*Strepera graculina*	✓	✓
	Rhipiduridae			
	Grey Fantail	*Rhipidura albiscapa*	✓	✓
	Willie Wagtail	*Rhipidura leucophrys*	✓	✓
	Corvidae			
	Australian Raven	*Corvus coronoides*	✓	✓
	Monarchidae			
	Magpie-lark	*Grallina cyanoleuca*	✓	✓
	Corcoracidae			
	White-winged Chough	*Corcorax melanoramphos*		✓
	Cisticolidae			
M	Golden-headed Cisticola	*Cisticola exilis*		✓
	Timaliidae			
	Silvereye	*Zosterops lateralis*	✓	
	Hirundinidae			
	Welcome Swallow	*Hirundo neoxena*	✓	✓
	Pycnonotidae			
*	Red-whiskered Bulbul	*Pycnonotus jocosus*	✓	
	Muscicapidae			
*	Eurasian Blackbird	*Turdus merula*	✓	✓
	Sturnidae			
*	Common Starling	*Sturnus vulgaris*	✓	
*	Common Myna	*Acridotheres tristis*	✓	✓
	Passeridae			
*	House Sparrow	*Passer domesticus*	✓	✓
	REPTILES			
	Agamidae			
	Eastern Water Dragon	*Physignathus lesueurii*	a	
	Scincidae			
	Cream-striped Shinning-skink	*Cryptoblepharus virgatus*		✓
	Ctenotus *sp*	Large skink	✓	
	Robust Ctenotus	*Ctenotus robustus*		✓
	Dark-flecked Garden Sun-skink	*Lampropholis delicata*	✓	✓
	Pale-flecked Garden Sun-skink	*Lampropholis guichenoti*	✓	

Status	COMMON NAME	SCIENTIFIC NAME	A	B
	Shingleback Lizard		a	
	Common Bluetongued Lizard	*Tiliqua scincoides*	a	
	AMPHIBIANS			
	Myobatrachidae			
	Common Eastern Froglet	*Crinia signifera*	✓	✓
	Striped Marsh Frog	*Limnodynastes peronii*		✓
	Hylidae			
	Eastern Dwarf Tree Frog	*Litoria fallax*		✓
	Verreaux's Tree Frog	*Litoria verreauxii*	✓	
	MAMMALS			
	Dasyuridae			
	Brown Antechinus	*Antechinus stuartii*		✓
	Petauridae			
	Sugar Glider	*Petaurus breviceps*	✓	
	Pteropidae			
V (TSC & EPBC)	Grey-headed Flying-fox	*Pteropus poliocephalus*	✓	✓
	Molossidae			
	Undescribed Mastiff-bat	*Mormopterus* sp 1	✓	
	Freetail Bat	*Mormopterus* sp		✓
	Vespertilionidae			
	Gould's Wattled Bat	*Chalinolobus gouldii*	✓	✓
	Chocolate Wattled Bat	*Chalinolobus morio*		✓
V (TSC)	Little Bent-wing Bat	*Miniopterus australis*		✓
V (TSC)	Eastern Bent-wing Bat	*Miniopterus schreibersii oceanis*	✓	
	Unidentified Long-eared Bat	*Nyctophilus* sp		✓
	Eastern Broad-nosed Bat	*Scotorepens orion*		✓
	Introduced Mammals			
*	Rabbit	*Oryctolagus cuniculus*	✓	
*	Dog	*Canis lupus familiaris*	✓	
*	Fox	*Vulpes vulpes*	✓	
	THREATENED INVERTEBRATES			
	Camaenidae			
E (TSC)	Cumberland Plain Land Snail	*Meridolum corneovirens*	✓	Shells only

AIRDS BRADBURY RENEWAL PROJECT

ECOLOGICAL AND BUSHFIRE ASSESSMENT

APPENDIX 4

Assessment of significance pursuant to s5A of the EP&A Act

March 2011

APPENDIX 4

Assessment of significance of potential impacts of the Airds Bradbury Renewal Project upon the Koala, four threatened microchiropteran bat species (Eastern False Pipistrelle, Eastern Freetail Bat, Yellow-bellied Sheath-tail Bat and Greater Broad-nosed Bat), upon Cumberland Plain Woodland and Shale Sandstone Transition Forest, pursuant to s.5A of the EP&A Act.

1 INTRODUCTION

The *NSW Threatened Species Conservation Act 1995* (TSC Act) modified the *NSW Environmental Planning & Assessment Act 1979* (EP&A Act) by including in Section 5A eight factors which were to be considered when determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*". The *NSW Threatened Species Legislation Amendment Act 2004* has further modified the EP&A Act such that the eight factors have been replaced by a set of seven factors.

These seven factors "*must be taken into account*" by a consent or determining authority when deciding "*whether there is likely to be a significant effect on threatened species, populations or ecological communities*", particularly in administering Sections 78, 79 and 112 of the EP&A Act.

Based on considerations in Appendix 1, the Koala *Phascolarctos cinereus* and four microchiropteran bat species (Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail Bat *Mormopterus norfolkensis*, Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris*, Greater Broad-nosed Bat *Scoteanax rueppellii*), could be affected by development in accordance with the Concept Plan.

Development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of Cumberland Plain Woodland, a "*critically endangered ecological community*" listed under the TSC Act, and loss of approximately 4.41 hectares of Shale Sandstone Transition Forest, an "*endangered ecological community*" listed under the TSC Act.

The potential impacts of the Airds Bradbury Renewal Project upon these threatened biota have been assessed pursuant to s.5A of the EP&A Act. Details are provided below.

2 FACTORS for CONSIDERATION

2.1 Koala *Phascolarctos cinereus*

(a) "*in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*"

A viable population of the Koala is known to occur in the Georges River area to the east of the subject site.

There are records of the Koala within the subject site (refer to Figure 3 above) which indicate that the Koala occasionally ventures into the site. There is no evidence that Koalas choose to remain within the subject site.

It is not likely that the site is of importance for the life cycle of the Koala.

It is possible that the site may provide a temporary refuge from bushfire.

Development in accordance with the Concept Plan would not be likely to have an adverse effect on the life cycle of the Koala, such that a viable local population of this species would be placed at risk of extinction.

(b) "*in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction*"

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

The Koala is not part of any relevant "*endangered population*" listed under the TSC Act.

(c) "*in the case of a critically endangered or endangered ecological community, whether the action proposed:*

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction"

The Koala is not an ecological community.

(d) "*in relation to the habitat of a threatened species, population or ecological community:*

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality"

(i) extent

Development in accordance with the Concept Plan would result in loss of approximately 4 hectares of vegetation providing occasional habitat for Koalas.

(ii) fragmentation

Development in accordance with the Concept Plan would alter the current arrangement of trees and vegetation within the subject site, and may further fragment potential refuge habitat for the Koala.

(iii) importance

Habitats that would be affected by the Airds Bradbury Renewal Project are not of particular importance for the Koala.

Conclusion

Development in accordance with the Concept Plan would result in loss of approximately 4 hectares of occasional habitat for the Koala, and may further fragment retained such habitat for the Koala across the site. The habitat that would be affected is not of particular importance for the long-term survival of the Koala in the locality.

(e) "*whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)*"

The TSC Act 1995 defines "*critical habitat*" as "*habitat declared to be critical habitat under part 3*" of the Act.

There is no declared "*critical habitat*" of relevance to the subject site. Development in accordance with the Concept Plan would not affect any area of "*critical habitat*".

(f) "*whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan*"

A '*Recovery Plan for the koala* (*Phascolarctos cinereus*)' prepared by DECC (November 2008) has recently been approved. The Concept Plan would not hinder the objectives or actions of the Recovery Plan.

There are no specific measures relevant to the subject site, or development proposal. There are a range of general impact mitigation measures relating to traffic management, dog management, fire control *etc* listed within the Recovery Plan. These measures can and should be implemented during the more detailed design of each stage of the development.

No threat abatement plans are of specific relevance to the Airds Bradbury Renewal Project.

(g) "*whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process*"

There are several key threatening processes which have previously occurred on the site, some of which are likely to be ongoing.

Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act.

However, the proposal would not result in loss of important or significant habitat for the Koala. The increase of the impact of this threatening process in the locality for the Koala is not significant.

Summary

In summary of the above seven parts:

(a) the Airds Bradbury Renewal Project would not be likely to have an adverse effect on the life cycle of the Koala, such that a viable local population of this species would be placed at risk of extinction;

(b) the Koala is not part of any relevant "*endangered population*" listed under the TSC Act;

(c) the Koala is not an ecological community;

(d) development in accordance with the Concept Plan would result in loss of approximately 4 hectares of occasional habitat for the Koala, and may further fragment retained such habitat for the Koala across the site. The habitat that would be affected is not of particular importance for the long-term survival of the Koala in the locality;

(e) there is no declared "*critical habitat*" of relevance to the subject site. Development in accordance with the Concept Plan would not affect any area of "*critical habitat*";

(f) a '*Recovery Plan for the koala* (*Phascolarctos cinereus*)' has been prepared by DECC (November 2008). The Concept Plan would not hinder the objectives or actions of the Recovery Plan. No threat abatement plans are of specific relevance to the Airds Bradbury Renewal Project;

(g) there are several key threatening processes which have previously occurred on the site, some of which are likely to be ongoing. Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. However, the proposal would not result in loss of important or significant habitat for the Koala. The increase of the impact of this threatening process in the locality for the Koala is not significant.

2.2 Threatened Microchiropteran Bats

(Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Eastern Freetail Bat *Mormopterus norfolkensis*, Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris*, Greater Broad-nosed Bat *Scoteanax rueppellii*)

(a) "*in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*"

The site contains a very limited extent of highly degraded woodland vegetation. Remnant trees within the main patch of Cumberland Plain Woodland and along the Smiths Creek corridor contain hollows of potential value for microchiropteran bats. These features are to be retained within the site.

It is likely that some trees to be removed from the site do also contain hollows, which may be used by tree-dwelling microchiropteran bat species.

Extensive tracts of intact habitat occur to the east of the subject site, providing habitat for microchiropteran bats.

The site does not contain any resources or features that are unique or scarce within the locality. The site does not contain any features likely to be of importance for breeding.

Microchiropteran bats are known to change roost sites regularly, and so would not be likely to be dependent upon any particular tree within the subject site.

Development in accordance with the Concept Plan would not be likely to have an adverse effect on the life cycle of any of the four threatened microchiropteran bat species, such that a viable local population of any of the species would be placed at risk of extinction.

(b) "*in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction*"

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

None of the four threatened microchiropteran bat species are part of any relevant "*endangered population*" listed under the TSC Act.

(c) "*in the case of a critically endangered or endangered ecological community, whether the action proposed:*

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction"

None of the four threatened microchiropteran bat species are an ecological community.

(d) "*in relation to the habitat of a threatened species, population or ecological community:*

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality"

(i) extent

Development in accordance with the Concept Plan would result in loss of approximately 5.62 hectares of highly degraded woodland vegetation, which provides some potential foraging and roosting habitat for microchiropteran bats.

(ii) fragmentation

Development in accordance with the Concept Plan would alter the current arrangement of trees and vegetation within the subject site, and may further fragment areas of potential habitat for microchiropteran bats to a minor extent.

However, microchiropteran bats are highly mobile and wide-ranging and are not likely to be affected by the minor increases in fragmentation.

(iii) importance

It is probable that habitats on the site would be utilised by microchiropteran bats, at least on occasions. It is not likely that any microchiropteran bat species would be dependent upon the site for long-term viability in the locality.

The habitats that would be affected by the proposed subdivision are not likely to be of particular importance for microchiropteran bats.

Conclusion

Development in accordance with the Concept Plan would result in loss of approximately 5.62 hectares of highly degraded potential habitat for microchiropteran bats. The proposal may contribute to increased fragmentation of habitats for microchiropteran bats, although not to a significant extent. The habitat that would be affected is not likely to be of particular importance for the long term survival of any microchiropteran bat species in the locality.

(e) "*whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)*"

The TSC Act 1995 defines "*critical habitat*" as "*habitat declared to be critical habitat under part 3*" of the Act.

There is no declared "*critical habitat*" of relevance to the subject site. Development in accordance with the Concept Plan would not affect any area of "*critical habitat*".

(f) "*whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan*"

There are no Recovery Plans for any of the four threatened microchiropteran bat species.

No threat abatement plans are of specific relevance to the Airds Bradbury Renewal Project.

(g) "*whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process*"

There are several key threatening processes which have previously occurred on the site, some of which are likely to be ongoing.

Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act.

However, the proposal would not result in loss of important or significant habitat for microchiropteran bats. The increase of the impact of this threatening process in the locality for microchiropteran bats is not significant.

Summary

In summary of the above seven parts:

(a) development in accordance with the Concept Plan would not be likely to have an adverse effect on the life cycle of any of the four threatened microchiropteran bat species, such that a viable local population of any of the species would be placed at risk of extinction;

(b) none of the four threatened microchiropteran bat species are part of any relevant "*endangered population*" listed under the TSC Act;

(c) none of the four threatened microchiropteran bat species are an ecological community;

(d) development in accordance with the Concept Plan would result in loss of approximately 5.62 hectares of highly degraded potential habitat for microchiropteran bats. The proposal may contribute to increased fragmentation of habitats for microchiropteran bats, although not to a significant extent. The habitat that would be affected is not likely to be of particular importance for the long term survival of any microchiropteran bat species in the locality;

(e) there is no declared "*critical habitat*" of relevance to the Airds Bradbury Renewal Project. Development in accordance with the Concept Plan would not affect any area of "*critical habitat*";

(f) there are no Recovery Plans for any of the four threatened microchiropteran bat species. No threat abatement plans are of specific relevance to the Airds Bradbury Renewal Project;

(g) there are several key threatening processes which have previously occurred in the study area, some of which are likely to be ongoing. Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. However, the proposal would not result in loss of important or significant habitat for microchiropteran bats. The increase of the impact of this threatening process in the locality for microchiropteran bats is not significant.

2.3 Cumberland Plain Woodland

(a) "*in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*"

Cumberland Plain Woodland is not a "*threatened species*".

(b) "*in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction*"

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

Cumberland Plain Woodland is not an "*endangered population*".

(c) "*in the case of a critically endangered or endangered ecological community, whether the action proposed:*

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction"

(i) extent

Development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of Cumberland Plain Woodland, including two small isolated occurrences.

(ii) composition

Development in accordance with the Concept Plan would not directly affect the floristic composition of retained areas of Cumberland Plain Woodland, but may require some structural modifications, to meet safety requirements.

It is not expected that these structural modifications would place the local occurrence at risk of extinction.

Conclusion

Development in accordance with the Concept Plan would result in loss of the northeastern fringe of the main stand of Cumberland Plain Woodland, and two small isolated occurrences, and may affect the structure of retained areas of Cumberland Plain Woodland within the site.

(d) "*in relation to the habitat of a threatened species, population or ecological community:*

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality"

(i) extent

The extent of habitat for Cumberland Plain Woodland is the area that still supports this community, *ie* approximately 4.4 hectares within the subject site.

Development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of Cumberland Plain Woodland, comprised of some fringe areas and several small isolated occurrences.

(ii) fragmentation

Development in accordance with the Concept Plan would alter the current pattern of vegetation within the subject site, and may further fragment areas of habitat for Cumberland Plain Woodland to a minor extent.

(iii) importance

All habitat for Cumberland Plain Woodland is of importance. The habitat present within the subject site has not been identified as being of particular importance for the long term viability of this community in the locality.

Conclusion

Development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of habitat for Cumberland Plain Woodland, and may further fragment habitat for this community in the locality. The habitat to be affected is of some importance, but has not been identified as being of particular importance for the long term survival of Cumberland Plain Woodland in the locality.

(e) "*whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)*"

The TSC Act 1995 defines "*critical habitat*" as "*habitat declared to be critical habitat under part 3*" of the Act.

There is no declared "*critical habitat*" of relevance to the subject site. The Airds Bradbury Renewal Project would not affect any area of "*critical habitat*".

(f) "*whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan*"

DECCW have prepared a '*Cumberland Plain Recovery Plan*' (Jan 2011), including actions for the recovery of Cumberland Plain Woodland.

The plan advocates protection of 'priority conservation lands' which are identified in the plan. 4,171 hectares of Cumberland Plain Woodland have been identified as 'priority conservation lands'.

The subject site is not part of any area identified as 'priority conservation land', and would not be of particular value as a 'stepping stone' reserve between such areas.

The Airds Bradbury Renewal Project would not hinder implementation of the DECCW (2011) Cumberland Plain Recovery Plan.

No threat abatement plans are of specific relevance to the subject site.

(g) "*whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process*"

There are several key threatening processes which have previously occurred on the site, some of which are likely to be ongoing.

Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act.

The proposal would result in loss of approximately 1.21 hectares of Cumberland Plain Woodland.

Summary

In summary of the above seven parts:

(a) Cumberland Plain Woodland is not a "*threatened species*";

(b) Cumberland Plain Woodland is not an "*endangered population*";

(c) development in accordance with the Concept Plan would result in loss of the northeastern fringe of the main area of Cumberland Plain Woodland, and of two small isolated occurrences, and may affect the structure of retained areas of Cumberland Plain Woodland within the site;

(d) development in accordance with the Concept Plan would result in loss of approximately 1.21 hectares of habitat for Cumberland Plain Woodland, and may further fragment habitat for this community in the locality. The habitat to be affected is of some importance, but has not been identified as being of particular importance for the long term survival of Cumberland Plain Woodland in the locality;

(e) there is no declared "*critical habitat*" of relevance to the subject site. The Airds Bradbury Renewal Project would not affect any area of "*critical habitat*";

(f) DECCW have prepared a Cumberland Plain Recovery Plan (Jan 2011), including actions for the recovery of Cumberland Plain Woodland. The subject site is not part of any area identified as 'priority conservation land', and would not be of particular value as a 'stepping stone' reserve between such areas. The Airds Bradbury Renewal Project would not hinder implementation of the DECCW (2011) Cumberland Plain Recovery Plan. No threat abatement plans are of specific relevance to the subject site;

(g) 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. The proposal would result in loss of approximately 1.21 hectares of Cumberland Plain Woodland.

2.4 Shale Sandstone Transition Forest

(a) "*in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*"

Shale Sandstone Transition Forest is not a "*threatened species*".

(b) "*in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction*"

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

Shale Sandstone Transition Forest is not an "*endangered population*".

(c) "*in the case of a critically endangered or endangered ecological community, whether the action proposed:*

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction"

(i) extent

Development in accordance with the Concept Plan would result in loss of approximately 4.41 hectares of Shale Sandstone Transition Forest from the subject site.

Approximately 3.73 hectares of Shale Sandstone Transition Forest would be retained, predominantly along the Smiths Creek riparian corridor.

(ii) composition

Development in accordance with the Concept Plan would not directly affect the floristic composition of retained areas of Shale Sandstone Transition Forest, but may prevent recovery of the shrub layer, to meet safety requirements.

It is not expected that suppression of the understorey would place the local occurrence at further risk of extinction.

Conclusion

Development in accordance with the Concept Plan would result in loss of the majority of Shale Sandstone Transition Forest from the site, and may prevent recovery of the shrub layer in retained areas of this community. These actions may place the local occurrence at risk of extinction.

(d) "*in relation to the habitat of a threatened species, population or ecological community:*

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality"

(i) extent

The extent of habitat for Shale Sandstone Transition Forest is the area that still supports this community, *ie* approximately 8.14 hectares within the subject site.

Development in accordance with the Concept Plan would result in loss of approximately 4.41 hectares of Shale Sandstone Transition Forest.

(ii) fragmentation

Development in accordance with the Concept Plan would alter the current pattern of vegetation within the subject site, and would further fragment areas of habitat for Shale Sandstone Transition Forest to a minor extent.

(iii) importance

The habitat on the site for Shale Sandstone Transition Forest has been highly modified through previous clearing, earthworks and substantial weed invasions, and would have a low natural regeneration potential. The habitat present within the subject site has not been identified as being of particular importance for the long term viability of this community in the locality.
Conclusion

Development in accordance with the Concept Plan would result in loss of approximately 4.41 hectares of degraded habitat for Shale Sandstone Transition Forest, and would contribute to further fragmentation of this community. The habitat that would be affected has not been identified as being of particular importance for the long term viability of this community in the locality.

(e) "*whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)*"

The TSC Act 1995 defines "*critical habitat*" as "*habitat declared to be critical habitat under part 3*" of the Act.

There is no declared "*critical habitat*" of relevance to the subject site. The Airds Bradbury Renewal Project would not affect any area of "*critical habitat*".

(f) "*whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan*"

DECCW have prepared a '*Cumberland Plain Recovery Plan*' (Jan 2011), including actions for the recovery of Shale Sandstone Transition Forest.

The plan advocates protection of 'priority conservation lands' which are identified in the plan. 3,145 hectares of Shale Sandstone Transition Forest have been identified as 'priority conservation lands'.

The subject site is not part of any area identified as 'priority conservation land', and would not be of particular value as a 'stepping stone' reserve between such areas.

The Airds Bradbury Renewal Project would not hinder implementation of the DECCW (Jan 2011) Cumberland Plain Recovery Plan.

No threat abatement plans are of specific relevance to the subject site.

(g) "*whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process*"

There are several key threatening processes which have previously occurred on the site, some of which are likely to be ongoing.

Of relevance to the Airds Bradbury Renewal Project, 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act.

The proposal would result in loss of approximately 4.41 hectares of Shale Sandstone Transition Forest.

Summary

In summary of the above seven parts:

(a) Shale Sandstone Transition Forest is not a "*threatened species*";

(b) Shale Sandstone Transition Forest is not an "*endangered population*";

(c) development in accordance with the Concept Plan would result in loss of the majority of Shale Sandstone Transition Forest from the site, and may prevent recovery of the shrub layer in retained areas of this community. These actions may place the local occurrence at risk of extinction;

(d) development in accordance with the Concept Plan would result in loss of approximately 4.41 hectares of degraded habitat for Shale Sandstone Transition Forest, and would contribute to further fragmentation of this community. The habitat that would be affected has not been identified as being of particular importance for the long term viability of this community in the locality;

(e) there is no declared "*critical habitat*" of relevance to the subject site. The Airds Bradbury Renewal Project would not affect any area of "*critical habitat*";

(f) DECCW have prepared a Cumberland Plain Recovery Plan (Jan 2011), including actions for the recovery of Shale Sandstone Transition Forest. The subject site is not part of any area identified as 'priority conservation land', and would not be of particular value as a 'stepping stone' reserve between such areas. The Airds Bradbury Renewal Project would not hinder implementation of the DECCW (2011) Cumberland Plain Recovery Plan. No threat abatement plans are of specific relevance to the subject site;

(g) 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act. The proposal would result in loss of approximately 4.41 hectares of Shale Sandstone Transition Forest.

3 CONCLUSIONS

The seven factors which are required to be considered under Section 5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities*, *or their habitats*" are discussed above with regard to the Koala, four threatened microchiropteran bat species (Eastern False Pipistrelle, Eastern Freetail Bat, Yellow-bellied

Sheath-tail Bat and Greater Broad-nosed Bat) and two endangered ecological communities, Cumberland Plain Woodland and Shale Sandstone Transition Forest.

Based upon the considerations detailed above, development in accordance with the Concept Plan would not be likely to significantly affect any of the threatened fauna species.

Having regard to the critically endangered status of Cumberland Plain Woodland, and giving due consideration to the seven factors listed under s.5A of the EP&A Act, without consideration of compensatory works, the impact upon this community from development in accordance with the Concept Plan could be significant.

Similarly, due to the proportion of the local occurrence of Shale Sandstone Transition Forest that would be removed from the site, without consideration of compensatory works, the impact upon this community from development in accordance with the Concept Plan could be significant.

AIRDS BRADBURY RENEWAL PROJECT

ECOLOGICAL AND BUSHFIRE ASSESSMENT

APPENDIX 5

Project Team CV's

March 2011

REBECCA RUTH HAYES

CONTACT DETAILS

PO Box 2575, Bowral NSW 2576, AUSTRALIA

P: +61 2 4862 3488 F: +61 2 4862 3317
M: +61 412 600 173 E: rhayes@hayesenv.com.au

DATE OF BIRTH

21st June 1973

ACADEMIC QUALIFICATIONS

1996 Bachelor of Science, major in Environmental Biology - University of Technology, Sydney

2000 Master of Engineering Management - University of Technology, Sydney

PROFESSIONAL CONFERENCES and SHORT COURSES

2002 ECA NSW Conference (1 day) – 'Eight-part tests'

2003 Certificate Course in Alpine Ecology – La Trobe University, Victoria

2003 ECA NSW Conference (1 day) – 'Expert witness in the NSW Land & Environment Court'

2004 Workshop (3 days) – Ecological restoration for mountain environments: Approaches and techniques – Australian Network for Plant Conservation/Australian Alps National Parks

2004 ECA NSW Conference (1 day) – 'Survey Techniques: Towards industry standards for flora and fauna'

2005 EIANZ Conference (half day) – 'The good, the bad and the dodgy. Independence and professional ethics in environmental impact assessment in NSW'

2005 Seminar (1 day) – DEC accreditation and survey guidelines

2005 Seminar (half day) – Implementation of the new Native Vegetation Act

2005 EIANZ Seminar (half day) – 'Taking the impact out of environmental assessments'. Implications of the new Part 3A of the Environmental Planning & Assessment Act 1979

2006 ECA NSW Conference (1 day) – 'Wildlife Corridors: Their evaluation, restoration and protection'

2007 ECA NSW Conference (1 day) – 'Biobanking'

2008 EIANZ Course (2 days) – 'Professional Environmental Practice in the NSW Land & Environment Court'

2008 ECA NSW Conference (2 days) – 'Liabilities, assessments & expectations of the ecologist'

2008-9 Department of Primary Industries – 'Prograze' (12 days)

2008-9 Department of Primary Industries – 'Landscan' (12 days)

2009 ECA NSW Conference (1 day) – 'Ecology at the rural/urban interface'

2010 ECA NSW Conference (1 day) – 'Indirect Impacts of Development'

CURRENT MEMBERSHIPS

Full Member of the Environment Institute of Australia and New Zealand (EIANZ)

Full Member of the Ecological Consultants Association of NSW (ECA)

COMMITTEE POSITIONS

Elected member of the Ecological Consultants Association of NSW Council (2009-2011)

Member of the accreditation sub-commitee of the Ecological Consultants Association of NSW Council (2009-2011)

Member of the NSW National Parks & Wildlife Service South Coast Advisory Committee (2009, 2010, 2011)

PROFESSIONAL EMPLOYMENT HISTORY

Hayes Environmental

1998-2011 Principal

Hayes Environmental is an ecological consultancy which specialises in the assessment and management of impacts upon Australian native flora and fauna.

2001 Occasional Lecturer

Legal Issues - Protected Areas Management, component of a Masters course at the University of Western Sydney, Richmond.

Gunninah Environmental Consultants

1996-1999 Consultant

Project management, site inspections and field surveys, implementation of relevant environmental legislation (including the *NSW Threatened Species Conservation Act 1995*, *NSW Environmental Planning & Assessment Act 1979* and State Environmental Planning Policies - SEPPs), liaison with clients, preparation of proposals, research, compilation and interpretation of data, writing of reports.

Pacific Power

1994-1995 Technical Officer (part-time)

Several specific projects including the preparation of a Plan of Management for the Brown Mountain Power Station, south of Cooma, and the compilation of a database of environmentally significant features in the grid area for Transgrid Newcastle.

ENVIRONMENTAL VOLUNTEER WORK

1993-9 Leading of interpretive guided bushwalks, canoe trips, talks and nature activities with 'Chase Alive', a self-funding and organising program operating in Ku-ring-gai Chase National Park (and the North Metropolitan area generally) under the control of the NSW National Parks & Wildlife Service (7 years).

1992-9 Fostering and caring for injured or orphaned native wildlife with the Wildlife Information and Rescue Service Inc - WIRES (8 years).

1997 Field survey for the Regent Honeyeater in the Capertee Valley with the Regent Honeyeater Recovery Team and the Cumberland Bird Observers Club.

1997 Mapping of Pampas Grass in the Cowan Creek catchment for the Pampas Grass Eradication Project, organised by the Cowan Creek Catchment Management Committee.

MISCELLANEOUS

NSW Drivers License 1A

MSB Boat License

CURRICULUM VITAE

David Peterson

PRINCIPAL BUSHFIRE CONSULTANT

QUALIFICATIONS

- Fire Protection Association Australia BPAD Certified Practitioner (BPD-PA-18882)
- Graduate Diploma in Design for Bushfire Prone Areas from University of Western Sydney
- Research scholarship with University of Western Australia, Department of Geography
- Bachelor of Environmental Science (First Class Honours) from University of Wollongong

Responsible for leading and managing the Eco Logical Australia bushfire team, David is recognised as a specialist in bushfire protection planning and design and is a nationally certified practitioner. He has 12 years experience in managing environmental projects of a variety of backgrounds including 8 years dedicated to bushfire planning within both the public and private sectors. Formerly of Bushfire & Environmental Services (BES), David has specialised in providing bushfire consulting services at a senior capacity since 2003.

David has had experience managing bushfire planning projects across the eastern seaboard, with the majority of work occurring within the Sydney Basin and surrounding bioregions. Recent projects extend north to South East Queensland and south to the alpine resorts of NSW. Projects range from large master planning studies for new residential communities to smaller scale developments, and include aged care and eco-tourism. David is also experienced in landscape assessment and bushfire risk management relating to existing communities and land-uses, such as the preparation of Bushfire Management Plans for Defence estate, public reserves or mining leases, for example. David is also certified to prepare 'alternate solutions' for development applications and has experience as an expert witness in the NSW Land & Environmental Court.

David is an expert in bringing solutions to challenging projects where environmental, engineering or planning constraints need consideration amongst bushfire planning requirements.

PETER MONSTED

BSc (Resource and Environmental Management)

Peter is a senior environmental consultant with significant experience in the mining and resources sector as well as linear power and transportation infrastructure projects. His 10 years of ecological and environmental planning and management experience has been gained through positions with state government agencies and several national engineering and environmental consultancies.

Peter is currently fulfilling a senior environmental management role on the pipeline joint venture component of the Victorian desalination project. Prior to this, he provided environmental management services to Origin Energy in their gas field operations and has been involved with overseeing environmental compliance on gas well, pipeline and associated infrastructure in the Surat Basin . Other gas industry related work includes environmental/biodiversity assessments of the Sydney to Newcastle Gas Pipeline easement and the Munmorah Gas Pipeline Project.

Peter has a Bachelor of Science (Resource and Environmental Management) from Macquarie University , Sydney.

AIRDS BRADBURY RENEWAL PROJECT

ECOLOGICAL AND BUSHFIRE ASSESSMENT

APPENDIX 6

Previous ecology reports relevant to the study area

March 2011

AMBS CONSULTING

Flora and Fauna Assessment for the Airds Neighbourhood Renewal Masterplan Study

LFA (Pacific) Pty Ltd

Australian Museum Business Services
No. 1 Stanley Lane East Sydney, NSW 2010
Ph (02) 9320-6311, Fax (02) 9380-6964
URL: www.amonline.net.au/ambs
glenm@austmus.gov.au

August 2001

2000157

Project Team

Project Manager/Ecologist ..... Glenn Muir

Ecologist ..... Brendan Ryan

Ecologist ..... Cate Athey

Botanist ..... David Thomas

Technical Assistance ..... Melanie Zeppel

Scientific Review ..... Dr Walter Boles

Contents

Flora and Fauna Assessment for the Airds Neighbourhood Renewal Masterplan

1. Introduction

Australian Museum Business Services (AMBS Consulting) was commissioned by LFA (Pacific) Pty Ltd to carry out a Flora and Fauna Assessment in the suburb of Airds in south-western Sydney. The purpose of the Assessment is to provide baseline information and background material regarding flora and fauna for the Airds Neighbourhood Renewal Masterplan Study. The Masterplan Study will provide the information required for the rezoning and development of the area and will outline recommended urban design improvements. It is expected that the Masterplan Study will incorporate a range of possible concept plans which will include the release of land for new residential development.

1.1 Background

The Airds/Bradbury public housing estate currently faces a number of issues related to poor urban design, including high unemployment, lack of educational opportunities, poor health, poor services and high crime. The area is now considered to be significantly socially and economically disadvantaged. In order to address these issues, the Department of Housing has been implementing a Neighbourhood Improvement Program over the past 5 – 6 years involving the restructuring of housing in the estate. Work still required includes the restructuring of the Town Centre in order to improve services, to provide a centre for community activities and to provide new housing to accelerate the achievement of social mix in the estate. The aim of the Airds Neighborhood Renewal Masterplan Study is to outline the improvements required to make the Airds Town Centre viable, vibrant and functional.

1.2 Location

The suburb of Airds is located near Cambelltown and is approximately 45 km south-west of the Sydney CBD. Cambelltown Railway Station is located roughly 2.5 km to the north-west of Airds Town Centre. Lands to the north, south and west of Airds are primarily residential and include the adjoining suburbs of Ruse, St Helens Park and Bradbury respectively (Figure 1). Smiths Creek Reserve (currently managed by Sydney Water) is also located immediately to the north of Airds, between Ruse and Campbelltown. Lands to the east of Airds are largely undeveloped and include both areas which have been earmarked for the construction of the proposed Georges River Parkway and a number of conservation reserves associated with the western banks of the Georges River. Lands to the east of the Georges River are part of Holsworthy Military Reserve and contain substantial areas of remnant bushland.

The study area for this Flora and Fauna Assessment comprises various interconnecting lands located along the western and northern boundaries the Airds township and some developed lands within the town, the latter including reserves, playing fields and similar community facilities (Figure 2). The focus of this Assessment is on an easement of varying width located between the developed areas of Airds and Bradbury, bounded by Georges River Road to the north and Greengate Road to the south. The Assessment also includes sections of the road reserve south of Georges River Road.

The study area was divided into five distinct zones according to the major vegetation assemblages present and easily identifiable features such as location, orientation, and dividing structures such as roads. The vegetation in each zone was assessed and described separately. These zones were (Figure 3):

A. Georges River Road Reserve;

B. Northern Easement Zone (including Smiths Creek);

C. Central Easement Zone;

D. Southern Easement Zone; and

E. Developed Zones (including Airds High School, shopping centre and parts of the residential area).

1.3 Aims

The aims of this Flora and Fauna Assessment are to:

- identify and collate lists of flora and fauna species recorded at the study site;
- identify fauna species classified as vulnerable or endangered under the Threatened Species Conservation Act 1995 (TSC Act) and/or the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) which occur or have the potential to occur within the study site;
- identify and map existing fauna habitats and broad vegetation types on the site, including areas that are perceived to be 'degraded';
- assess the current value of bushland within the study site as habitat or wildlife corridors and provide management guidelines for future works that will maximise these values;
- assess the potential impacts of the proposed development on flora and fauna and recommend mitigation strategies;
- assess the potential for off-site impacts to occur from the development.

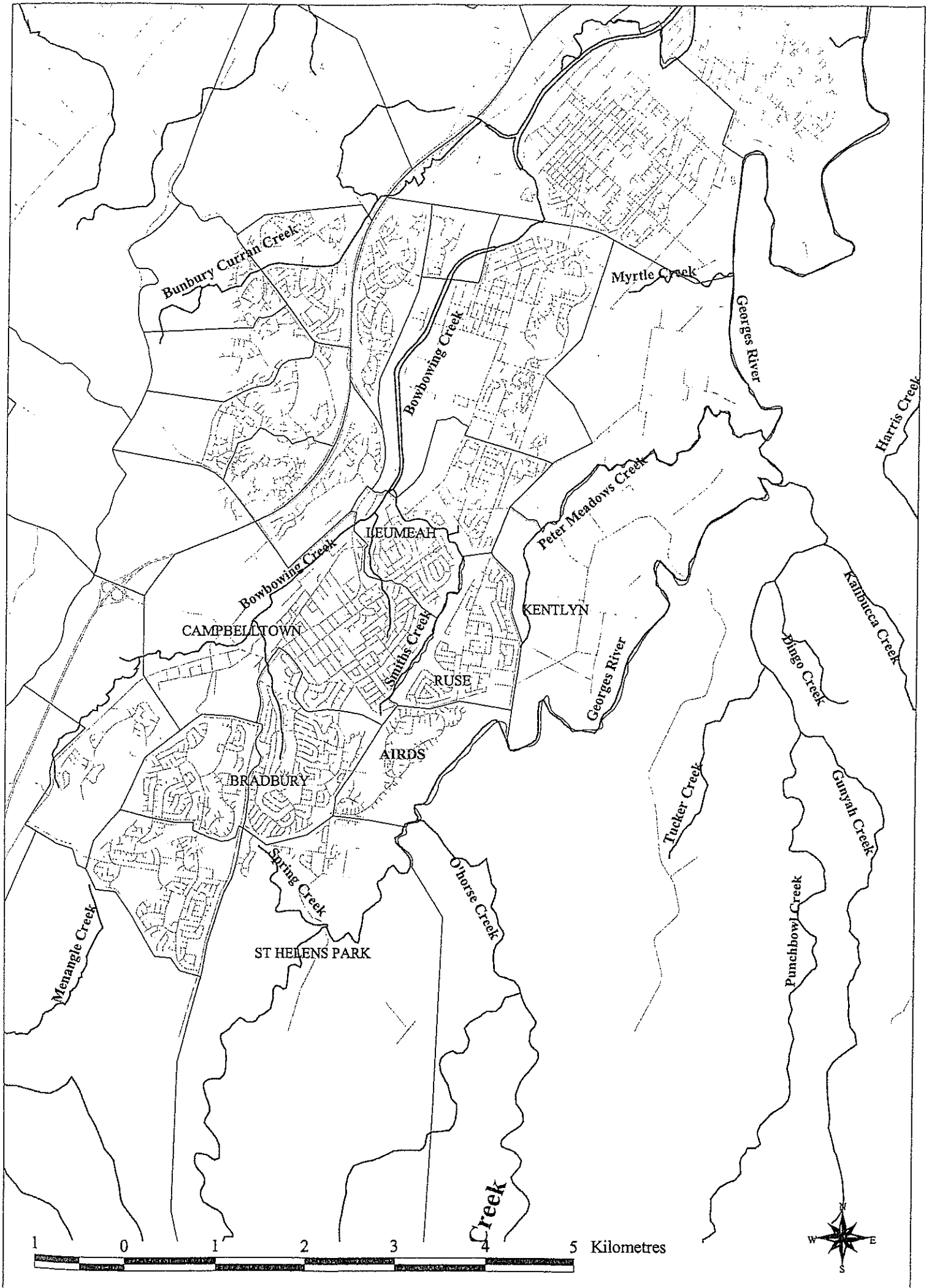

Figure 1: Location of Airds township

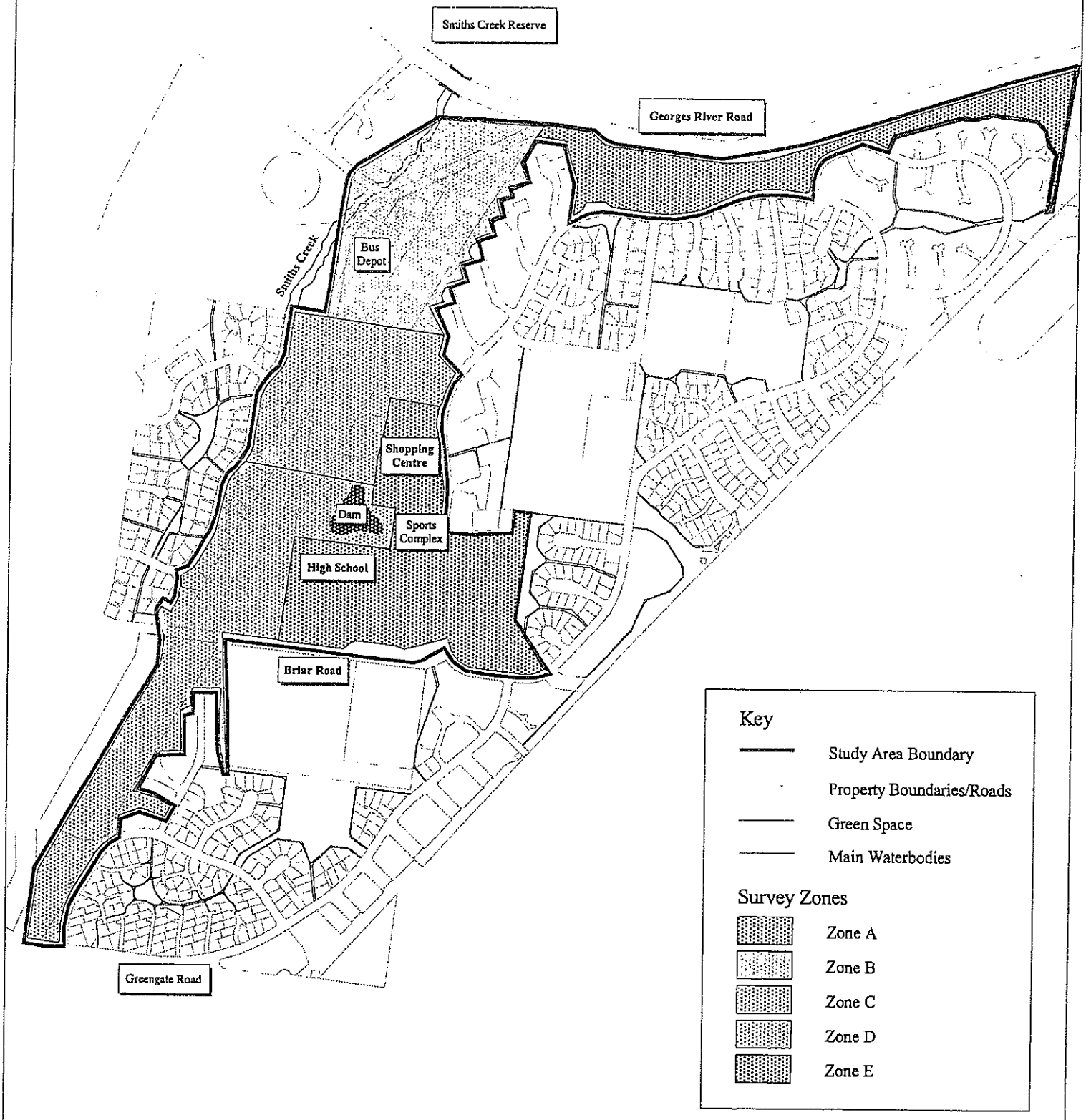

Figure 2: Study area and survey zones

2. Methods

2.1 Assessment of Existing Information

A review of literature and reference material regarding flora and fauna species and vegetation communities in the vicinity of the study area was carried out. National Parks and Wildlife Service (NPWS) vegetation maps of the area were examined to determine the vegetation assemblages occurring at or near the study site, in particular endangered ecological communities listed by the TSC Act and/or the EPBC Act. Database searches were conducted for records of flora and fauna species that have previously been recorded within 5 km of the perimeter of the study site, in particular species listed as threatened by the TSC Act and/or the EPBC Act (database records prior to the year 1900 were not considered). Campbelltown City Council, the NSW National Parks and Wildlife Service (NPWS), researchers working in the area and local wildlife care organisations were consulted regarding previous flora and fauna studies undertaken in the vicinity of Airds.

The following databases were searched:

- Australian Museum mammals (threatened species);
- Australian Museum birds (threatened species);
- Australian Museum reptiles and amphibians (threatened species)
- NPWS Atlas of Fauna (all fauna); and
- NPWS Atlas of Flora (threatened species).

Associate Professor Robert Close provided records of the Koala from the University of Western Sydney (Macarthur) Wildlife Database, and Stephanie Clark (Australian Museum/University of Western Sydney) provided information regarding endangered land snails in the area.

2.2 Flora Surveys

A flora survey of the study area was carried out on 20 July 2001. The main technique used was random meandering transects. Three additional 'zig-zag' transects were targeted in zones B, D and E in locations where indigenous plants were in greater abundance in comparison to other parts of the study area. Quadrat surveys were not undertaken in areas where the plant community was dominated by introduced species, which was the prevalent condition throughout much of the study area. Zone C contained a high concentration of native species in comparison to the remainder of the study area; surveys of this zone were more intensive and included a 20 x 20 m quadrat survey carried out in a location representative of the best condition of this bushland.

During both transect and quadrat surveys the dominant species in each stratum and all indigenous species detected were recorded. Searches for threatened flora species and other species considered to be of particular conservation significance were carried out concurrently. Vegetation communities were described in accordance with Specht (1970) on the basis of structure and the dominant species in each stratum. This was related to classifications used by the TSC Act, EPBC Act, NPWS (2000), Briggs & Leigh (1995) and James (1997) when considering the conservation significance of the plant community and the species present. Plant nomenclature accords with Harden (1990-93).

Special Environmental Planning Policy No. 19 (SEPP 19 – Bushland in Urban Areas) was used as the basis of determining whether the vegetation present was considered to be 'bushland'. This condition was

considered to be a practical prerequisite to the potential classification of any vegetation community as an endangered ecological community listed by the TSC Act or the EPBC Act.

SEPP 19 states that to be classified as bushland the vegetation should contain all of the following three attributes:

a) indigenous species comprising the canopy;

b) the understorey stratum and/or ground cover stratum comprising at least a component of "native species sufficient to re-establish those strata should the disturbance be arrested or reversed by management"; and

c) the structure is recognisably natural or is regrowth which has achieved a near natural structure or a seral stage towards that structure.

Weed species detected were classified in accordance with the Campbelltown Local Government Area Noxious Weed List. This list places noxious weeds into one of four major categories (W1 – W4). The relevant categories are described further in Section 6 of this document.

2.3 Fauna Surveys

Fauna surveys were carried out between 16 and 25 July 2001. A preliminary survey was undertaken throughout the study area on 16 July in order to assess the broad habitat types present and to target further surveys for specific fauna groups. On the basis of the preliminary survey the study area was divided into five zones consistent with those described in Section 1.2 above. More intensive fauna surveys were carried out on 19 July (nocturnal), 20 July (diurnal), 23 July (dusk and nocturnal) and 25 July (diurnal, dusk and nocturnal) and are detailed further below. Weather conditions during the surveys were cold but fine and sunny between 16 and 20 July, overcast on 23 July and with some rainfall occurring on 25 July.

Habitat Assessment

A survey of the type and condition of fauna habitats present within the study area was carried out diurnally on 20 July 2001. All sections of the study area were traversed along random transects. Fauna habitat features such as vegetation structure, drainage lines, tree hollows, fallen logs, rock outcrops, and leaf litter were assessed. Any evidence of fauna activity, including scats, tracks, nests or dens, bones or other remains and scratchings or diggings was noted.

Invertebrates

Searches for the endangered land snail *Meridolum corneovirens* were carried out diurnally on 20 and 25 July 2001. These involved turning surface material such as fallen logs and branches and hand searches through leaf litter and bark near the base of trees. Searches on 20 July were carried out in all sections of the study area with a particular focus on remnant bushland sites which were likely to represent the best potential habitat for this species. Searches on 25 July were targeted in zone B in remnant bushland adjacent to Smiths Creek.

Amphibians

Surveys for frogs were targeted at habitats suitable for this taxonomic group. Survey techniques included:

- listening for calling males, carried out diurnally and/or nocturnally at a dam located in zone D to the west of the shopping centre (Figure 2), small drainage lines in grassland near the dam, and Smiths Creek (all survey dates);
- turning over surface material and hand searches of substrates around the dam and Smiths Creek (20 and 25 July); and
- nocturnal (spotlight) searches of the dam (19, 23 and 25 July) and Smiths Creek (25 July).

Frogs were also opportunistically recorded if heard calling within or near the study area at any time during all survey periods. Species nomenclature accords with Cogger (2000).

Reptiles

Searches for reptiles were carried out diurnally on 20 and 25 July 2001, involving the turning of surface material such as loose rocks, fallen logs and branches, building materials, car parts and other rubbish, and hand searches through leaf litter and bark near the base of trees. Nocturnal (spotlight) surveys for arboreal reptiles (such as geckos) were carried out in areas of remnant bushland on 19, 23 and 23 July 2001. Species nomenclature accords with Cogger (2000).

Birds

Targeted surveys for birds were carried out diurnally at the dam on 16 July 2001, throughout all sections of the study area on 20 July 2001, at dusk at the dam and in bushland in zone C on 23 July 2001 and at dusk in bushland in zone B on 25 July 2001. Surveys involved slowly walked transects (approx. 2 km/hr) with randomly spaced stops. Birds detected within the study area or flying overhead were identified visually with the aid of binoculars and/or by call identification. Birds were also opportunistically recorded if detected within or near the study area at any time during all survey periods.

Nocturnal birds were surveyed by spotlighting and call identification on 19, 23 and 25 July 2001. The proximity of local residences made the use of call playback difficult; consequently, this technique was not employed.

Bird species nomenclature accords with Pizzey and Knight (1999).

Mammals

Arboreal mammals were surveyed by spotlighting in the remnant bushland areas of the study site on 19, 23 and 25 July, and at the southern end of the nearby Smiths Creek Reserve on 25 July. Searches for Koalas were also carried out diurnally in conjunction with the bird surveys described above, and searches for Koala scats and tree scratchings were carried out opportunistically in conjunction with the reptile searches described above. Ground-dwelling mammals were surveyed opportunistically during the diurnal and spotlighting surveys, particularly along Smiths Creek and near the dam. Any signs of mammal activity such as scats, diggings and tree incisions that could be confidently identified were noted. Species nomenclature accords with Strahan (1995).

Microbats were surveyed by recording ultrasonic calls using the Anabat II call detection system. The detector was hand-held during random transects through and around the edges of remnant bushland areas of the site on 19 July and 23 July, at dusk on 23 July around the dam and at dusk on 25 July along Smiths Creek. Species nomenclature accords with Churchill (1998), except for currently undescribed species of the genus *Mormopterus* which accord with Parnaby (1992).

3. Results

3.1 Site Description

The study area is generally located in gently undulating terrain of low relief. Most of the area slopes in a westerly direction towards the eastern edge of the easement. The eastern edge of the easement slopes towards the north-east and contains small drainages, which coalesce with stormwater channels towards the northern end of the site to form Smiths Creek. Some small tributary channels running roughly east-west occur in the northern and central zones of the easement. A large dam is located on the western edge of the easement immediately north of the High School and east of the Hotel.

The study area lies near the boundary between the Wianamatta Shales of the Cumberland Plain and the Hawkesbury Sandstone of the coastal areas east of the Georges River. Across the study area this is evidenced by patches of shale derived clays, soils with a high content of sand, and some exposures of sandstone bedrock. Sandstone is found outcropping along Smiths Creek and there are several sandstone boulders found scattered throughout the northern half of the study area. Most of these appear to lie in a secondary position and were probably moved as a result of historic land clearance or land use.

The majority of the study area has been disturbed by either major earth movement or minor earthworks and subsequent erosion. Across the majority of the study area, it appears that most of the original topsoil has been lost, except in zone C. Many areas of exposure contain a heavy cover of ironstone gravel, indicative of surface erosion of topsoil, and/or predominantly consist of skeletal sandy soils overlying weathered red/brown clay.

3.2 Literature and Database

Vegetation assemblages in the vicinity of the study area west of the Georges River were mapped by NPWS (2000). However, the location (and, in the case of the study area, the composition) of many of the vegetation communities indicated on these maps are not consistent with the results of the field survey carried out for this assessment. In particular, many of the areas mapped by NPWS (2000) as woodland were covered by residential development at the time of the survey. It is assumed that the maps were based upon data which are no longer valid for the study area.

Notwithstanding the above, the NPWS (2000) maps were consistent with the vegetation that would have once been expected to occur in the region on the basis of the underlying geology. The maps indicated that vegetation communites to the west of the study area were largely Cumberland Plain Woodland with scattered small areas of Shale Plains Woodland, while east of the study area was primarily Shale/Sandstone Transition Forest (High sandstone influence). The study area itself was mapped as a mosaic of urban areas, Cumberland Plain Woodland, Shale/Sandstone Transition Forest (High sandstone influence) and Shale/Sandstone Transition Forest (Low sandstone influence). All of these vegetation assemblages are currently listed as endangered ecological communities on the TSC Act and the EPBC Act.

Database search results indicated that four plant species listed as threatened on the TSC Act have previously been recorded within a 5 km radius of the perimeter of the study area (Figure 4): *Acacia rivalis*, *Melaleuca deanei*, *Persoonia hirsuta* ssp. *hirsuta* and *Pterostylis saxicola*.

Database search results indicated that 12 fauna species listed as threatened by the TSC Act have previously been recorded within a 5 km radius of the perimeter of the study area, two of which are also listed by the EPBC Act (Table 1, Figure 3). Ten of these species were considered to have some potential to occur within the study area. The other two species, the Giant Burrowing Frog (*Heleioporus australiacus*) and Red-crowned Toadlet (*Pseudophryne australis*) occur almost exclusively in sandstone

areas within the Sydney Basin (eg Moore 1961) and are not found on the Cumberland Plain (Recsei 1997; Thumm and Mahony 1997). The recorded locations for these frog species within 5 km of the study area were all within the rugged sandstone country east of the Georges River. Since both species are ground-dwelling, habitat specialists and the study area is separated from their habitat by a band of urban development, these frog species were considered likely to occur within the study area only rarely, if at all.

Table 1: Threatened fauna species recorded within 5 km of the study site

Species	Common Name	Source*	TSC Act Classification		EPBC Act Classification	
			E	V	E	V
Invertebrates						
Meridolum corneovirens	a land snail	2, 3	Y			
Frogs						
Heleioporus australiacus	Giant Burrowing Frog	1, 2		Y		Y
Pseudophryne australis	Red-crowned Toadlet	1,2		Y		
Birds						
Ninox strenua	Powerful Owl	2		Y		
Mammals						
Pteropus poliocephalus	Grey-headed Flying-fox			Y		
Chalinolobus dwyeri	Large-eared Pied Bat			Y		
Falsistrellus tasmaniensis	Eastern False Pipistrelle			Y		
Myotis adversus	Large-footed Myotis	1, 2		Y		
Scoteanax rueppellii	Greater Broad-nosed Bat	2		Y		
Dasyurus maculatus	Spotted-tailed Quoll	2		Y		Y
Phascolarctos cinereus	Koala	2, 4		Y		
Petaurus norfolcensis	Squirrel Glider	2		Y		

* Source: 1 = Australian Museum database

2 = NPWS database

3 = Stephanie Clark (pers. comm.)

4 = University of Western Sydney database

E denotes endangered

V denotes vulnerable

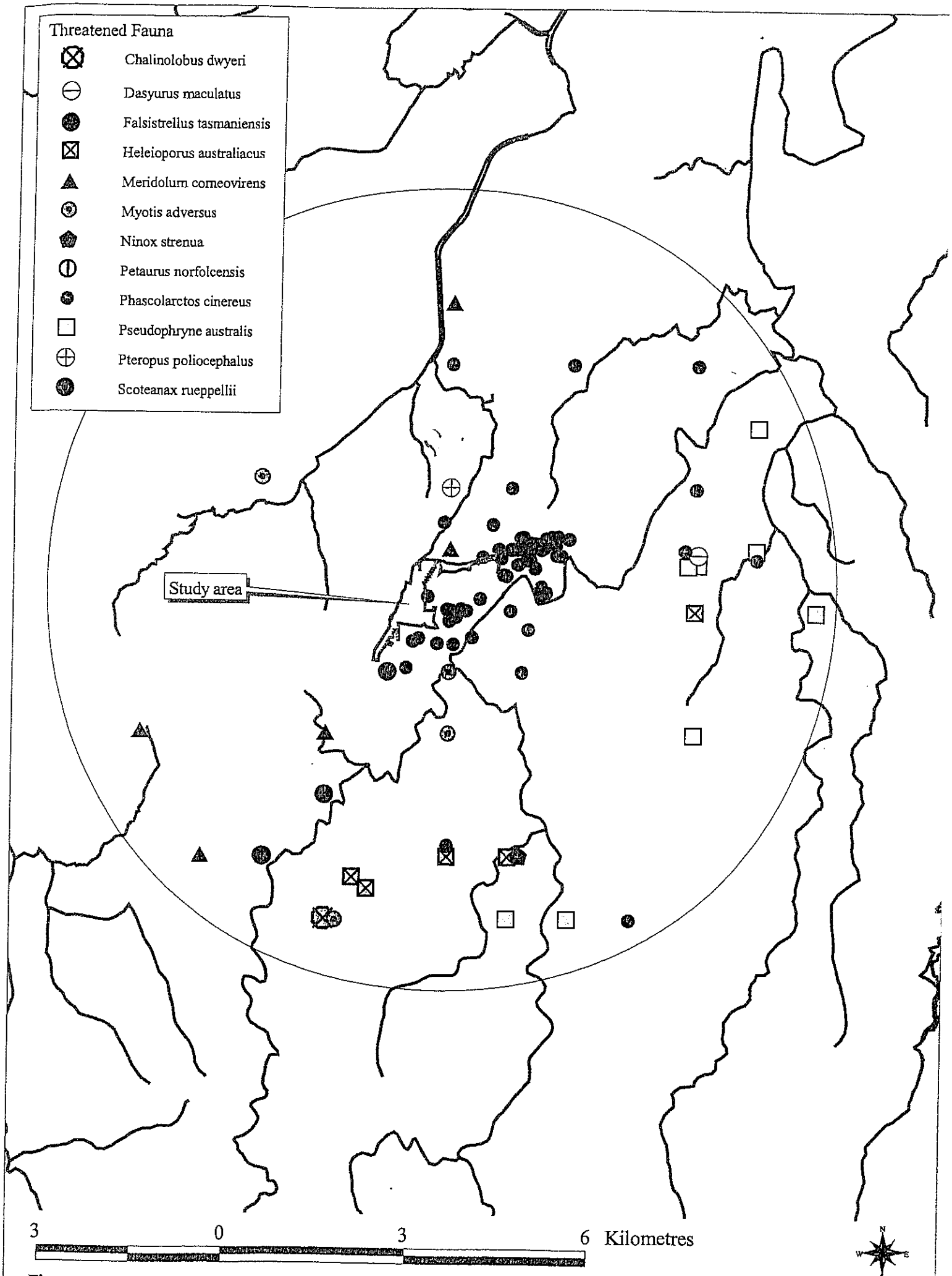

Figure 3: Location of threatened fauna species records within a 5km radius of the study site

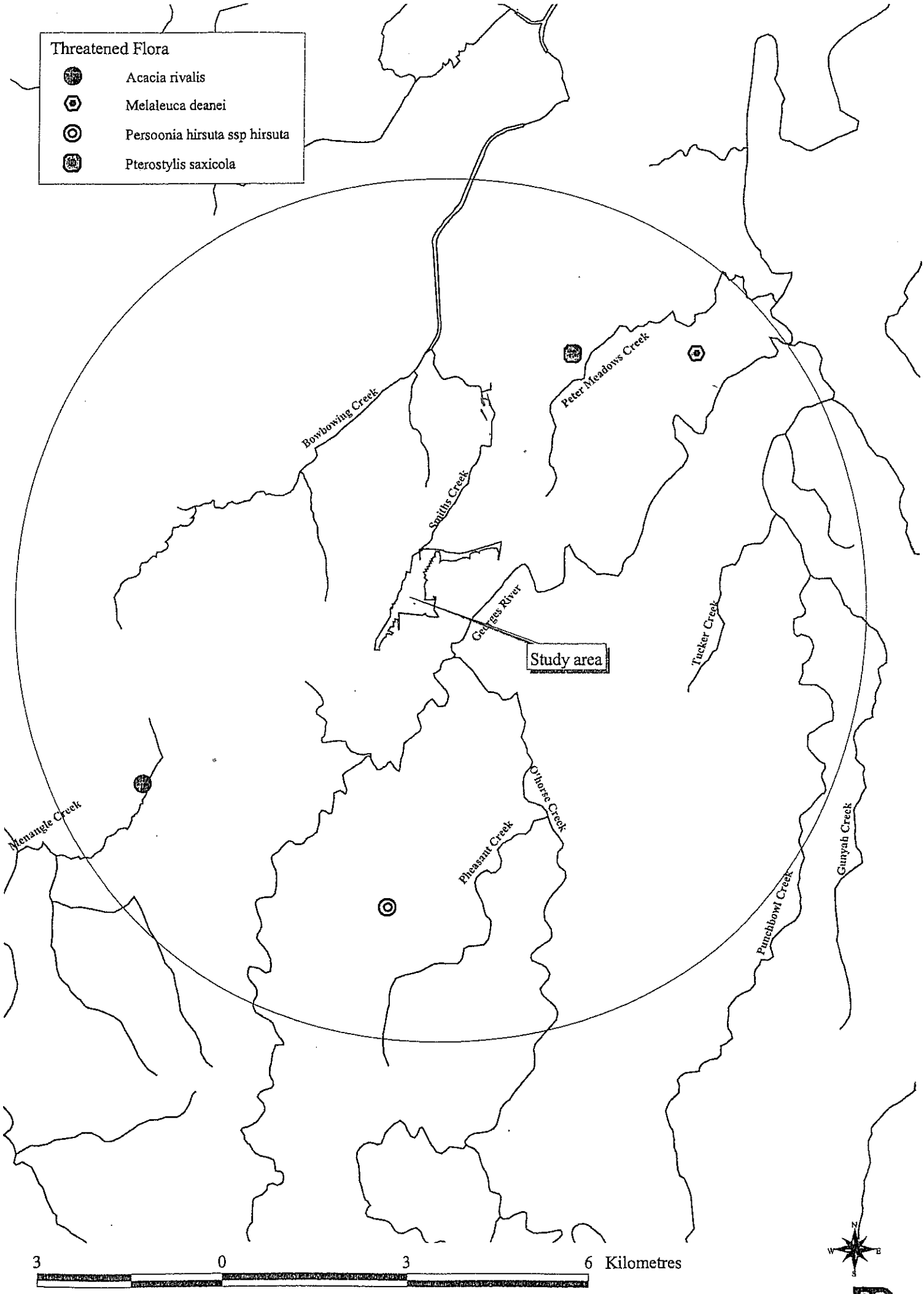

Figure 4: Location of threatened flora records within a 5 km radius of the study site

Campbelltown City Council (Environment Branch and Library) were aware of one previous flora and fauna assessment conducted in the area, involving a survey of the Georges River catchment by the NPWS which included two sites at Dalkeith Place, approximately 500 m south-east of the study area. Results from this study were included on the NPWS Fauna Atlas and have therefore been included in the database search results.

The Wildlife Information and Rescue Service (WIRES) had records of 23 native fauna species (15 bird, 3 mammal and 5 reptile species) collected from Airds or Bradbury. All of these species are considered to be relatively common and widespread. Most of the species collected by WIRES are typical of the fauna regularly found in suburban parks and gardens, however, two (the Short-beaked Echidna *Tachyglossus aculeatus* and an unspecified wallaby) appear to have become uncommon in many urban areas.

Data provided by Associate Professor Robert Close from research on the Koala (*Phascolarctos cinereus*) indicated that this species has been detected on numerous occasions close to the study area, although records from the study area itself are few (Figure 3). Stephanie Clark advised that she had detected the endangered land snail *Meridolum corneovirens* in the Airds/Bradbury area.

3.3 Flora Survey and Fauna Habitat Descriptions

Zone A: Georges River Road Reserve

Zone A comprised lands forming the southern road reserve along Georges River Road, between College Road and Canally Reserve, and included areas of public open space of varying widths. This zone had been heavily disturbed in the past and contained few natural features at the time of the survey. The vegetation was mainly mown introduced grass with scattered strips and 'islands' of planted trees, some with natural regrowth at the base. Parts of this zone were subject to ongoing disturbance from vehicular traffic between residences and Georges River Road.

Pennisetum clandestinum (Kikuyu) was the main grass, with lesser amounts of *Cynodon dactylon* (Couch Grass), *Paspalum dilatatum* (Paspalum) and other typical lawn weeds. Small numbers of a few native ground covers were present near Canally Reserve (*Bothriochloa* sp., *Danthonia* sp. and *Dichondra repens*).

The planted trees were mainly Australian species, including numerous species of eucalypts introduced to the area such as *Eucalyptus scoparia* (Wallangarra Gum), *Corymbia maculata* (Spotted Gum), *Eucalyptus saligna* (Sydney Blue Gum) and *Casuarina glauca* (Swamp Oak). *Eucalyptus punctata* (Grey Gum) and *Eucalyptus tereticornis* (Forest Red Gum) were planted but were likely to have previously occurred in the locality.

The scattered canopy trees that had been retained from the original plant community indicated that this zone was once Shale/Sandstone Transition Forest (NPWS 2000). Trees present included three *Angophora* species, four *Eucalyptus* species, one *Acacia* species and *Syncarpia glomulifera* (Table 2).

Habitat features suitable for most species of native fauna were scarce within this zone. No species of frog or reptile were detected during the surveys, although it appeared likely that some common reptile species such as Garden Skinks (*Lampropholis delicata*) still occur in the more deeply vegetated 'islands'. The zone was considered likely to be utilised mostly by some bat species (for foraging) and a number of bird species that are common to urban parks and that are not reliant on a dense understorey, such as the Pied Currawong (*Strepera graculina*). Seven such bird species were detected during the surveys.

Table 2: Locally indigenous tree species recorded in the Georges River Road Reserve

SCIENTIFIC NAME	COMMON NAME
Acacia decurrens	Green Wattle
Angophora bakeri	Narrow-leaved Apple
Angophora costata	Smooth-barked Apple
Angophora floribunda	Rough-barked Apple
Eucalyptus crebra	Narrow-leaved Ironbark
Eucalyptus fibrosa	Broad-leaved Ironbark
Eucalyptus globoidea	White Stringybark
Eucalyptus punctata	Grey Gum

Zone B: Northern Easement Zone

This zone extended along the easement from Georges River Road to the southern end of the bus depot and comprises a mosaic of developed land, abandoned pasture and regenerating bushland. Smiths Creek is located at the eastern edge of this zone and aged remnant trees occur to either side of the creek. The electrical sub-station and bus depot occur approximately in the centre of the zone. The western edge is public open space and is similar to zone A, being mainly introduced lawn with scattered planted shrubs and trees.

The Smiths Creek riparian zone contained a mixture of native and introduced vegetation. Introduced species dominated most of this section, however, indigenous species were common in the northern (downstream) part of the creek. These species (Appendix 1) and the occurrence of sandstone bedrock in the creek indicated that the original plant community was Shale/Sandstone Transition Forest. Numerous weed species formed a significant part of the vegetation in this zone. Of special concern was the occurrence of *Ludwigia peruviana*, a wetland margin species that appears to be spreading throughout the metropolitan area in recent years. This species was also recorded around the dam near the shopping centre. This weed has been declared to be noxious (W2 category) in the Campbelltown local government area.

At the time of the survey most of the Smiths Creek riparian zone was not considered to be bushland, owing to a localised lack of indigenous canopy and understorey and, due to a high likelihood of ongoing weed infestation, the improbability of natural regeneration to a bushland state in the future.

Although degraded and heavily weed infested, Smiths Creek and its riparian zone contained fauna habitat features that were not observed elsewhere within the study area. In particular, this zone contained sandstone outcrops that may be suitable for reptile species such as the Eastern Water Skink (*Eulamprus quoyii*), and (probably due to the prevalence of invasive weeds) a more dense understorey than other parts of the study site. The small bird species Spotted Pardalote (*Pardalotus punctatus*) and Buff-rumped Thornbill (*Acanthiza reguloides*) were detected only in this undergrowth area during the surveys. Despite the lack of natural ability for bushland to be restored, it would be possible to re-establish a simplified (albeit high maintenance) bushland in this area if this was required as a part of a flora and fauna corridor.

Other weeds recorded in this section included:

W2 species

Cortaderia selloana (Pampas Grass), *Lantana camara* (Lantana), *Rubus fruticosus* (Blackberry)

W3 and W4 species

Cardiospermum grandiflorum (Balloon Vine), *Cestrum parqui* (Green Cestrum), *Ligustrum lucidum* (Large-leaved Privet), *Ligustrum sinense* (Small-leaved Privet), *Myrsiphyllum asparagoides* (Bridal Veil Creeper), *Salix babylonica* (Weeping Willow).

Regrowth bushland occurred as discontinuous bands to either side of the bus depot and above the Smiths Creek riparian zone. This comprised a variable canopy of *Eucalyptus punctata*, *Eucalyptus tereticornis* and understorey mainly of *Microlaena stipoides* and *Themeda australis* (Kangaroo Grass). Shrubs were generally limited to a few *Bursaria spinosa* (Blackthorn) and localised *Pultenaea villosa*, *Indigofera australis* and *Dodonaea viscosa* ssp. *cuneata* (Appendix 1). The indigenous species diversity of this section was relatively low in most locations inspected.

The plant community in this section was modified Shale/Sandstone Transition Forest (NPWS 2000). The modification has been largely caused by previous use of the land for grazing. Continuing impacts on the bushland were observed, including pedestrian paths, rubbish dumping and frequent burning.

Zone C: Central Easement Zone

Zone C extends from the southern end of the bus depot to just north of the dam. This zone contains deeper clay soils than zone B and contains scattered old remnant trees and younger bushland regrowth. The bushland is partially disturbed by pedestrian and vehicular paths, rubbish dumping and frequent burning.

The vegetation community comprised regrowth of Cumberland Plain Woodland which covered most of this zone. Typical species included *Eucalyptus moluccana* (Grey Box), *Eucalyptus tereticornis* and two ironbark species (Appendix 1 Quadrat 1). The variable shrub stratum mainly contained *Bursaria spinosa*, and the ground cover was predominantly *Themeda australis*. Despite the presence of weeds in many locations (see below), much of the bushland was considered to be viable and in the process of developing a more widespread shrub stratum.

Weeds were common in the bushland, as individuals and localised islands. Most of the margins of the bushland were dominated by introduced species, some of which had been established to prevent soil erosion adjacent to development areas (eg. *Chloris gayana* [Rhodes Grass], *Pennisetum clandestinum* [Kikuyu], and *Cynodon dactylon* [Couch Grass]). Rhodes Grass and Kikuyu are incompatible with bushland owing to their highly invasive natures.

Noxius weed species that were recorded in this section were:

W2 species

Lycium ferrosissimum (African Boxthorn), *Rubus fruticosus* (Blackberry).

W4 species

Ligustrum spp.(Privets), *Myrsiphyllum asparagoides* (Bridal Veil Creeper).

A number of fauna habitat features were more prevalent in this section than in other parts of the study area. In particular, most of this section contained a relatively continuous canopy cover and a regenerating

(although sparse) understorey occurred in patches throughout. While most of the trees present were relatively young, the zone contained a number of aged remnant trees with well-developed hollows scattered throughout. Ground-based fauna refuges were, however, scarce, probably as a result of frequent burning and possibly firewood collection.

Although this zone contained bushland in better condition than most other parts of the study area, the diversity of fauna recorded during the surveys was relatively low. A number of common woodland birds were detected, however, other taxonomic groups were represented solely by two relatively common species of skink. While this result may be partially due to the limitations of the survey, it appears likely that the proximity of nearby residences and shops and ongoing anthropogenic disturbances have reduced the species diversity of the zone. These disturbances are likely to include the creation and use of pathways by vehicles, bikes, pedestrians and dogs, pollution from rubbish dumping and the elimination of ground cover and understorey through burning.

Zone D: Southern Easement Zone

This zone comprised the remainder of the easement area extending from the southern end of the bushland area of zone C. The zone has been extensively cleared in the past and at the time of the survey contained grassland with scattered trees. An isolated patch (c. 10 x 30 m) of degraded bushland occurred near the southern boundary. A large (c. 200 x 80 m) dam was located in the north-western corner of this zone. There was evidence of major past disturbance in several areas in the form of a spoil heap located near the dam and constructed drains and channels, and continuing disturbance in the form of mowing, pedestrian movement, rubbish dumping and burning. North of Briar Road this zone contained thick grassland.

The grassland was a mosaic of native and introduced species, particularly the native species *Sporobolus creber* (Slender Rat's Tail Grass), *Eragrostis leptostachya*, *Themeda australis* (Kangaroo Grass), *Bothriochloa* sp. (Red Leg Grass) and *Microlaena stipoides* (Meadow Weeping-grass), and the introduced *Pennisetum clandestinum* (Kikuyu), *Setaria gracilis* (Slender Pigeon Grass) and *Paspalum dilatatum* (Paspalum). Naturally occurring trees were similar to those occuring in other parts of the study area and included most of the species recorded from Zone C. Shrubs were absent except for a few individuals.

Apart from a few small isolated areas, the species diversity of this zone was low and was not considered to be representative of bushland.

The dam was located to the west of the Hotel and appears to be a former sediment basin. It collects runoff from the developed area immediately to the east including the Hotel carpark. The dam is relatively degraded and contains a considerable amount of rubbish near the edges; consequently, for safety reasons it was not possible to accurately determine its depth. Depth was inferred to be between 0 and 1.5 m near the edges on the basis of the presence of macrophytic vegetation, which occurred in stands between 2 m and 20 m wide around most of the circumference. Most of the area in the centre of the dam was open water and depth was inferred to be greater than 1.5 m. One species of native eel (*Anguilla* sp.) was detected and the dam also contained a dense population of the introduced Plague Minnow (*Gambusia holbrooki*). Predation by the latter has recently been listed as a threatening process on the TSC Act, on the basis of its impact on native frog and fish populations.

The vegetation around the dam was similar to that described above for this zone with the addition of *Foeniculum vulgare* (Fennel) and *Andropogon virginicus* (Whisky Grass). A significant weed species, *Ludwigia peruviana*, occurred in a small drainage line adjacent to the dam. Vegetation in and adjacent to the water comprised a mixture of indigenous and introduced wetland species: (indigenous) *Elaeocharis sphacelata*, *Typha orientalis* (Cumbungi), *Juncus usitatus* and (introduced) *Myriophyllum* sp., *Salix babylonica* (Weeping Willow) and a large population of *Ludwigia peruviana*.

Fauna habitats in this zone were extremely scarce except in the area north of Briar Road where a number of grassland species may occur. Despite its degraded nature the dam and surrounding drainage lines are likely to represent habitat for species such as the Long-necked Tortoise (*Chelodina longicollis*), some frogs and waterbirds, including (but not limited to) those detected during this survey. The dam also represents potential habitat for the endangered Green and Golden Bell Frog (*Litoria aurea*). Although not previously reported from the vicinity of the study area, there are recent (post-1990) records of this species from Hammondville, Holsworthy, Liverpool and Milperra (White and Pyke 1996). It was not possible to assess with confidence the presence or otherwise of this species at Airds during the current survey as the frog is not active at this time of year.

Noxious plants in this section included *Ludwigia peruviana* (W2) and *Salix babylonica* (W4).

Zone E: Developed Zones

This zone included Airds High School, Airds shopping centre and a residential area east of these. All comprised built environment with landscaped areas of introduced lawn with gardens and trees.

Some of the trees were remnants or regrowth from the original plant community that have been preserved as a component of the surrounding development. They included *Eucalyptus crebra*, *Eucalyptus tereticornis*, *Eucalyptus moluccana*, *Eucalyptus paniculata* (Grey Ironbark) and *Melaleuca decora*, and ranged in height from approximately 10-25 m. The *Melaleuca decora* was the only one recorded in the study area, although it was expected that it would have occurred more widely in the original natural plant community on clay soil. The original plant community would have been Cumberland Plain Woodland, however no bushland now remains in this zone.

3.4 Fauna

Invertebrates

Due to the lack of ground cover and tree dropped material, habitat for the endangered land snail *Meridolum corneovirens* is considered to be relatively scarce at the study site. No evidence of the species was found on or adjacent to the study site. The only molluscs detected during the surveys were introduced species. However, there are recent records of *Meridolum corneovirens* near the study site boundary. It is therefore considered possible that the species occurs in areas of remnant bushland at the study site, but has a limited distribution and is likely to be adversely impacted by the current fire frequency and consequent lack of leaf litter.

Frogs

The study area contains a variety of frog habitats including Smiths Creek, the large dam, bogs and soaks in the grassland area near the dam and some of the small drainage lines. While the diversity of species recorded during the surveys was low, with only two species recorded (Common Eastern Froglet *Crinia signifera* and Verreaux's Tree Frog *Litoria verreauxii*), this is more likely to be a reflection of the time of year the surveys were carried out than of a true lack of species diversity. Most summer-breeding frog species in the Sydney region are difficult to detect in winter.

No frog species listed as threatened on the TSC Act and/or EPBC Act were detected during the surveys, however, the dam is considered to be potential habitat for one such species, the Green and Golden Bell Frog (*Litoria aurea*), which is listed as endangered on the TSC Act and Vulnerable on the EPBC Act. Accordingly, further targeted surveys in appropriate conditions in spring/summer are recommended for this species.

Reptiles

With the exception of the Smiths Creek riparian zone, habitat for reptiles is limited within the study area. It is not likely that any threatened reptile species occur there. Only three species of skink (*Ctenotus* sp., *Lampropholis delicata* and *Lampropholis guichenoti*) were recorded during the survey. This low species diversity is, however, likely to result in part from the time of year the surveys were carried out; reptile activity is relatively low during the winter months and many species are difficult to detect.

Birds

Habitat for many bird species at the study site is limited. Apart from the dam the site currently contains no suitable habitat for wading birds, and apart from the Smiths Creek riparian zone it contains little habitat for species that require a dense canopy, understorey or ground cover. There are few potential roosting sites for any species. Forty-five (38 native, 7 introduced) species of bird were identified on or adjacent to the study site (Appendix B).

It is likely that the study site forms part of the foraging range of a number of raptor species, potentially including the threatened Square-tailed Kite (*Lophoictinia isura*) and Powerful Owl (*Ninox strenua*), the latter of which has previously been recorded in the area. However, due to the lack of understorey and ground cover, prey density is likely to be relatively low for these and similar species throughout most of the study area. Further, there are large areas of potential foraging habitat nearby (Holwsworthy) that are likely to support greater numbers of prey species. No raptor species or nests were observed during the surveys and it is assumed on this basis that no raptor species are currently nesting within the study area. It is therefore considered to be unlikely that the study site represents a significant area of habitat for the Square-tailed Kite, the Powerful Owl or other raptor species.

The eucalypts at the study site may provide feed trees for vagrant or dispersing individuals of species such as the Painted Honeyeater *Grantiella picta* and Regent Honeyeater *Xanthomyza phrygia*, and migratory species such as the Swift Parrot *Lathamus discolor*. The Swift Parrot has previously been reported from the vicinity of the study area.

Mammals

Habitat for arboreal and small ground-dwelling mammal species is scarce within the study area, with virtually no ground-based refuge or shelter and only a few widely spaced mature hollow-bearing trees. Apart from bats (see below) and companion animals (dogs and cats) the only mammal species detected during the surveys was the Sugar Glider (*Petaurus breviceps*) which occurred at the northern end of Smiths Creek. Local residents backing onto the bushland did not report ever seeing Brushtail Possums or similar fauna, although it is considered probable that these occur in the area.

Koalas in the area are the subject of a University of Western Sydney research project and have been reported from within or nearby the study site on numerous occasions. However, the species was not detected during the current survey and this initial assessment suggests that there are no resident animals. The study site is likely, at present, to represent a dispersal corridor for animals moving from and to the Georges River area and a known colony at Kentlyn to the north of the Airds. The study site does support Koala feed tree species such as *Eucalyptus tereticornis* and *E. punctata*. Therefore the potential of the study site, particularly in zones B and C, to support Koalas could be enhanced by the retention or restoration of vegetation and the management of threats such as introduced predators.

There are few potential roost sites for microbats at the study site, and it is likely that most or all of the microbats recorded on site roost nearby. A number of microbats were recorded foraging at the study site with most activity occurring adjacent to the large dam and street lighting adjacent to and within zone C.

Anabat tape analysis identified the following species: definite identifications of Gould's Wattled Bat *Chalinolobus gouldii*; and probable identifications of the Large Bent-wing Bat *Miniopterus schreibersii* (listed as vulnerable on the TSC Act) and a species of *Mormopterus* (*Mormopterus sp.* 1 in accordance with Parnaby 1992). Threatened bat species previously recorded in the area and potentially utilising the study site for foraging include the East-coast Freetail Bat *Mormopterus norfolkensis* and the Large-footed Myotis *Myotis adversus*. The Grey-headed Flying Fox (*Pteropus poliocephalus*), a fruit bat listed as vulnerable on the TSC Act, was observed flying over the study area on two occasions during the surveys.

4. Conservation Significance

4.1 Plant Species

No plant species listed as threatened by the TSC Act and/or the EPBC Act have previously been reported from within or adjacent to the study area, although four species have previously been detected within a 5 km radius of the study area (Table 1). No such species were detected anywhere within the study area during flora surveys carried out as part of this assessment. No Rare or Threatened Plant Species (ROTAPS) listed by Briggs & Leigh (1995) were detected during the flora survey. Twelve plant species detected within the study area are listed by James (1997) as being 'vulnerable' in Western Sydney. These are: *Bothriochloa decipiens/macra*, *Brachychiton populneus*, *Danthonia racemosa*, *Dodonaea viscosa* ssp. *cuneata*, *Einadia nutans* ssp. *linifolia*, *Eucalyptus paniculata*, *Euchiton sphaericus*, *Glycine microphylla*, *Olearia viscidula*, *Oxalis chnoodes*, *Senecio hispidulus* var. *hispidulus*, and *Sporobolus creber*.

4.2 Vegetation Communities

Zone A: Georges River Road Reserve

In addition to the dominant introduced vegetation, this zone contained scattered naturally-occurring trees. Although these would have previously been part of Shale/Sandstone Transition Forest, which is listed as an endangered ecological community by both the TSC Act and the EPBC Act, these scattered trees in themselves do not comprise this community. None of this zone could be described as containing bushland according to the SEPP 19 definition.

The vegetation in this zone has no conservation significance for flora, with the exception of a single *Eucalyptus globoidea*, a species that is considered by James (1997) to be vulnerable in Western Sydney.

Zone B: Northern Easement Zone

This zone contains a mixture of native and introduced vegetation. The native vegetation is a highly modified form of the endangered ecological community Shale/Sandstone Transition Forest. Under present conditions the Shale/Sandstone Transition Forest in this zone is considered unlikely to be viable in the long-term, due primarily to areas of dominance by invasive weeds, a lack of species diversity and ongoing anthropogenic impacts such as excessive periodic burning. On this basis it is considered that the conservation significance of the bushland sections of this zone is nominally high, but has been reduced by its poor condition.

Owing to the listing of this plant community as being endangered, an eight-part test would need to be applied if it was proposed to clear or otherwise impact on the bushland.

Zone C: Central Easement Zone

This zone contains the best condition of bushland within the study area. The two native plant communities occurring are Cumberland Plain Woodland and Shale/Sandstone Transition Forest. These communities are contiguous and are part of the continuum of the vegetation from shale to sandstone soil areas. As both native plant communities are listed as being endangered by the TSC Act and the EPBC Act and are in relatively good condition, their conservation significance is high.

Both would need to be assessed by an eight-part test of significance if any impact was proposed or likely to occur due to any development.

Zone D: Southern Easement Zone

Most of this zone contains grassland, with a few native trees. The vegetation of this zone would have previously been Cumberland Plain Woodland, however, throughout most of the zone the original vegetation has been cleared and this ecological community is no longer considered to exist. On the basis of the SEPP 19 definition, most of this zone does not comprise bushland, and has little potential for regeneration into a community representative of the original vegetation.

One small area of bushland, approximately 10 x 30 m in size, occurred near the southern boundary of the study area. This would need to be assessed in an eight-part test as a part of any development proposal that would affect it.

Zone E: Developed Zones

Apart from scattered naturally occurring trees, this zone contains virtually no native species. The vegetation of this zone would have previously been Cumberland Plain Woodland, however, almost all of the original vegetation has been cleared and this ecological community is no longer considered to exist. None of the vegetation in this zone is considered to be bushland and the conservation significance of the remaining native vegetation is considered to be very low. However, the occurrence of *Eucalyptus paniculata* and *Melaleuca decora* is of botanical interest as these species were not recorded elsewhere within the study area, and may have practical use (for seed collection) if restoration nearby bushland is area in the future.

5. Discussion

All bushland in the study area appears to have been heavily impacted by previous land uses. The indigenous species diversity of bushland was low in most locations inspected. This suggested that the area was still in the early stages of recovery from its protracted period of use for grazing.

All bushland in the study area is also subject to ongoing impacts, including frequent burning of the understorey. While occasional burning could stimulate regrowth of some species from the soil seedbank, excessive burning would be likely to exhaust the soil seedbank and prevent mature plants developing and setting seed for the next generation. Excessive burning could also facilitate the spread of weeds into regenerating bushland, reducing its viability, and reduce the amount of leaf litter and tree debris, which is required by species such as the endangered land snail *Meridolum corneovirens*.

The frequency of burning is probably related to the proximity of remnant bushland to gathering areas such as the community centre and high school. The existing ready access through most of the bushland would enhance the likelihood of fires being lit.

Notwithstanding the above, sections of the study area are of ecological significance. The Masterplan Study therefore represents an opportunity to include the protection and rehabilitation of urban bushland within plans for urban design improvements and social and educational programs. The most significant areas for flora and fauna include the majority of the bushland in zone C, regenerating bushland and the Smiths Creek riparian area in zone B, and the dam and its surrounds in zone D. These areas contain remnant or regenerating endangered ecological communities and some potential habitat for threatened species. It may be possible to enhance the ecological values of these areas through community-based projects. The remainder of the study area is considered to be of low significance for native flora and fauna species, populations and ecological communities.

A general principle of planning and management of urban bushland is that, where possible, larger rather than smaller areas should be retained and linked with other bushland. This is aimed at:

- maintaining habitat viability (including adequate population sizes, genetic variation and flow, minimising the edge effect (ie. perimeter to area ratio) to reduce impacts on bushland;
- retaining as wide a range of natural plant communities as possible; and
- preserving sufficient habitat linked by corridors for fauna preservation.

In addition to ecological values large linked bushland areas can provide passive recreation, landscape, historical and educational values. It may be suitable to use some cleared locations for active or passive recreation provided that a significant amount of native vegetation is retained and/or planted as flora and fauna corridor. Considerations regarding minimisation and control of fire would need to be taken into account.

Bushland was observed to occur east of the study area and contiguously in the Smiths Creek corridor north of the study area. Owing to the conservation value of the core bushland in the study area and current discontinuity with other bushland, ecological and other advantages could be gained by improving its connectivity with other bushland, such as Smiths Creek Reserve to the north of the study area.

6. Recommendations and Considerations for the Masterplan Study

6.1 Further Assessment

It is recommended that follow-up fauna surveys are carried out outside of the winter period. Habitat assessment of the study area indicates that four threatened bat species previously detected in the vicinity of the study area may occur there, and that the dam and surrounding grasslands are potential habitat for one threatened frog species (the Green and Golden Bell Frog *Litoria aurea*). These species are relatively inactive and difficult to detect during the winter period. If any of these threatened species do occur in the study area they are likely to be at least partially dependant on the dam, and in the case of micro-chiropteran bats the remnant woodland. Accordingly, concept plans for the remnant bushland and for the dam and its immediate surrounds would best be finalised after assessing the results of targeted surveys for these species. The most appropriate period to survey for the Green and Golden Bell Frog is likely to be between October and December, preferably after heavy rain. This would also be a suitable period in which to target surveys for the majority of the micro-chiropteran bats.

6.2 Legislative Requirements

Ecological Communities

The study area contains the endangered ecological communities Cumberland Plain Woodland and Shale/Sandstone Transition Forest. These vegetation assemblages would have once occurred throughout the study area but are now degraded to varying extents. Accordingly, developments proposed by the Masterplan Study are likely to require the preparation of an 8 Part Test and an Assessment of Significance (under the provisions of the TSC Act and the EPBC Act respectively), in order to determine whether the proposed Masterplan will have a significant impact on these ecological communities.

The outcome of the assessments of significance will, unless there are significant indirect impacts, be primarily determined by the location and extent of any vegetation clearance required to implement the Masterplan, together with the location and extent of any mitigation measures proposed by the Masterplan. Recommendations in regard to these considerations are presented below.

If a significant impact is likely to occur, then a Species Impact Statement (SIS) and the approval of the Commonwealth Environment Minister would be required (under the provisions of the TSC Act and the EPBC Act respectively).

SEPP 44: Koala Habitat Protection

Bushland remnants or regrowth within zones B and C the study area contain individuals of the tree species *Eucalyptus tereticornis* and *E. punctata*, both of which are listed on SEPP 44 as Koala feed tree species. Accordingly, development applications involving more than 1 ha of land will require assessment under the provisions of SEPP 44. The initial assessment process involves determining whether the land is defined as potential Koala habitat and, if so, whether the land is defined as core Koala habitat.

Fauna Species

Threatened fauna species detected within the study area were the Grey-headed Flying Fox (*Pteropus poliocephalus*) and the Large Bent-wing Bat (*Miniopterus schreibersii*). In addition, the Koala (*Phascolarctos cinereus*) has been previously recorded from several locations close to the study area and is highly likely to occur within the study area from time to time. Threatened fauna species that have previously been recorded from within 5 km of the study area and which may occur there are the Powerful Owl (*Ninox strenua*), four species of micro-chiropteran bat, the Spotted-tailed Quoll (*Dasyurus*

maculatus) and the Squirrel Glider (*Petaurus norfolcensis*) (Table 1). Threatened fauna species not previously detected in the area but which may occur include the Square-tailed Kite (*Lophoictinea isura*) and the Green and Golden Bell Frog (*Litoria aurea*).

Accordingly, developments proposed by the Masterplan Study are likely to require the preparation of 8 Part Tests under the provisions of the TSC Act for the Koala, the Grey-headed Flying Fox and the Large Bent-wing Bat, and may require the preparation of 8 Part Tests for some of the other species listed above. The requirement to carry out 8 Part Tests and the likely outcomes will be primarily determined by the location and extent of any vegetation clearance required to implement the Masterplan, together with the location and extent of any mitigation measures proposed by the Masterplan. Recommendations in regard to these considerations are presented below.

With the exception of the Green and Golden Bell Frog and the micro-chiropteran bat *Myotis adversus* (Large-footed Myotis), threatened species occurring or potentially occurring within the study area are primarily woodland or forest dependent. Consequently, an urban design concept that includes the protection or enhancement of existing bushland would not be likely to significantly affect these threatened fauna species and has some potential to improve the habitat values of the study area. The Green and Golden Bell Frog and the Large-footed Myotis, if they occur, would be highly dependent on the large dam within the study area.

If a significant impact is likely to occur, then a Species Impact Statement (SIS) and the approval of the Commonwealth Environment Minister would be required (under the provisions of the TSC Act and the EPBC Act respectively).

Noxious Weeds

A number of noxious weeds were detected within the study area, and these, together with their classification, are detailed in Section 3.3 above. The *Noxious Weeds Act 1993* requires that noxious weeds must be controlled using techniques specified by NSW Agriculture. On private land the responsibility lies with the occupier of the land. Weed classifications in the Campbelltown Local Government Area are as follows:

W1 The presence of the weed must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.

W2 The weed must be fully and continuously suppressed and destroyed.

W3 The weed must be prevented from spreading and its numbers and distribution reduced

W4 Action must be taken as specified below.

- a Shall not be sold, propagated of knowingly distributed. Occupier must prevent spread to adjoining property.
- b Must not be sold, propagated or knowingly distributed and any existing weed must be prevented from flowering or fruiting.
- c Must not be sold, propagated or knowingly distributed and any existing weed must be prevented from spreading to an adjoining property.
- f Must not be sold, propagated or knowingly distributed. Any biological control or other program directed by a local control authority must be implemented.
- g Must not be sold, propagated or knowingly distributed.

6.3 Recommendations

It is recommended that:

- bushland in the central section of the main easement corridor (zone C) be permanently retained and, if practicable, restored;
- degraded bushland (or part thereof) in the northern section of the study area (zone B) be retained and, if practicable, rehabilitated or landscaped and linked with the bushland north of Georges River Road to provide a corridor for native fauna;
- noxious weed controls are implemented;
- margins of the bushland that are infested with weeds be utilised as fuel free zones in order to protect people and property in adjoining areas from fires;
- other strategies be explored in order to minimise the occurrence and effect of frequent fires within bushland;
- consideration be given to involving the local community in planning and management of local public open space and bushland, where practicable;
- consideration be given to the provision of facilities for skateboarders and BMX cyclists to prevent further degradation of the bushland;
- some of the existing paths and tracks be 'closed' for regeneration with barriers and interpretive signage;
- urban design concepts include the cleanup and rehabilitation of the dam (including the eradication of the introduced Plague Minnow *Gambusia holbrooki*), or its replacement with a suitable water feature, to provide habitat for frogs and a watering/foraging area for bats; and
- consideration be given to planning transport corridor linkages along already cleared areas such as the existing transmission line easement.

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Appendix A: Plant Species Recorded during the Survey

NB. This list is not comprehensive. Apart from Quadrat 1 only locally indigenous species are listed

Plant Communities

Quadrat 1 (Q1): *Eucalyptus moluccana-E. tereticornis-E. crebra/fibrosa* (Zone C)

Transect 1 (T1): *Eucalyptus moluccana-Eucalyptus tereticornis-E. crebra/fibrosa* (Zone B)

Transect 2 (T2): *Sporobolus creber-Pennisetum clandestinum* (Zone D)

Transect 3 (T3): Landscaped residential area east of shops (Zone E)

FAMILY	SPECIES	COMMON NAME	Q1	T1	T2	T3
Trees						
Fabaceae	*Acacia decurrens*	Green Wattle		x	x	x
	A. implexa	Hickory Wattle	2	x	x	
	A. parramattensis	Parramatta Wattle			x	
Myrtaceae	*Angophora floribunda*			x		
	Eucalyptus crebra	Narrow-leaved Ironbark	1	x	x	x
	E. eugenioides	Thin-leaved Stringybark	adj			
	E. fibrosa	Broad-leaved Ironbark	4b	x	x	x
	E. globoidea	White Stringybark		x		
	E. moluccana	Grey Box	4b	x	x	x
	E. paniculata	Grey Ironbark				x
	E. punctata	Grey Gum		x		
	E. tereticornis	Forest Red Gum	4b	x	x	x
	Melaleuca decora					x
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	adj	x		
Sterculiaceae	*Brachychiton populneus*	Kurrajong	adj	x		
Shrubs						
Asteraceae	*Olearia viscidula*		adj			
	Ozothamnus diosmifolius	White Dogwood				
Euphorbiaceae	*Breynia oblongifolia*	Dwarf's Apples	1	x		
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea	2			
	Indigofera australis	Australian Indigo	1	x	x	
	Jacksonia scoparia			x		
	Pultenaea villosa			x		
	Acacia falcata	Sickle Wattle			x	
	A. longifolia	Sydney Golden Wattle	adj			
	A. ulicifolia	Prickly Moses	1			
Myrtaceae	*Kunzea ambigua*	Tickbush		x		
Oleaceae	**Ligustrum sinense*	Small-leaved Privet	1			
Pittosporaceae	*Bursaria spinosa*	Blackthorn	4b	x	x	
Sapindaceae	*Dodonaea viscosa* ssp. *cuneata*	a Hop Bush	adj	x	x	
Herbs						
Ferns						
Sinopteridaceae	*Cheilanthes sieberi*	Rock Fern	4a	x		
Dicots						
Acanthaceae	*Brunoniella australis*	Purple Trumpet	4a			

FAMILY	SPECIES	COMMON NAME	Q1	T1	T2	T3
Apiaceae	*Centella asiatica*			x	x	
Asteraceae	**Bidens pilosa*					
	Chrysocephalum apiculatum	Yellow Buttons	1			
	Euchiton sphaericum		3			
	Senecio hispidulus var. hispidulus			x		
	**S. madagascariensis*	Fireweed	3			
	Sigesbeckia orientalis			x		
	Vittadinia sp.				x	
Chenopodiaceae	*Einadia hastata*			x		
	E. nutans ssp. linifolia		adj			
Clusiaceae	*Hypericum gramineum*		3		x	
Convolvulaceae	*Dichondra sp. A*	Hairy Kidney Weed	2	x		
	D. repens	Kidney Weed			x	
Crassulaceae	*Crassula sieberiana*	Stonecrop		x		
Fabaceae	*Desmodium varians*		1	x		
Geraniaceae	*Geranium homeanum*	Storksbill		x		
Goodeniaceae	*Goodenia hederacea*		1	x		
Lamiaceae	*Plectranthus parvflorus*	Cockspur Flower		x		
Oxalidaceae	*Oxalis chnoodes*		1			
Rubiaceae	*Opercularia diphylla*		3			
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell		x		
Monocots						
Cyperaceae	*Lepidosperma laterale*	Broad Sword-sedge	1			
Laxmanniaceae	*Laxmannia compacta*			x		
Lomandraceae	*Lomandra filiformi var. filiformis*		2		x	
	L. longifolia	Spiny Mat-rush		x		
	L. multiflora		3	x		
Phormiaceae	*Dianella longifolia*		1	x		
	D. revoluta	Paroo Lily		x		
Poaceae	*Aristida ramosa*	a three-awned grass	adj	x		
	A. vagans	a three-awned grass	2	x		
	Bothriochloa sp.	Red Leg Grass			x	
	Cymbopogon refracta	Barb-wire Grass	2	x	x	
	Danthonia racemosa	a Wallaby Grass	adj			
	Dichelachne sp.	Plume Grass	2	x	x	
	Echinopogon caespitosus	Hedgehog Grass	1	x		
	Eragrostis leptostachya			x	x	
	Microlaena stipoides	Weeping Meadow-grass	3	x	x	
	Panicum effusum			x		
	Sporobolus creber	Rat's Tail Grass		x	x	
	Themeda australis	Kangaroo Grass		x	x	
Vines						
Dicots						
Fabaceae	*Glycine microphylla*			x	x	
	G. tabacina		2	x	x	
	Hardenbergia violacea	Purple Coral Pea	2			
Monocots						
Asparagaceae	**Myrsiphyllum asparagoides*	Bridal Veil Creeper	2			

Appendix C: Fauna Species Identified during Survey

TAXA	SPECIES	COMMON NAME	STATUS	A	B	C	D	E
Molluscs								
	Helix aspera	Garden Snail			✓			
	Limax maximus	Leopard Slug			✓			
Amphibian								
	Crinia signifera	Brown Froglet	P		✓		✓	✓
	Litoria verreauxii	Verreaux's Tree Frog	P				✓	
Reptile								
	Ctenotus sp.	Large Skink	P		✓			
	Lampropholis delicata	Garden Skink	P		✓			
	Lampropholis guichenoti	Wall Skink			✓			
	Lampropholis sp.		P		✓			
		Eastern Blue-tongued Lizard	P	Residents observation				
		Shingleback Lizard	P	Residents observation				
		Eastern Water Dragon	P	Residents observation				
Bird								
	*Gallus gallus**	Domestic Chicken	P				✓	
	Tachybaptus novaehollandiae	Australasian Grebe	P				✓	
	Chenonetta jubata	Australian Wood Duck	P					
	Anas supercilliosa	Pacific Black Duck	P				✓	
	A. castanea	Chestnut Teal	P				✓	
	Phalacrocorax melanoleucos	Little Pied Cormorant	P				✓	
	Egretta novaehollandiae	White-faced Heron	P				✓	
	Porphyrio porhyrio	Purple Swamphen	P				✓	✓
	Vanellus miles	Masked Lapwing	P		✓			✓
	*Columba livia**	Rock Dove	U				✓	
	Ocyphaps lophotes	Crested Pigeon	P		✓			
	*Streptopelia chinensis**	Spotted Turtle-dove	U	✓	✓		✓	✓
	Cacatua roseicapilla	Galah	P		✓	✓	✓	
	C. galerita	Sulphur-crested Cockatoo	P		✓	✓	✓	✓
	C. tenuirostris #	Long-billed Corella	P		✓			
	C. sanguinea #	Little Corella	P					
	Trichoglossus haematodus	Rainbow Lorikeet	P	✓	✓	✓	✓	✓
	T. chlorolepidotus	Scaly-breasted Lorikeet	P					✓
	Platycercus eximius	Eastern Rosella	P		✓	✓	✓	
	Psephotus haematonotus	Red-rumped Parrot	P		✓	✓	✓	
	Dacelo novaeguineae	Laughing Kookaburra	P	✓	✓	✓		✓
	Malurus cyaneus	Superb Fairy-wren	P		✓			
	Pardalotus punctatus	Spotted Pardalote	P		✓			
	Acanthiza reguloides	Buff-rumped Thornbill	P		✓			
	Smicrornis brevirostris	Weebill	P		✓			
	Anthochaera carunculata	Red Wattlebird	P	✓	✓	✓	✓	
	A. chrysoptera	Little Wattlebird	P	✓		✓	✓	

TAXA	SPECIES	COMMON NAME	STATUS	A	B	C	D	E
	Philemon corniculatus	Noisy Friarbird	P			✓	✓	
	Manorina melanocephala	Noisy Miner	P	✓	✓	✓	✓	✓
	Pycnonotus jocosus	Red-whiskered Bulbul	U				✓	
	Pachycephala sp.	Whistler	P		✓			
	Grallina cyanoleuca	Magpie-lark	P		✓	✓	✓	✓
	Rhipidura fuliginosa	Grey Fantail	P		✓			
	Rhipidura leucophrys	Willie Wagtail	P				✓	✓
	Coracina novaehollandiae	Black-faced Cuckoo-shrike	P		✓	✓	✓	
	Cracticus torquatus	Grey Butcherbird	P		✓	✓	✓	
	Gymnorhina tibicen	Australian Magpie	P		✓	✓	✓	
	Strepera graculina	Pied Currawong	P	✓	✓	✓	✓	✓
	Corvus coronoides	Australian Raven	P	✓	✓	✓	✓	
	*Passer domesticus**	House Sparrow	U		✓		✓	✓
	Hirundo neoxena	Welcome Swallow	P		✓		✓	✓
	Zosterops lateralis	Silvereye	P		✓			
	*Sturnus vulgaris**	Common Starling	U		✓		✓	
		Blackbird	U		✓			✓
	*Acridotheres tristis**	Common Myna	U		✓	✓	✓	✓
Mammal								
	Petaurus breviceps	Sugar Glider			✓			
	*Canis familiaris**	Dog	U	✓	✓	✓	✓	✓
	*Vulpes vulpes**	Red Fox	U		✓			
	*Oryctolagus cuniculus**	Rabbit	U	✓	✓		✓	✓
	Pteropus poliocephalus	Grey-headed Flying Fox			✓			
	Chalinolobus gouldii	Gould's Wattled Bat				✓	✓	
	Miniopterus schreibersii	Large Bent-wing Bat	V			✓		
	Mormopterus sp. 1					✓		

* denotes introduced

# denotes not native to area

AMBS CONSULTING

Additional Flora and Fauna Studies for the Airds Neighbourhood Renewal Masterplan

LFA (Pacific) Pty Ltd

Final Report

2000157-03

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Contents

1 Introduction

1.1 Background

The Airds/Bradbury public housing estate currently faces a number of issues related to poor urban design, including high unemployment, lack of educational opportunities, poor health, poor services and high crime. The area is now considered to be socially and economically disadvantaged. In order to address these issues, the Department of Housing has been implementing a Neighbourhood Improvement Program over the past 5 – 6 years, involving the restructuring of housing in the estate. Work still required includes the restructuring of the Town Centre in order to improve services, to provide a centre for community activities and to provide new housing to accelerate the achievement of social mix in the estate.

In July - August 2001 Australian Museum Business Services (AMBS Consulting) undertook an initial flora, fauna and archaeological study at a number of locations within the suburb of Airds identified as potential areas for new developments and housing (AMBS 2001). The purpose of the study was to provide baseline information and background material regarding flora and fauna for the Airds Neighbourhood Renewal Masterplan Study undertaken by LFA (Pacific) Pty Ltd for the Department of Housing. The initial flora and fauna study divided the area into five zones of varying ecological significance, and indicated those zones for which more detailed study might be required.

A draft Masterplan was subsequently prepared by LFA (Pacific) for the Department of Housing, incorporating options and proposals for: a network of open spaces; roads and other transport infrastructure; housing; community facilities and the retail centre. A number of recommendations from the initial flora, fauna and archaeological study were incorporated, including the retention and restoration of a bushland zone and corridor.

In accordance with the initial flora and fauna study the draft Masterplan identified a need for further detailed assessment of flora and/or fauna in some of the areas proposed for development. AMBS Consulting was subsequently commissioned by LFA (Pacific) Pty Ltd to undertake a further assessment of flora and fauna in particular areas identified for potential housing. This document presents the results of the additional assessment.

1.2 Location

The suburb of Airds is located near Campbelltown and is approximately 45 km south-west of the Sydney CBD. Campbelltown Railway Station is located roughly 2.5 km to the north-west of Airds Town Centre. Lands to the north, south and west of Airds are primarily residential and include the adjoining suburbs of Ruse, St Helens Park and Bradbury respectively. Smiths Creek Reserve (currently managed by Sydney Water) is also located immediately to the north of Airds, between Ruse and Campbelltown. Lands to the east of Airds are largely undeveloped and include both areas that have been 'earmarked' for the construction of the proposed Georges River Parkway and a number of conservation reserves associated with the western banks of

the Georges River. Lands to the east of the Georges River are part of Holsworthy Military Reserve and contain substantial areas of remnant bushland.

The study area for the initial flora and fauna study (AMBS 2001) comprised various interconnecting lands located along the western and northern boundaries the Airds township and some developed lands within the town. This area was divided into five distinct zones according to the major vegetation assemblages present and easily identifiable features such as location, orientation, and dividing structures such as roads. The draft Masterplan includes provision for:

- retention and restoration of an existing bushland area between Airds and Bradbury;
- restoration of Smiths Creek to a natural stream system and establishment of a vegetated riparian corridor;
- incorporation of a wetland element to the site of the existing dam;
- construction of a new road along the north-south services easement; and
- development of housing and infrastructure in a number of zones, including part of the zones defined as B and C in the initial study.

Zone B of the initial study contained a mosaic of developed land, abandoned pasture and regenerating bushland (AMBS 2001). Although degraded and subject to disturbance and weed invasion, elements of the original Shale / Sandstone Transition Forest communities were present. Zone C of the initial study contained areas of Cumberland Plain Woodland. These community types are listed as endangered on the *Threatened Species Act* 1995 (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Additionally, two of the tree species present are listed on Schedule 2 of the State Environmental Planning Policy No. 44 (SEPP 44) as Koala feed tree species. Accordingly, a more detailed investigation of the areas proposed for housing in Zones B and C was requested by LFA (Pacific) on behalf of the Department of Housing, focussing on an assessment of the vegetation communities and Koala habitat.

The study area for the purpose of this assessment is defined as the area south of Georges River Road to the southern end of the proposed park, bounded to the west by the Bus Depot, electrical sub-station and the proposed Smiths Creek riparian corridor, and to the east by the existing Youth Centre, Riverside Drive and residences (Figure 1).

1.3 Aims and Scope

The purpose of this study was to assess the significance of potential impacts of the proposed provision of housing and access road in the study area defined above, focussing on the vegetation and potential Koala habitat present. Specific aims were to:

- undertake a detailed survey of the vegetation community;
- undertake surveys for Koala habitat and for evidence of Koalas;
- examine records of Koala sightings in the area;
- undertake Eight Part Tests for the vegetation communities;
- undertake assessments of significance under the EPBC Act; and
- assess the study area's value as Koala habitat in accordance with SEPP 44.

2 Methodology

2.1 Flora

The study area was divided into six units on the basis of broad characteristics such as structure and condition of the vegetation (Figure 2):

1. Cumberland Plain Woodland with a mown understorey (adjacent to the Youth Centre);
2. Shale / Sandstone Transition Forest (low sandstone influence) (adjacent to the southern end of the Bus Depot and adjoining the Cumberland Plain Woodland);
3. grassland dominated by indigenous species (north of unit 2);
4. grassland dominated by introduced species (north of unit 3);
5. Shale / Sandstone Transition Forest (high sandstone influence) (at the northern end of the study area); and
6. Shale / Sandstone Transition Forest contiguous with unit 5, within 40 m of the eastern side of Smiths Creek.

General descriptions of the vegetation communities present were provided in AMBS 2001. Additional surveys were not undertaken in the area proposed to be retained as parkland, as the area will not be directly impacted by the proposed Masterplan; however, as the area contains Cumberland Plain Woodland, potential indirect impacts on this area were considered. A flora survey of the other units was undertaken on 26 August 2002 in order to confirm previous observations regarding the nature, condition and extent of the vegetation present and to provide additional data regarding specific areas for the purposes of potential impact assessment.

Quadrat surveys were undertaken in units 1, 2 and 5. All quadrats were 20 x 20 m and used methodology that was compatible with that used by NPWS (2000) in their Cumberland Plain mapping surveys. The information recorded included: species present; area coverage of each species (based on a modified Braun-Blanquet system); significant existing impacts and threats to native vegetation; and connectivity between vegetated areas.

Plant community descriptions were based on structure (Specht, 1970) and the dominant species present. This was related to systems used by other authors when considering conservation significance. Plant nomenclature accords with Harden (1990-93) except for the subsequent revision of *Tradescantia albiflora* to *T. fluminensis*. Conservation significance was assessed on the basis of the TSC Act, EPBC Act, Briggs & Leigh (1995) and James (1997). Consideration was also given to generally accepted ecological planning principles for small reserves.

It was assumed that vegetation that could potentially be an endangered ecological community would also largely conform to the State Environmental Planning Policy No. 19 (SEPP 19) definition of bushland. This states that bushland should have all of the following three attributes:

- indigenous species comprising the canopy;

- the understorey stratum and/or ground cover stratum comprising at least a component of "native species sufficient to re-establish those strata should the disturbance be arrested or reversed by management"; and
- the structure is recognisably natural or is regrowth which has achieved a near natural structure or a seral stage towards that structure.

Assessment of potential impacts was based on the information obtained during surveys for the initial flora and fauna study (AMBS 2001) and the additional surveys undertaken on 26 August 2002.

2.2 Koala (*Phascolarctos cinereus*)

Surveys of the study area were undertaken on 26 August 2002. The study area was initially inspected to determine areas where potential Koala habitat could occur. Sites for targeted surveys were then selected on the basis of differences in the structure of the vegetation and the dominant tree species present. Survey methodology was generally consistent with that used in developing the Koala Habitat Atlas for the Campbelltown Local Government Area (Phillips and Callaghan 1998) except where tree cover was sparse or partially absent.

Five areas within the study area were selected for targeted surveys, with survey methodology as follows (Figure 3):

- a 40 x 40 m quadrat in an area behind the Youth Centre dominated by *Eucalyptus moluccana*;
- a 40 x 40 m quadrat in the area of Cumberland Plain Woodland with a mown understorey;
- a 40 x 40 m quadrat in the area dominated by regenerating *E. tereticornis* adjacent to the southern end of the Bus Depot;
- a 50 x 10 m transect located in a treed section of the disturbed Shale / Sandstone Transition Forest at the northern end of the study area; and
- surveys of a number of individual trees in the partially cleared and degraded area between Smiths Creek, College Road and Georges River Road.

Surveys involved: identifying each tree species; measuring the circumference of each tree with a DBH of approximately 100 mm or greater; counting the number of each tree species present with a DBH of less than 100 mm; examining the trunk of each tree greater than 100 mm DBH for Koala scratchings; and searching for Koala scats beneath each tree greater than 100 mm DBH for a period of approximately 2 minutes. Searches for scats and scratchings were undertaken for all trees in quadrats 1 and 2, regardless of DBH.

Determination of 'potential Koala habitat' was made on the basis of definitions provided in SEPP 44 and the Koala Habitat Atlas for the Campbelltown LGA (Phillips & Callaghan 1996; 1998). Determination of 'core Koala habitat' was made on the basis of records of Koalas in the vicinity of Airds provided by Dr Robert Close and Lynn Coxall from the University of Western Sydney database.

Observations of fauna utilising the study area were made on an opportunistic basis during the Koala surveys.

3 Results

3.1 Flora

Data recorded during the quadrat surveys is presented in Appendix 1.

3.1.1 Cumberland Plain Woodland proposed for inclusion in parkland

The vegetation in this zone was described in AMBS 2001. The vegetation community comprised regrowth of Cumberland Plain Woodland. Typical species included *Eucalyptus moluccana* (Grey Box), *Eucalyptus tereticornis* and two ironbark species. The variable shrub stratum mainly contained *Bursaria spinosa*, and the ground cover was predominantly *Themeda australis*. The bushland was partially disturbed by pedestrian and vehicular paths, rubbish dumping and frequent burning. Weeds were common in the bushland, as individuals and localised islands. Most of the margins of the bushland were dominated by introduced species. Despite the presence of weeds in many locations, much of the bushland was considered to be viable and in the process of developing a more widespread shrub stratum.

This area contained the most intact structure of any bushland in the study area, although parts had been disturbed by localised low intensity fires, rubbish and weeds. It is contiguous with the Cumberland Plain Woodland of unit 1, the Shale / Sandstone Transition Forest of unit 2 and the Smiths Creek riparian corridor.

3.1.2 Unit 1: Cumberland Plain Woodland with a mown understorey

This unit was bounded by Riverside Drive, the existing Youth Centre, the powerline easement and existing residential development (Figure 2).

The vegetation in this unit comprised open woodland with a mown understorey. At the time of the survey the shrub stratum was absent; shrub species were present but had been prevented from growing to maturity by the mowing regime. Inspection of the understorey indicated that the ground cover contained a high proportion of over 20 native species that are typical of Cumberland Plain Woodland. Introduced species were present but were generally in low proportions, except on the eastern and northern margins. Although modified and degraded to some extent by the mowing, the resilience of the community appeared to be excellent and it was considered that the area had a high potential to re-establish vegetation that was representative of Cumberland Plain Woodland if mowing was discontinued.

3.1.3 Shale / Sandstone Transition Forest

The remainder of the study area comprised a mosaic of developed land, abandoned pasture and regenerating bushland. The plant community was modified Shale / Sandstone Transition Forest. Modification of the community appears to have been caused primarily by previous use of the land for grazing. Continuing impacts on the bushland were observed, including pedestrian paths, rubbish dumping and frequent burning. The eastern edge was mainly introduced lawn with scattered planted shrubs and trees. Regrowth bushland occurred as discontinuous bands to either side of the Bus Depot and above the Smiths Creek riparian zone. This comprised a variable canopy of *Eucalyptus punctata*, *E. tereticornis* and understorey mainly of *Microlaena*

stipoides and *Themeda australis* (Kangaroo Grass). Shrubs were generally limited to a few *Bursaria spinosa* (Blackthorn) and localised *Pultenaea villosa*, *Indigofera australis* and *Dodonaea viscosa* ssp. *cuneata*. The indigenous species diversity was relatively low in most locations inspected.

The vegetation was comprised of four main elements:

- Forest Red Gum woodland east of the bus depot (unit 2);
- a cleared area dominated by indigenous grassland species (unit 3);
- cleared areas dominated by introduced grassland (unit 4);
- repeatedly disturbed Grey Gum - Forest Red Gum - Rough-barked Apple woodland (unit 5); and
- modified Grey Gum - Forest Red Gum - Rough-barked Apple woodland near Smiths Creek (including riparian vegetation – unit 6).

Unit 2 contained a simplified native plant community that contained low concentrations of environmental weeds (AMBS 2000; Appendix 1). This vegetation was contiguous with the Cumberland Plain Woodland units described above and was considered to have a reasonable potential for rehabilitation. Due to its location the area is likely to have some significance to maintaining the viability of adjoining Cumberland Plain Woodland, including that to be conserved in the proposed park.

Unit 3 contained a simplified community with no tree or shrub strata present at the time of the survey.

Some of the previously cleared areas contained predominantly introduced grasses that were probably established in order to prevent soil erosion (unit 4). Common species included *Pennisetum clandestinum* (Kikuyu), *Eragrostis curvula* (African Love-grass), *Chloris gayana* (Rhodes Grass) and *Cynodon dactylon* (Couch Grass). Native species were absent to uncommon in these areas and were considered to be unable to be able to re-establish a natural plant community.

The highly modified and repeatedly disturbed northern area (unit 5) contained sufficient indigenous species to enable it to be restored to bushland that is representative of Shale / Sandstone Transition Forest. However, weeds dominated many locations in this area and have the potential to spread to currently weed-free areas. The repeated incidence of small fires appears to be advantaging weed spread. Frequent fire also tends to result in the loss of native species that require longer fire-free periods to be able to reproduce.

Most of the riparian vegetation (unit 6) was dominated by environmental weeds. Native vegetation was generally restricted to tree cover in this zone, apart from a couple of very localised occurrences of largely indigenous ground cover.

Remnant indigenous vegetation with generally low concentrations of weeds occurred between about 10 and 40 m east of Smiths Creek, north of the electricity substation. Although this vegetation could be included in that of unit 5, and has been mapped as such (Figure 2), it does not appear to have been burnt as frequently as the remainder of unit 5 and is in better condition.

3.2 Koala Habitat

Data collected during the quadrat surveys is presented in Appendix 3.

Quadrat 1 was dominated by *Eucalyptus moluccana* to approximately 15 m in height with a relatively sparse canopy, but with many lower trees. Two *E. tereticornis* were also present. Feed tree species identified on Schedule 2 of SEPP 44 made up 7.5 % of the total number of trees present.

Quadrat 2 had been partially cleared and contained a sparse canopy of *E. fibrosa*, *E. tereticornis*, *E. moluccana* and *E. crebra* up to approximately 25 m in height. Feed tree species identified on Schedule 2 of SEPP 44 made up 33 % of the total number of trees present.

Quadrat 3 was dominated by *E. tereticornis* with a few specimens of *E. moluccana* and one *E. crebra* also present. Large trees in this area were sparse and the quadrat was dominated by numerous lower trees. Feed tree species identified on Schedule 2 of SEPP 44 made up over 90 % of the total number of trees present.

Transect 4 had been partially cleared and contained only two trees greater than 10 m in height, one *Acacia floribunda* and one *E. punctata*. A number of lower trees were present, dominated by *A. floribunda* but also including *E. tereticornis*, *E. punctata, A. amplexa* and *A. decurrens*. Feed tree species identified on Schedule 2 of SEPP 44 made up 17 % of the total number of trees present.

The area between Smiths Creek, College Road and Georges River Road had been mostly cleared of large trees and the shrub stratum was also absent in many locations. The exception was the area to the east of Smiths Creek, which contained a reasonably dense canopy dominated by large *E. tereticornis* (generally to about 40 m east of the creek but extending further in some locations). Feed tree species identified on Schedule 2 of SEPP 44 generally made up the majority of the trees where a canopy was still present.

Data provided by the University of Western Sydney shows that Koalas have been detected during 2000 and 2001 on numerous occasions close to the study area, with the majority of records occurring at or near the interface of the Airds suburban area and the Reserve above the Georges River (Figure 4). There are also a number of records from within the suburban area itself, to the east of the study area. There is one record of a male Koala from the Bus Depot in June 2001. The same animal was later reported from three locations near Deans Road in July 2001.

No Koalas were observed either during the current survey or the previous (AMBS 2001) surveys. No Koala scats were detected. Scratchings (not recent) that may be attributable to a Koala were detected on one *E. punctata* in Transect 4.

A review of the Campbelltown Koala Habitat Atlas indicates that the study area and its surrounds was classified as "Mainly Cleared Land" and adjoins an area classified as "Secondary Habitat Class A" (the Smiths Creek Reserve) (Phillips & Callaghan 1996). The vegetation of the study area was not consistent with any of the Koala habitat descriptions provided in the Koala Habitat Atlas (Phillips & Callaghan 1998).

However, the limitations of the Koala Habitat Atlas project mean that the potential significance of the habitat within the study area for the Koala may have been underestimated (see Discussion below).

3.3 Opportunistic Observations

Two species of conservation significance were observed during the Koala habitat survey; the Cumberland Land Snail (*Meridolum corneovirens*) and the White-winged Chough (*Corcorax melanorhamphos*). Two live specimens and one shell of the Cumberland Land Snail were detected in the mown area of Cumberland Plain Woodland behind the Youth Centre. The snail is listed as an endangered species on the TSC Act. The White-winged Chough was observed in regenerating Shale / Sandstone Transition Forest in the vicinity of the Bus Depot. This species is considered to be of regional significance in western Sydney (NPWS 1997).

4 Discussion

4.1 Flora

Cumberland Plain Woodland and Shale / Sandstone Transition Forest are listed in the TSC Act and EPBC Act as endangered ecological communities.

The introduced grassland areas have no conservation significance, provided they are not needed for linking existing bushland areas that are to be retained, nor have an adverse impact on remaining bushland.

No threatened species of flora were recorded during this or the previous surveys in the study area. Seven species (Table 1) are considered by James (1997) to be inadequately conserved and vulnerable in Western Sydney. With the exception of *Glycine microphylla* and *Oxalis exilis*, these are uncommon or generally absent from other parts of Sydney and are therefore significant within the whole Sydney district.

Table 1: Inadequately conserved species recorded in the Airds study area

Brachychiton populnea	Kurrajong
Euchiton sp.	a daisy
Glycine microphylla	a slender vine
Hemarthria uncinata	a moist zone grass
Oxalis exilis	a small dicot herb
Senecio quadridentatus	a daisy
Sporobolus elongatus	Rat's Tail Grass

The likely impact of a proposed development on threatened species, populations or ecological communities listed on the TSC Act is assessed by application of the "eight-part test" of significance. The provisions of the eight-part test are listed in Section 5A of the *Environmental Protection and Assessment Act 1979* (EP&A Act). The purpose of the test is to determine whether the impact of the development is significant. If the impact is found to be significant further assessment (e.g. a species impact statement) may be required under the TSC Act. Eight part tests were conducted for Cumberland Plain Woodland and Shale / Gravel Transition Forest areas (Appendix 1). The conclusions of the eight part tests were:

- Cumberland Plain Woodland with a mown understorey (unit 1). This area has potential to regenerate and is contiguous with the larger area of Cumberland Plain Woodland to be preserved in the proposed park. On the basis of the size of the area, its condition and connectivity to bushland the eight-part test concluded that the proposed development of housing on this area would be a significant impact on the ecological community. If this area was retained and restored as bushland it is anticipated that fire issues would become important for the plant community and for life and property.
- Regenerating Forest Red Gum community (Shale / Sandstone Transition Forest – unit 2). Application of the eight-part test indicated that the loss of this area, in conjunction with the loss of the mown bushland area described above, would be a significant impact.

- Disturbed Shale / Sandstone Transition Forest (units 5 and 6). If it is assumed that the current fire regime cannot be improved, application of the eight-part test would indicate that the proposed development of this area would be nominally insignificant in terms of the Act. The riparian zone and adjacent land is, however, important as a link between the proposed park bushland and Smiths Creek Reserve, without which the bushland in the proposed park will be isolated.

Threatened species, populations or ecological communities listed on the EPBC Act are considered to be "matters of national environmental significance". The *EPBC Administrative Guidelines on Significance, July 2000* provide guidelines for assessing whether the impact of a proposed development is likely to be significant on matters of national environmental significance, and therefore whether further assessment under the EPBC Act is required. An action has, will have, or is likely to have a significant impact on a critically endangered or endangered ecological community if it does, will, or is likely to:
a) lead to a long-term adverse affect on an ecological community
b) reduce the extent of a community
c) adversely affect habitat critical to the survival of an ecological community
e) result in invasive species that are harmful to the critically endangered or endangered community becoming established in an occurrence of the community, or
f) interfere with the recovery of an ecological community.

The proposed development will reduce the extent of both Cumberland Plain Woodland and Shale / Sandstone Transition Forest. As this falls within the criteria for determining significant impact under the current guidelines, a referral to the Commonwealth Environment Minister would be required.

4.2 Koala (*Phascolarctos cinereus*)

SEPP 44 defines "potential Koala habitat" as "areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15 % of the total number of trees in the upper or lower strata of the tree component." Two of the feed tree species listed on Schedule 2 occur within the study area; *Eucalyptus tereticornis* and *E. punctata*. The results of the survey indicate that parts of the study area comprise potential Koala habitat. These are mainly areas of Shale / Sandstone Transition Forest where *E. tereticornis* is the dominant tree species, including the regenerating bushland to the east of the Bus Depot (unit 2) and the riparian corridor along Smiths Creek, but also includes the mown area of Cumberland Plain Woodland (unit 1) and parts of the partially cleared and degraded vegetation where canopy species are still present or are regenerating (unit 5).

SEPP 44 defines "core Koala habitat" as "an area of land with a resident population of Koalas, evidenced by attributes such as breeding females and recent sightings of and historical records of a population". The evidence from this survey and records held by the University of Western Sydney do not indicate that the study area currently supports a resident population of Koalas. Koalas have been reported from the Bus Depot on one recent occasion and from nearby the study site on numerous occasions; however, the lack of scats, scratchings or sightings during the current and previous surveys suggests that there are no resident animals within the study area itself.