Appendix 2 Terrestrial Flora & Fauna Assessment

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BIOSIS
RESEARCH

Terrestrial Flora & Fauna Assessment

Picton Sewerage Scheme Boundary Modifications

Report for Sydney Water

23rd March 2011

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ABBREVIATIONS

CAMBA	*China-Australia Migratory Bird Agreement*
Council	Wollondilly Shire Council
CPW	Cumberland Plain Woodland
DECCW	NSW Department of Environment, Climate Change and Water (formerly NSW Department of Environment and Climate Change)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (formerly Department of the Environment, Water Heritage and the Arts)
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
EPI	Environmental Planning Instrument
ESL	Environmentally Significant Land (according to WLEP)
JAMBA	*Japan-Australia Migratory Bird Agreement*
KTP	Key Threatening Process
LEP	Local Environmental Plan
LES	Local Environmental Study
LGA	Local Government Area
Locality	10 km radius of Study Area
NPWS	NSW National Parks and Wildlife Service (now part of DECC)
NW Act	*Noxious Weeds Act* 1993
REF	Review of Environmental Factors
RL	Riparian Land (according to the WLEP)
ROKAMBA	*Republic of Korea-Australia Migratory Bird Agreement*
SSTF	Shale Sandstone Transition Forest
Study Area	Area of direct impact and any areas subject to potential indirect impacts
Subject Site	Area of direct impact
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act* 1995
sp.	species (singular)
spp.	species (plural)
ssp.	subspecies

var.	variety
WDCP	Wollondilly Development Control Plan 2009
WLEP	Wollondilly Local Environment Plan 2009
WSC	Wollondilly Shire Council

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1.0 INTRODUCTION

Biosis Research Pty. Ltd. has been commissioned by Sydney Water to undertake a Flora & Fauna Assessment as part of the site investigations required for the Picton Sewerage Scheme boundary extension. An extension to the Picton sewerage scheme boundary is required to allow for urban expansion as forecast in the NSW Department of Planning's 2007-08 Metropolitan Development Plan. The proposed boundary extension constitutes a modification under Part 3A of the NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act) to an existing approval.

In addition to the proposed scheme boundary expansion Sydney Water also proposes to install three new sewerage pumping stations and rising mains at three separate sites within the Wollondilly Local Government Area (LGA). Site investigations were undertaken at these three locations, referred to as Study Areas A, B and C. Study Areas A and B are located in Tahmoor, Study Area C is located in Thirlmere. Figure 1 shows the general locality of the three sites. The three proposed pumping station locations occur on private land and are located in cleared paddocks with scattered remnant trees. The proposed rising mains run from the pumping stations out to the road and along the road verge at each site. The proposed position of the pumping stations and rising mains for each of the three Study Areas is shown in Figures 2a, 2b & 2c.

This report assesses the conservation significance of terrestrial flora and fauna on the Subject Site and potential impacts of the proposal on threatened species, populations (and their habitats) or ecological communities that occur, or have the potential to occur in the Study Area in accordance with the requirements of the EP&A Act, *Threatened Species Conservation Act* 1995 (TSC Act), *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and the *Fisheries Management Act* 1994 (FM Act).

For the purpose of this assessment, the following definitions are used:

- **Subject Site** - The area of direct impact associated with the proposal.
- **Study Area** – The area of direct impact and any areas subject to potential indirect impacts.
- **Locality** - The area within a 10km radius surrounding the Study Area.

1.1 Aims

The general aim of this project is to undertake a terrestrial flora and fauna assessment of the three Subject Sites and Study Areas and to determine the impact of the proposal on matters of conservation significance.

The specific aims are to:

- Conduct a literature review and database search for the Study Area;
- Describe the natural values associated with the Study Area;
- Map any significant flora and fauna recorded during the field survey;
- Undertake targeted field surveys for habitat of threatened species, populations and ecological communities listed under the schedules of the TSC, FM and/or EPBC Acts that are known or likely to occur within the Study Area;
- Recommend Assessments of Significance under the TSC/FM Acts and/or Significant Impact Criteria Assessments under the EPBC Act for threatened species, populations and ecological communities that are likely to be either directly or indirectly impacted by the proposal; and,
- Provide recommendations to minimise environmental impacts from the proposal.

2.0 METHODS

In developing the field survey methods and reporting requirements for this study reference has been made to the *Draft Guidelines for Threatened Species Assessment* (DEC & DPI, 2005) and the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft* (DEC, 2004).

2.1 Desktop

The following databases, literature, scientific studies and reports have been reviewed in order to assess the natural values of the Study Areas in regards to flora and fauna that may occur.

Database searches were undertaken to obtain records of threatened species, populations or communities listed under state and federal biodiversity legislation with potential to occur within the Subject Site and Study Area. Searches encompassed an area within 10km of the Subject Site. Records from the following databases were collated and reviewed:

- NSW Department of Environment Climate Change and Water (DECCW), Atlas of NSW Wildlife.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) online Protected Matters Search Tool.

- Existing regional vegetation mapping including Native Vegetation of Southeast NSW (Tozer *et. al.* (2006), and Native Vegetation of the Cumberland Plain Western Sydney (NPWS 2002).

All database searches were conducted in February 2010. Results were used to inform field surveys; however the results are not mapped herein.

2.2 Field Surveys

Flora and fauna surveys were carried out across each of the three Subject Sites and immediate surrounds of the Study Area on the 4th February 2011. The general condition of each Subject Site and the surrounding Study Area was assessed and observations were made of plant communities, plant and animal species and flora and fauna habitats. Weather conditions consisted of hot temperatures and clear skies during the field survey.

2.2.1 Flora Survey

The flora survey conducted over the Study Area applied the following methods:

- A 20 x 20 metre quadrat was surveyed at the proposed location for the pumping station at each of the 3 sites. Study Area A includes two possible locations. A quadrat was conducted at location A1 only;
- Random meanders were conducted through areas adjacent to the proposed pumping station locations within the Study Area;
- The proposed route of the rising main for each of the three Study Areas was walked as a transect and all species sighted were recorded;
- Threatened flora species and ecological communities previously recorded in the Locality and with potential to occur within the Study Area were targeted in quadrats and random meanders;
- An inventory of the native and exotic flora species observed within the Study Area was compiled. Noxious and environmental weeds were recorded and their distribution over the Study Area noted;
- The general condition of the vegetation was assessed based on disturbance history, the degree of infestation by exotic species, structure and overall resilience;
- A habitat assessment focussed on the potential for threatened flora species to occur on the Subject Site and the presence of threatened ecological communities.

- The Scientific Determination and Environmental Protection Biodiversity Conservation Listing Advice have been referenced in determining the presence of Threatened Ecological Communities predicted occur within the Study Area.

2.2.2 Fauna Survey

The presence of fauna species at each Subject Site and in the surrounding Study Area was primarily determined through consideration of suitable habitats, with the majority of species recorded opportunistically during the habitat assessment. Habitat assessments have been used in this assessment as a surrogate for intensive surveys (e.g. trapping, call playback). Consequently, it is assumed that threatened species are present if the habitat features necessary for completion of their life cycles are located in the Study Area.

Each of the three Study Areas were traversed using a strategic parallel-line method to record opportunistic sightings of species through the following methods:

- Direct sightings and observations of other signs and traces such as tracks and scats and aural recognition of calls;
- Active searches by turning logs, rocks and other debris providing habitat for native fauna in locations of preferential habitat such as the woodland areas of the Study Area;
- Searches for evidence of Koala's to inform a SEPP 44 assessment including searches for scats and scratches on trees;
- Assessments of broad fauna habitat types and identification of fauna habitat features such as feed trees, hollows, rock outcrops and waterways,
- Identification of opportunities and constraints to minimise or ameliorate impacts on native fauna and their habitats throughout the proposal.

Fauna habitats were assessed by examining the following characteristics of the Study Area:

- Structure and floristics of the canopy (where present).
- Understorey and ground cover vegetation.
- Presence of hollows and fissures in trees.
- Structure and composition of the litter layer.
- Water bodies and aquatic habitats.

- Disturbances, including weed invasion, clearing, rubbish dumping or fire.
- Potential foraging, nesting or roosting resources.
- Connectivity to off site habitats.

The following criteria were used to evaluate habitat values:

High: good condition endemic vegetation supporting a full range of fauna habitat components (e.g. hollow bearing trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.

Moderate: Some fauna habitat components are missing (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.

Poor: Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

2.3 Likelihood of occurrence criteria

The likelihood of occurrence assessment for threatened flora and fauna and migratory species was based on previous records collated from database searches, data collected during the field survey, the current (known) distribution range of these species, and the presence and condition of suitable habitat in the Study Area. The likelihood of occurrence assessments for threatened flora and fauna are provided in Appendix 3.

The criteria used to assess the likelihood of threatened or migratory species occurring within the Study Area is presented in Table 1.

Table 1: Likelihood of occurrence criteria for threatened or migratory species

Likelihood of occurrence	Assessment Criteria
Low	Species considered to have a low likelihood of occurrence include species not recorded in the field surveys that fit one or more of the following criteria: ▪ have not been recorded previously in the Study Area or locality and the Study Area is beyond the known distribution or range;

Likelihood of occurrence	Assessment Criteria
	▪ are dependant on a narrow range or specific habitats that do not or are not likely to occur in the Study Area; ▪ are considered locally extinct; ▪ are a non-cryptic perennial flora species that were targeted during field surveys; and ▪ are flora species that have a very limited range and highly specific dispersal mechanisms.
Moderate	Species considered to have a moderate likelihood of occurrence include species not recorded in the field surveys that fit one or more of the following criteria: ▪ there are infrequent records for the species in the Study Area and locality; ▪ preferential habitats of the species are present in the Study Area but these are mainly in a poor or modified condition; ▪ may use or occur in habitats within the Study Area opportunistically during seasonal migration but are unlikely to be present on permanent basis as a populations or vagrant individuals; and ▪ are cryptic flowering flora species that were not seasonally targeted during surveys.
High	Species considered to have a high likelihood of occurrence include species recorded during the field surveys or species not recorded that fit one or more of the following criteria: ▪ have a high incidence of previous records in the Study Area and locality and appropriate habitat is present; ▪ preferentially use habitats that are present in the Study Area which are abundant and/or in good condition; ▪ resident populations are known in the Study Area or locality and appropriate habitat is present; and ▪ are known to regularly use habitats of the site or locality or are highly likely to visit the site during seasonal dispersal or migration.

2.1 Limitations

Flora and fauna field surveys were conducted over one day in mid summer 2011. The survey effort was based on the level of assessment required to provide a flora and fauna assessment based on a combination of the flora and fauna species present and habitat assessments of each of the three Study Areas in regard to matters of conservation significance.

In relation to the amount of survey effort and its timing, an adequate sample of the spectrum of flora and fauna species and assessment of the ecological processes that are likely to occur on the Study Area have been made from desktop assessments, background research and the field survey. However, ecological surveys provide a sampling of flora and fauna at a given time and season. Not all species will be detected at a site due to a number of reasons such as dormancy, seasonal conditions and migratory or breeding behaviour of some fauna. In many cases these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

Given that field surveys provided a snapshot of the range of species present at each Subject Site and assumptions on species likely to occur have been established on habitat assessment and desktop analysis, a precautionary approach has been adopted when assessing impacts of the proposal on matters of state and national conservation significance.

3.0 BACKGROUND REVIEW

3.1 Wollondilly Shire Biodiversity Strategy

The Wollondilly Biodiversity Strategy (ELA 2004) was prepared to guide Council and the community towards considering biodiversity in the planning and management decision making processes. The Wollondilly Biodiversity Strategy considers and integrates relevant statutory and planning documents and Environmental Planning Instruments (EPI). The synthesis of these, and in particular the vision statements from the *Wollondilly Vision 2025*, provides a guide to formulating a coordinated approach to protecting biodiversity over the short, medium and longer term. The aims of the strategy are to:

- Provide a coordinated approach to the conservation of Wollondilly's native plants, animals, their habitats, and the ecological processes that sustain them;
- Provide Council and staff with direction and assistance in making effective and efficient management decisions regarding biodiversity and long term strategic planning for biodiversity;
- Ensure the principles of Ecologically Sustainable Development are employed when making decisions about the use of natural resources in the Wollondilly Shire; and,
- Provide the Wollondilly community with processes that are transparent and accountable.

The recommended strategies focus mainly on non-protected and non-catchment lands as these areas face the greatest pressures. Not withstanding, the strategy recognises that the whole landscape of the LGA including the extensive conservation reserves and protected catchment areas contribute to the region's biodiversity.

The Biodiversity Strategy provides a 'snapshot' of the flora and fauna values of the Wollondilly LGA with inventories of threatened and non-threatened flora and fauna derived from regional vegetation mapping, local studies and database searches. Threats to biodiversity are highlighted and this is generally framed in the context of Key Threatening Processes (KTP's) listed under Schedule 3 of the TSC Act. In addition to the flora and fauna inventories, the study provides vegetation mapping based on a standardised composite of the multiple regional vegetation mapping projects that incorporate various parts of the Wollondilly LGA (ELA 2004).

The strategy proposes eleven conservation targets to protect and improve biodiversity in the Wollondilly LGA. A number of prioritised strategies and actions are suggested to meet these conservation targets. Strategies and actions are prioritised according to WSC vision statements and goals and overall these strategies are designed to assist in reducing the loss of biodiversity within the WSC LGA (ELA, 2004).

3.2 Vegetation Mapping

3.2.1 Native Vegetation of the Cumberland Plain

Multiple regional vegetation mapping projects cover parts of the Wollondilly LGA. The *Native Vegetation of the Cumberland Plain, Western Sydney − 1:25 000 Map Series* (NPWS 2002a) incorporates the majority of the Wollondilly LGA into Maps 1 to 3 of the series including the Study Area and Subject Site. The *Native Vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities* (Tozer 2003) provides a survey of vegetation communities occurring on the Cumberland Plain and adjacent plateaus characterised by Wianamatta Shale soils. The Tozer (2003) study recognises that most of the native vegetation communities of the Cumberland Plain and neighbouring Wianamatta Shale geography are listed as threatened ecological communities (TEC) under the TSC Act. Due to the pressures of urban expansion in western Sydney and surrounding areas, part of the rationale for the survey was to address the need for quantitative data to assist in the identification of native plant communities and provide an assessment of the conservation value of vegetation remnants. The aim of the survey was to revise the existing plant community classification to take account of:

- Recently described vegetation communities and other communities warranting recognition;

- Provide quantitative data for characteristic species in each community (frequency of occurrence and relative abundance);
- Identify species showing high fidelity to each community as a basis for diagnosing community type in the field;
- Estimate the present cover of native vegetation; and,
- Derive a spatial model as a basis for predicting the vegetation type and conservation value of all remaining remnants.

The survey incorporated systematic, stratified field sampling to record floristic structure and composition, a classification procedure based on hierarchical, agglomerative clustering analysis, spatial modelling of community distributions using geological, climatic and topographic variables; and the interpretation of patterns in canopy composition and remnant condition in aerial photographs (Tozer 2003).

The NPWS (2002a) Cumberland Plain vegetation mapping is used as a reference for this study. Vegetation community descriptions from the Tozer (2003) study and *Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney, Final Edition* (NPWS 2002c) have been referenced to validate the presence or absence of native plant communities from the NPWS (2002a) mapping on the Subject Site following field surveys. Further, assessment of the occurrence and distribution of TEC's in this survey has been determined by referring to criteria and characteristic species from the final determinations for communities listed on the TSC and/or EPBC Act.

3.3 Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region

The *Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region* (DECC 2007) was a joint project undertaken by the Department of Environment and Conservation (now the Department of Environment, Climate Change and Water (DECCW)).

The main objective of this project was to gather and synthesise information to provide a greater understanding of the vertebrate fauna of the Greater Southern Sydney Region for use in land management. Specifically, this project aimed to (but is not limited to):

- Collect information on vertebrate fauna and to examine fauna at a bioregional context;

- Make this information accessible to land managers and the broader community for use in conservation planning;
- Identify all threatened fauna species occurring in the region as listed under the TSC Act or the EPBC Act (termed Species of Conservation Concern);
- Identify and assess the risk of all vertebrate and introduced pest species found with the region;
- Identify any additional fauna species that are thought to be in decline, isolated or regionally under threat;
- Identify particular locations, regions or habitats of high conservation significance for vertebrate fauna across the region and within each of the Special Areas;
- Identify all Key Threatening Processes (as defined under the TSC Act) which operate in the region, and assess how these are impacting on the natural values of the region; and,
- Identify faunal migration pathways within the Greater Southern Sydney Region, and any corridors between protected areas that would be a priority for addition to the reserve system, revegetation or other conservation measures.

Regional pathways were developed as a component of the project by identifying Species of Conservation Concern that undertake migrations, are nomadic or are large bodied, wide ranging and are likely to require landscape connections for their continued survival in the area. These are defined as primary landscape connections between larger important areas of habitat. The Wollondilly LGA is encompassed within the Southern Blue Mountains to Woronora Regional Pathway, an east-west link that covers a range of regional scale physiographic and climatic gradients. This link is an extremely important link between the two major sandstone plateaux of the region.

There are two separate fauna linkages that have been identified within this Regional Pathway; the Cumberland Koala Linkage and the Bargo Linkage. Fauna linkages are defined as areas comprising a single fauna habitat and are designed to facilitate the movement of a particular species, or a suite of species about the landscape. The Study Area is situated in close proximity of the Cumberland Koala Linkage which connects to the Bargo Linkage in the west.

3.3.1 Cumberland Koala Linkage

The Cumberland Koala Linkage consists of linked remnant vegetation around the edge of the Cumberland Plain, providing a connection of suitable habitat between the four Koala colonies at Wedderburn, Avon/Nepean, south Nattai and Glenbrook. In

addition to the Koala, other Species of Conservation Concern that have been identified to use this linkage include:

- Black-chinned Honeyeater (eastern subsp.);
- Diamond Firetail;
- Hooded Robin;
- Squirrel Glider;
- Speckled Warbler;
- Masked Owl;
- Spotted-tailed Quoll; and,
- Large-eared Pied Bat.

3.3.2 Bargo Linkage

The Bargo Fauna Linkage consists of the sandstone vegetation that links the sandstone plateau of the Woronora area with that of the southern Blue Mountains. It is the only remaining connection between these large patches of extant vegetation. This linkage facilitates the movement of migratory species and nomadic species between these plateaus, but it also connects populations of a number of species that utilise sandstone habitats. Species of Conservation Concern that may utilise this linkage include:

- Turquoise Parrot;
- Masked Owl;
- Koala;
- Spotted-tailed Quoll;
- Squirrel Glider; and,
- Large-eared Pied Bat.

3.4 Draft Wollondilly Local Environmental Plan 2009

The *Draft Wollondilly Local Environmental Plan 2009* has been prepared according the NSW Standard Instrument. The Draft WLEP was placed on public exhibition from November to December 2009. In guiding the development and planning decisions for

land in Wollondilly Shire, the Draft WLEP sets a number of aims including many that consider the management of biodiversity in the LGA. Specific aims of the Draft WLEP that consider biodiversity are:

- To provide protection and conservation measures for native flora, fauna and areas of high ecological value;
- To protect and enhance watercourses, riparian habitats and wetlands to maintain or improve water quality; and,
- To ensure new development is designed and located to minimise conflict with existing land uses.

The Draft WLEP addresses the management of biodiversity in multiple components of the planning and assessment process. These include zonings that have conservation as the primary land use. Additionally the Draft WLEP has specific biodiversity management objectives listed for other rural and residential zonings and 'Clause 7.9 Development on environmentally significant land'. A range of other mechanisms and guides, also support the planning for and management of, biodiversity in the Draft WLEP.

Accompanying the Draft LEP is the *Draft Wollondilly Development Control Plan 2009* (Draft WDCP) (2009). The Draft WDCP was placed on public exhibition in conjunction with the Draft WLEP and it provides the technical detail for the implementation of the Draft WLEP. Volume 1 of the Draft WDCP provides specific details relevant to all forms and types of development and all future development applications. This includes information on state or federal legislation, which must be considered for development applications such as the TSC and EPBC Acts and *Native Vegetation Act* 2003. The specific requirements for actions such as retention of trees and vegetation, heritage conservation and development in water catchment areas are addressed in the Draft WDCP.

The key section of the Draft WDCP relating to the management of biodiversity is '2.3 Tree and Vegetation Provisions'. This section specifies the requirements for the protection and preservation or clearing of trees and bushland vegetation for where development consent is, or is not, required. The detailed planning and assessment provisions under section 2.3 include guidance and controls for certain actions such as tree or vegetation removal and development near riparian areas.

Clause 7.9 'Development on environmentally significant land' of the Draft WLEP applies to land identified as Environmentally Significant Land (ESL) and land identified as Riparian Land (RL). Land currently classified as ESL or RL is mapped in the Draft WLEP. Any development application proposal within an area identified as ESL according to the draft maps must meet the provisions of Clause 7.9 from the Draft

WLEP and Section '2.3.9 Requirements for Environmentally Significant Land' (ESL) of the Draft WDCP. The characteristics of land determined as ESL include part or all of the following features:

- Threatened Ecological Communities (TEC's);
- Core Vegetation and Critical Habitats.
- Flora and fauna corridors;
- Habitat for threatened species;
- Key areas of biodiversity; and,
- Riparian corridors along major rivers, creeks and their tributaries.

As part of the Draft WDCP, WSC has developed a rating system that classifies ESL into 5 categories. Primarily, the categories from 1 to 5 consider the quality and integrity of the vegetation and are designed to ensure that biodiversity is considered as part of the development assessment process. The rating system highlights vegetation through its location, conservation and biodiversity values, opportunities to link areas of strategic importance, the potential of the vegetation in supporting threatened species and water quality outcomes. The five vegetation categories form the basis of the current ESL draft maps.

4.0 FLORA RESULTS

The results of the flora survey are presented separately for each of the three Study Areas included within this study. The species list for all three sites is presented in Appendix 1.

4.1 Study Area A

4.1.1 Vegetation **description**

Study area A includes two possible pumping station locations, shown in the Project Brief as A1 and A2. Past land use in the area, involving clearing of native vegetation and ongoing grazing, have resulted in a simplified vegetation community with relatively low diversity of native species. The vegetation at both of these locations is characterised by *Eucalyptus tereticornis* in the canopy, with a predominantly cleared mid-storey and a ground layer dominated by exotic grasses. *Eucalyptus moluccana* and *Eucalyptus globoidea* are also present. The *E. tereticornis* occur more densely in A1 and the canopy is connected through most of the area. *E. tereticornis* is present as

sparsely scattered individual trees and small clumps in A2. Native grasses and groundcovers including *Microlaena stipoides, Themeda australis and Dichondra repens* occur sparsely throughout the Study Area and are most abundant along the property boundary fence and within the road verge. Areas within the Study Area adjacent to the proposed pumping station locations are entirely cleared of canopy species. The road verge where the rising main is proposed along Cross Street and Myrtle Creek Avenue is dominated by exotic grasses and is regularly mown.

4.1.2 Plant Species

The field survey recorded 30 species from Study Area A (Appendix 1). This includes 15 locally occurring native species and 15 exotic species. No noxious weeds were recorded.

4.1.3 Plant communities

The Cumberland Plain Mapping (NPWS 2002) shows the vegetation community Shale Sandstone Transition Forest to occur over Study Area A. Shale Sandstone Transition Forest is a TEC listed as endangered on the TSCA Act and the EPBC Act.

The diversity of native species within the Study Area is significantly reduced; however the native species present, soil type and the position in the landscape correspond with the description in the NSW Scientific Determination for Shale Sandstone Transition Forest. This study has determined vegetated parts of Study Area A, including the Subject site at possible location A1 and some of the Subject Site At location A2 are representative of Shale Sandstone Transition Forest in a degraded form of the community. Cleared areas within the study site including the road verge where the rising main is proposed are Exotic Closed Grassland. Figure 6a shows the vegetation community mapping for Study Area A.

There are no threshold criteria for the EPBC Act listed community currently available. However available policy statements for similar TECs require a predominantly native understorey of 30-50% to be present in order to meet the threshold criteria for the TEC. Due to a significantly modified understorey vegetation within Study Area A is not considered to be the EPBC Act listed TEC.

4.2 Study Area B

4.2.1 Vegetation description

Study Area B is characterised by Eucalyptus species in the canopy with few mid-story species present and a ground layer dominated by exotic grasses. As in Site A previous clearing and ongoing grazing has reduced the diversity of native species significantly. The canopy is dominated by *E. tereticornis* and *Eucalyptus fibrosa* with

E.moluccana, *E.globoidea* and *E.punctata* also present. Canopy trees occur sparsely as individuals and include one very large *E.teretecornis* and one very large *E.fibrosa* each to approximately 30 metres. There is also a dense stand of *Acacia decurrens* covering approximately 200 square metres. Native grasses and groundcovers include; *M.stipoides Entolasia marginata, Glycine clandestina* and *Hardenbergia violaceae*. The road verge where the rising main is proposed along Progress Street is dominated by exotic grasses which are regularly mown as well as mature *E. tereticornis* occurring as individual street trees. The northern boundary of the property to the far north of the Study Area where the rising main is proposed is planted with exotic and non local native species including *Casuarina sp*. The ground layer vegetation consists of exotic grasses. Access to this property was restricted; however observations from the road verge were adequate to confirm there are no matters of conservation significance within this part of the Study Area

Directly to the south of Study Area B is an area of approximately 4 hectares of bushland in good condition with native species dominant in all strata.

4.2.2 Plant Species

The field survey recorded 49 species from Study Area B (Appendix 1). This includes 33 locally occurring native species and 16 exotic species. No noxious weeds were recorded. The increase in native species present compared with Study Area A is attributed to a higher concentration of native groundcover species occurring along the boundary of the Study Area adjacent to healthy bushland.

4.2.3 Plant communities

The Cumberland Plain Mapping by NPWS (2002) shows the vegetation community Shale Sandstone Transition Forest to occur over Study Area B As for Study Area A the species diversity is significantly reduced by past and current land use; however the intact bushland to the south of the site represents Shale Sandstone Transition Forest. Although degraded in nature the Study Area supports a similar suite of native species to this area and this study concludes the same community occurs within the Study Area. The species recorded within the Study Area, soil type and position in the landscape concur with the NSW Scientific Determination, and this study has determined vegetated parts of Study Area B are representative of TSC Act listed Shale Sandstone Transition Forest TEC in a degraded form of the community. Cleared areas within the Study Area including the road verge where the rising main is proposed are Exotic Closed Grassland. Figure 6b shows the vegetation community mapping for Study Area B.

As for Study Area A, due to a significantly modified understorey, vegetation within Study Area B is not considered to be the EPBC listed TEC.

4.3 Study Area C

4.3.1 Vegetation description

Study Area C has been grazed until recently and is currently dominated by exotic grasses and annual weeds. One *E. tereticornis* occurs on the northern boundary fence adjacent to the Study Area. A small clump of sapling *E. tereticornis* occur within the Study Area. The site has previously been cleared. Mature *Acacia decurrens* are scattered sparsely over the Study Area and are the only native mid-storey species present. The road verge where the Rising Main is proposed along Marion and Rita Street is mown exotic grass with planted exotic and non local native tree species.

4.3.2 Plant Species

The field survey recorded 30 species from Study Area C (Appendix 1). This includes 11 locally occurring native species and 19 exotic and non local native species. One noxious weed was recorded:

- *Rubus fruiticosus* (aggregate) (Blackberry) – Class 4. 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

4.3.3 Plant communities

The Cumberland Plain Mapping NPWS (2002) shows the vegetation communities Cumberland Plain Woodland (Shale Hills Woodland) and Shale Sandstone Transition Forest to occur at the edges of Study Area C. The low diversity of native species present does not constitute a native vegetation community therefore Study Area C does not support the TEC as indicated in the Cumberland Plain Mapping. The vegetation community over Study Area C is Exotic Closed Grassland with some exotic plantings.

4.4 Threatened flora

Fourteen species of national or state significance appear on database searches within 10km of the three Subject Sites (Figure 4). Thirteen of these are listed on the NSW TSC Act and all 14 species are listed on the EPBC Act. Targeted searches conducted at each Study Area during the field survey recorded no occurrence of Threatened flora on any of the three sites. An assessment of the likelihood of occurrence within the Study Areas based on the habit requirements for each species is presented in Appendix 3. This assessment has found that none of the threatened species recorded in the database search has higher then a low likelihood of occurrence within the Study Areas.

5.0 FAUNA RESULTS

5.1 Terrestrial Fauna Habitats

5.1.1 Study Area A

Study Area A consists of cleared Exotic Closed Grassland with areas of scattered *E .teretacornis* forming an open woodland habitat. Canopy connectivity is of moderate density, allowing for some sunlight to reach the ground, providing suitable basking sites for reptiles, although no reptiles were recorded during the field investigation. The remainder of the Subject Site, including habitat along the route of Rising Main A, consists of an open exotic grassland habitat.

Very few hollow bearing trees were observed in the Subject Site. Tree hollows provide critical shelter and nesting habitat for a range of hollow dependent fauna, including threatened species of microbats and birds. Given the limited supply of mature hollow-bearing trees in this habitat, those that are present are likely to provide roosting and nesting opportunities for these species.

Given that there are limited sheltering, breeding and foraging opportunities available for fauna species utilising the Subject Site at Study Area A, fauna habitat is considered to be of **moderate** conservation value in the open woodland and **poor** conservation value in the open exotic grassland habitat.

5.1.2 Study Area B

Study Area B consists of cleared exotic grassland with remnant trees and two stands of *A.decurrens* reaching to 10 metres in height. A small flock of Australian Magpies *Cracticus tibicen* were recorded foraging in the open groundcover of leaf litter under these stands. Very few other fauna species were recorded.

Habitat located along the route of Rising Main B has been cleared and maintained as an access trail or asset protection zone for the house previously located on the property fronting Progress Street. Very few habitat features exist in this area of the proposed works.

Several large remnant trees are present in Study Area B and adjacent to the proposed location for Rising Main B. Although canopy connectivity is limited, these trees act as stepping stones for birds migrating locally to remnant stands of bushland such as that located on adjoining land to the south of the Subject Site. Two of the trees that formed part of this habitat support hollows and fissures which may provide potential roosting habitat for several fauna species such as the Eastern Rosella *Platycercus eximius.* This species, as well as the introduced Common Myna

Acridotheres tristis, which also nests in tree hollows, were recorded foraging in canopy trees in remnant bushland adjacent to the Subject Site.

The majority of the shrub layer over Study Area B has been removed and the ground layer is heavily grazed by domestic cattle, which were observed during field investigations. Although there are few areas of accumulated woody debris and leaf litter, one large hollow-bearing log is present providing potential sheltering habitat for reptiles.

A small ephemeral drainage line is present running east-west across the Subject Site. At the time of field survey, this drainage line contained one small pool, approximately one metre across.

Although very limited, Study Area B provides some sheltering, breeding and foraging habitat for native fauna species in the form of tree and ground hollows, and large remnant trees. Therefore the fauna habitat is considered to be of **moderate** conservation value.

5.1.3 Study Area C

The majority of native vegetation has been removed from the Subject Site at Study Area C. The Study Area consists of a cleared exotic grassland habitat with a limited number of habitat resources for native fauna species. The vegetation consisted of a dense weedy understorey up to 1.5m in height. Woody debris and urban refuse are present in the ground layer providing sheltering habitat for reptiles including the Bearded Dragon *Pogona barbata* and Blue Tongue Lizard *Tiliqua scincoides*.

The shrub layer has been completely cleared; however scattered Acacia trees approximately 8m in height are present. One semi-mature *E. tereticornis* tree and one *E. tereticornis* sapling are present within the area of the proposed works. All fauna species detected during field investigations were recorded adjacent to the Subject Site in the canopy of surrounding *E.punctata, Eucalyptus crebra* and *E. tereticornis* and around farm dams.

Very little breeding, foraging or sheltering habitat is present within the Subject Site for amphibians, mammals or birds, however there is limited sheltering habitat for reptile. Given that the majority of native vegetation has been removed, the fauna habitat is considered to be of **poor** conservation value.

5.2 Animal Species

Incidental observations of animal species recorded over the three Study Areas are listed in Appendix 2. A total of 34 fauna species were recorded across the three Study Areas, which included 28 (82 %) native species, three of which were anecdotal

records. The most abundant fauna group recorded were birds with 26 species recorded. No threatened species or migratory species were recorded during field surveys. A total of six introduced fauna species were recorded.

Table 2: Summary of fauna recorded during the field survey

Group	Native species			Introduced species		
	Study Area A	Study Area B	Study Area C	Study Area A	Study Area B	Study Area C
Amphibians	0	0	0	0	0	0
Reptiles	0	0	3	0	0	0
Birds	11	14	16	1	2	1
Mammals	1	1	0	2	4	2
TOTAL	**12**	**14**	**19**	**3**	**6**	**3**

5.3 Threatened Species of Animals

Thirty-four species of national or state significance appear on database searches within 10km of the three Subject Sites (Figure 4, Appendix 3). Of these, all are listed under the TSC Act and 9 are listed under the EPBC Act.

No threatened fauna were recorded during field surveys and 15 fauna species were considered to have a moderate likelihood to occur within the Study Areas on the basis of previous records and the presence of suitable habitats (Appendix 3). For the majority of these species the habitats present in the Subject Sites within the larger Study Area may comprise marginal foraging or they may act as movement corridors to more preferable and better quality habitat in the locality.

5.4 Koala Habitat Assessment

SEPP 44 applies to land within local government areas (LGA's) listed in SEPP 44, Schedule 1 (including Wollondilly LGA) for which a development application has been made (SEPP 44, Section 6) and Council is the consent authority. Under this policy the following distinction is made between 'potential' and 'core' Koala habitat:

- "Potential Koala Habitat" means 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.

- "Core Koala Habitat" means 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.

As the proposed works are within a Part 3A application under the EP&A Act and will not be assessed by council, SEPP 44 does not apply. However this assessment is relevant as Sydney Water considers it important to assess the impact of the proposal on Koala habitat should this occur within the Study Areas.

There are no known records of Koalas occurring on any of the three Study Areas or in adjoining bushland areas. No Koalas were observed or heard calling during field surveys, nor were any scats or tree scratchings observed on or near trees within the Study Areas. Therefore none of the Study Areas constitute Core Koala Habitat.

Forest Red Gum *E. tereticornis*, considered a Koala feed tree (as listed on SEPP 44), was recorded at Study Areas A, B and C of the Locality. However, given this species does not constitute at least 15% of the total number of canopy trees where present, the Study Areas are not considered to be potential Koala habitat and as such any modification of this vegetation is unlikely to impact this species.

5.5 Migratory Species

Eleven species listed under the migratory provision of the EPBC Act appear on database searches within 10km of the three Subject Sites (Appendix 3). The likelihood for these species occurring within the Study Areas has been assessed. (Appendix 3).

Australia is a signatory to international agreements aimed at protecting migratory species. These include the *Japan Australia Migratory Bird Agreement* (JAMBA), the *China Australia Migratory Bird Agreement* (CAMBA), the *Republic* of *Korea Australia Migratory Bird Agreement* (RoKAMBA), and the *Bonn Convention on the Conservation of Migratory Species of Wild Animals*. Migratory species are considered to be Matters of National Environmental Significance and as such are protected under the EPBC Act.

While migratory bird species may potentially use the locality (see Appendix 3), the Study Area would not be classed as an 'important habitat' as defined under the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DEWHA 2009) because the site does not contain:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- Habitat that is of critical importance to the species at particular life stages;
- Habitat utilised by a migratory species which is at the limit of the species range; and

- Habitat within an area where the species is declining.

6.0 IMPACT ASSESSMENT

The potential impacts of the proposal have been assessed according to the proposed locations of the pumping stations and rising mains within the three Study Areas. The footprint of the pumping station has been considered as well as excavation required for the pumping station and rising mains at each site. The construction / installation phase is considered to be the cause of the primary impacts. The long-term impact of the ongoing operation of the pumping stations and rising mains may include overflows from pumping stations during operation.

Potential impacts include;

- Tree removal and removal of other vegetation;

Two possible pumping site locations, A1 and A2 are identified for Site A. The pumping station at location A1 would be installed within a group of approximately 15 *E. tereticornis*. This will require up to eight trees to be removed. A further seven trees would be within the construction footprint. A worst case scenario may require up to 15 trees to be removed to allow for construction. This is based on an approximate construction footprint for the pumping station of 2100 square metres and an actual footprint of approximately 500 square metres. The trees are 15 to 20 metres tall with a diameter at breast height (DBH) of approximately 20 - 40 cm and appear to be in good health. The removal / disturbance of these trees would result in a reduction of the extent and condition of the Shale Sandstone Transition Forest TEC within the Study Area. This impact would also reduce biodiversity on the site due to the reduced habitat for birds, insects and arboreal mammals and reduce the habitat value of the Study Area through increased fragmentation of a group of trees currently with connectivity in the canopy.

Removal of canopy increases the risk of weed invasion and erosion by surface water runoff. However the understorey is currently dominated by exotic grasses and annual weeds therefore this amount of tree removal would not cause a significant change in this regard.

The location of the proposed pumping station in Study Areas C is unlikely to require removal of native trees however one mature tree at Study Area B is within the Subject Site and will potentially be impacted by construction activities and may require removal to allow for construction of the pumping station.. The vegetation within the footprint for the pumping station at these sites is dominated by exotic grasses with

some native grass and groundcover species present. The rising mains at each of the three Study Areas are positioned to avoid the removal of trees.

- Root disturbance to trees caused by excavation for pumping stations and trenching to install rising mains.

Trenching is required for the installation of 150mm and 225mm rising mains at Study Areas A and C and at Study Area B respectively. The rising main at Study Area B is parallel to the edge of bushland directly south of the Study Area and is potentially within the root zone of trees in this area particularly where the main reaches the bushland edge at Progress Street. Native trees along Progress Street, Study Area B may also be affected by trenching. Trenching within the root zone of native trees poses a risk of damage and severance of roots which will affect the health and longevity of the tree. There is a risk of root damage to trees at Study Area A for both proposed pumping station locations. This risk however is less than at Study Area B as the rising main and required trenching is within the root zone of fewer trees. There is no risk of root disturbance from the proposal to native trees at Study Area C.

- Potential overflow from pumping stations during operation.

Potential overflow from pumping stations poses a risk of impact to native vegetation present within the Subject Sites for the three Study Areas. Overflow from pumping stations may result in excess soil nutrients potentially causing adverse affects to the health and longevity of native flora species and increasing weed invasion.

The potential impacts from the proposal listed above are assessed in more detail in the Assessment of Significance in Appendix 4 where these may impact on the TEC Shale Sandstone Transition Forest.

7.0 CONCLUSIONS AND RECOMMENDATIONS

This report assesses the ecological significance of the flora and fauna within the three Study Areas proposed as part of the Picton Sewerage Scheme boundary modification with a particular focus on threatened plant and animal species, threatened populations and TEC's that occur, or have the potential to occur within the Study Areas. The potential impacts of the proposed pumping stations and rising mains at each of the three Study Areas has been assessed and measures to minimise impacts identified.

Desktop research including database searches for threatened biodiversity potentially occurring within the Study Areas have been conducted and background research into the Wollondilly LEP and Biodiversity Strategy has informed the field survey effort and provides a context for this study.

Database searches recorded 14 species of threatened flora and 34 species of threatened fauna within the Locality of the Study Areas. An assessment of the likelihood for these species to occur within the Study Areas has found there is no likelihood of any flora species and a moderate likelihood of 15 fauna species occurring within the Study Areas. No threatened flora or fauna species were recorded during field surveys.

The NPWS Cumberland Plain Mapping (2002) shows the TEC Shale Sandstone Transition Forest to be mapped within Study Area A and Study Area B and Shale Sandstone Transition Forest and Cumberland Plain Woodland to occur at the edges of Study Area C. The field survey confirmed the presence of Shale Sandstone Transition Forest at Study Areas A and B. Shale Sandstone Transition Forest is listed as endangered on the TSC Act.

Potential impacts of the proposal have been assessed according to the proposed positions of the pumping stations and rising mains within the three Study Areas. The potential impacts of the proposal include removal/disturbance of native canopy trees at Study Area B, root disturbance to trees caused by trenching for the installation of rising mains at Study Areas A and B and overflow from pumping stations during operation at all three Study Areas.

An Assessment of Significance (Appendix 4) has been conducted to assess the impact of the proposal on the TEC Shale Sandstone Transition Forest. This assessment concludes that the proposal will not have a significant impact on the habitat or habitat connectivity of Shale Sandstone Transition Forest occurring at Study Areas A and B and will not represent a significant affect on the current disturbance regime.

Recommendations

The following recommendations are made to minimise the potential impacts on the general biodiversity and environment of the three Study Areas. The recommendations cover the direct impacts of the proposal caused during the construction / installation phases of the project as well as ongoing impacts.

- Position pumping stations to minimise tree removal. For Study Area A the second possible pumping station location (A2) would minimise the requirement to remove native trees. There is also a clear area to the north east of location A1 that may not require tree removal;

- Position rising mains to minimise trenching required within the tree protection zone of native trees. A tree protection zone is defined as up to 15 x the trees diametre at breast height (DBH);

- Pruning tree roots encountered during trenching works in any location should be according to AS 4373 - 2007 Pruning of amenity trees (Standards Australia, 2007);

- Tree protection measures should be implemented according to AS 4970 – 2009 Protection of trees on development sites (Standards Australia, 2009) Plants should be of local provenance for any trees potentially impacted by the proposal;

- Trees, mid-storey and ground-layer species should be planted to replace native vegetation removed or disturbed as a result of the proposal. Plants must be of local provenance and be species occurring within the vegetation community. Tubestock is recommended. Planting a mix of species in dense clusters (three to six tubes per square metre) will provide good habitat and reduce the requirement for weeding within planted areas.

- Areas of soil disturbance resulting from the construction / installation phases of the proposal should be managed to prevent these areas being colonised by weeds. Disturbed areas should be mulched. Disturbed grass areas should be re turfed. A weed control program is recommended.

- Installation of sediment and erosion controls as required;

- Excavated trenches are to be covered when construction sites are not active (i.e. overnight or weekends) to prevent accidental entrapment of native fauna;

- Machinery parking, equipment or materials storage compounds, temporary stockpiling of excavated material and work areas are to be in cleared parts of the Subject Sites away from creeks and drainage lines. These construction tasks are not to occur in any area identified in this assessment as supporting a native plant community as mapped in Figures 6a, and 6b of this report.

- A Construction Environmental Management Plan or similar should incorporate recommendations to mitigate the potential impacts from the construction phase of the project.

FIGURES

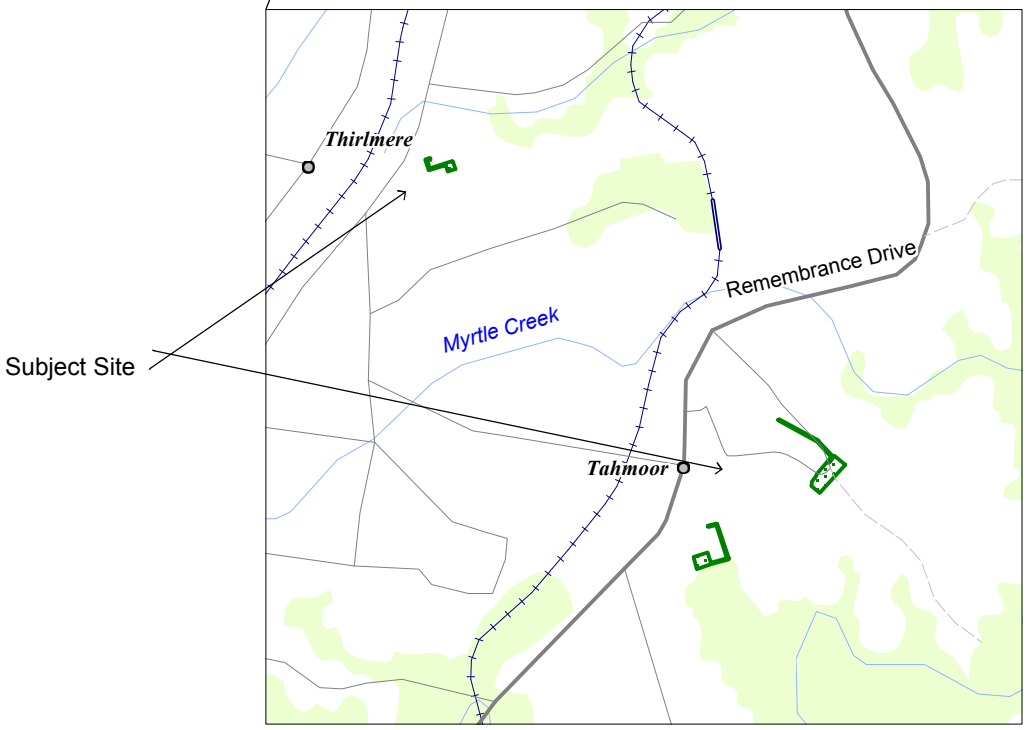

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Figure 1: Location of the Study Area in a regional context

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File number: 12711	Checked by: BC
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Scale: 0 0.5 1.0 1.5 2.0 kilometres

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Figure 2a: Overview of Study Area A.

Date: 11 March 2011	Drawn by: ANP
File number: 12711	Checked by: BC
Location:-..P:\12700s\12711\Mapping\12711 F2a_Overview.WOR	

Acknowledgements:
Sydney Water

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metres

Scale: 1:2,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Figure 2a

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Figure 2b: Overview of Study Area B.

Date: 23 February 2011	Drawn by: ANP
File number: 12711	Checked by: BC
Location:-..P:\12700s\12711\Mapping\12711 F2b_Overview.WOR	

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Scale: 1:2,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Figure 2b

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Figure 2c: Overview of Study Area C.

Date: 23 February 2011	Drawn by: ANP
File number: 12711	Checked by: BC
Location:-..P:\12700s\12711\Mapping\12711 F2c_Overview.WOR	

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Grid: Map Grid of Australia, Zone 56

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Figure 2c

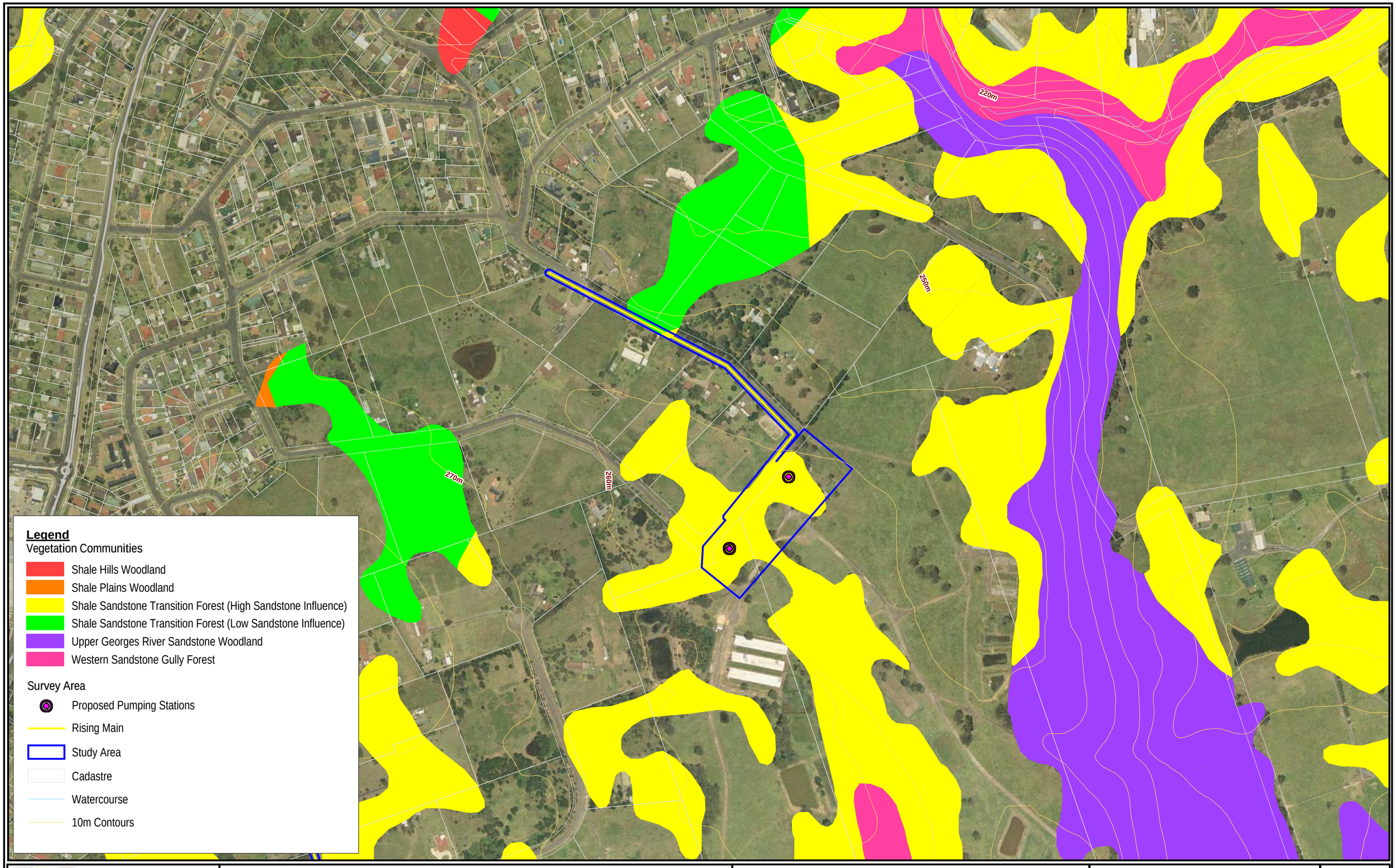

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Figure 3a: Distribution of vegetation communities over Study Area A from NPWS Cumberland Plain mapping.

Date: 11 March 2011	Drawn by: ANP
File number: 12711	Checked by: BC
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Acknowledgements:
Sydney Water
NPWS

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Figure 3a

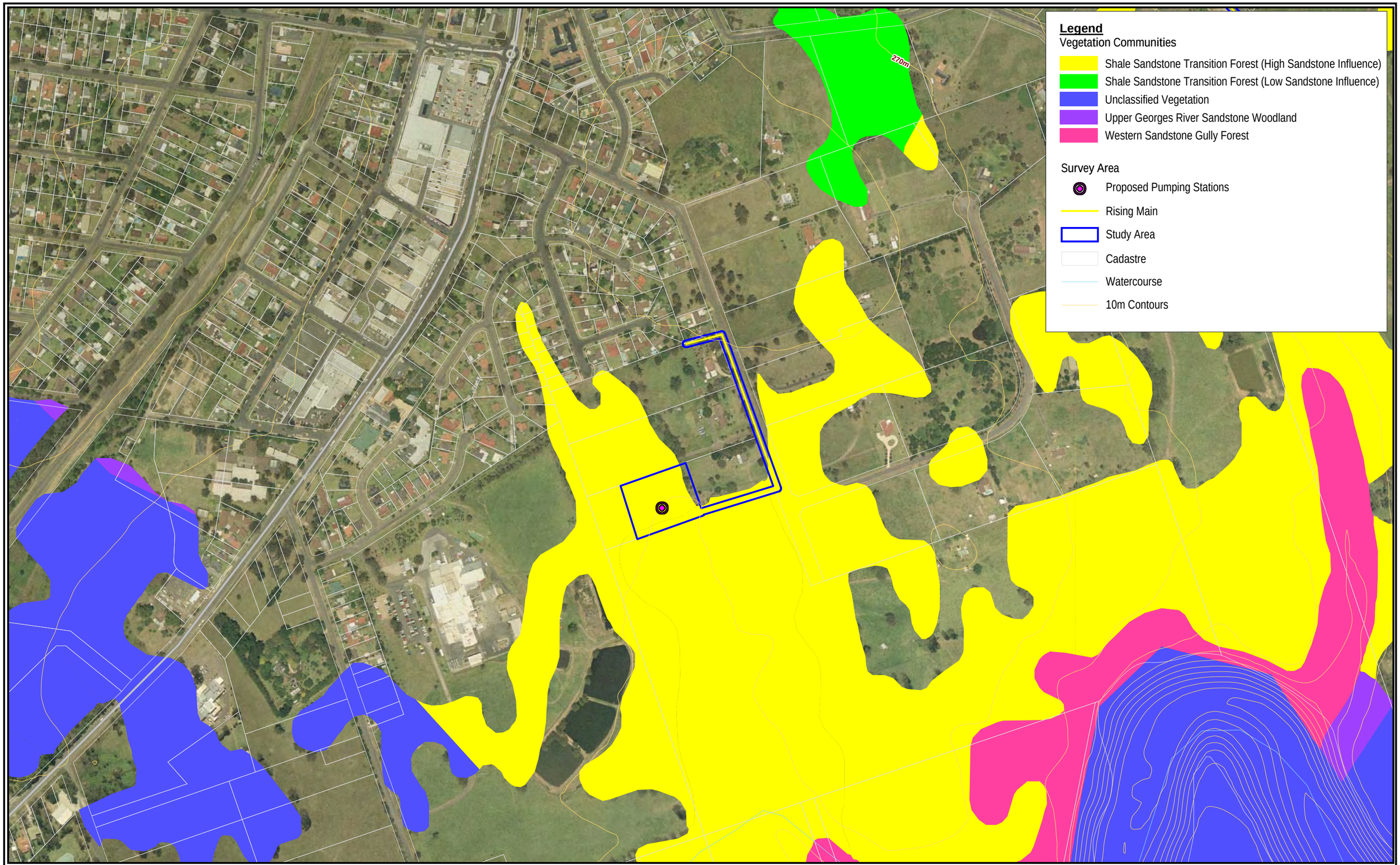

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Figure 3b: Distribution of vegetation communities over Study Area B from NPWS Cumberland Plain mapping.

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Acknowledgements:
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NPWS

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Scale: 1:5,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
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Figure 3b

Legend

Vegetation Communities

- Shale Hills Woodland
- Shale Plains Woodland
- Shale Sandstone Transition Forest (High Sandstone Influence)
- Shale Sandstone Transition Forest (Low Sandstone Influence)
- Upper Georges River Sandstone Woodland

Survey Area

- Proposed Pumping Stations
- Rising Main
- Study Area
- Cadastre
- Watercourse
- 10m Contours

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Figure 3c: Distribution of vegetation communities over Study Area C from NPWS Cumberland Plain mapping.

Date: 11 March 2011	Drawn by: ANP
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Acknowledgements:
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NPWS

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Grid: Map Grid of Australia, Zone 56

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Figure 3c

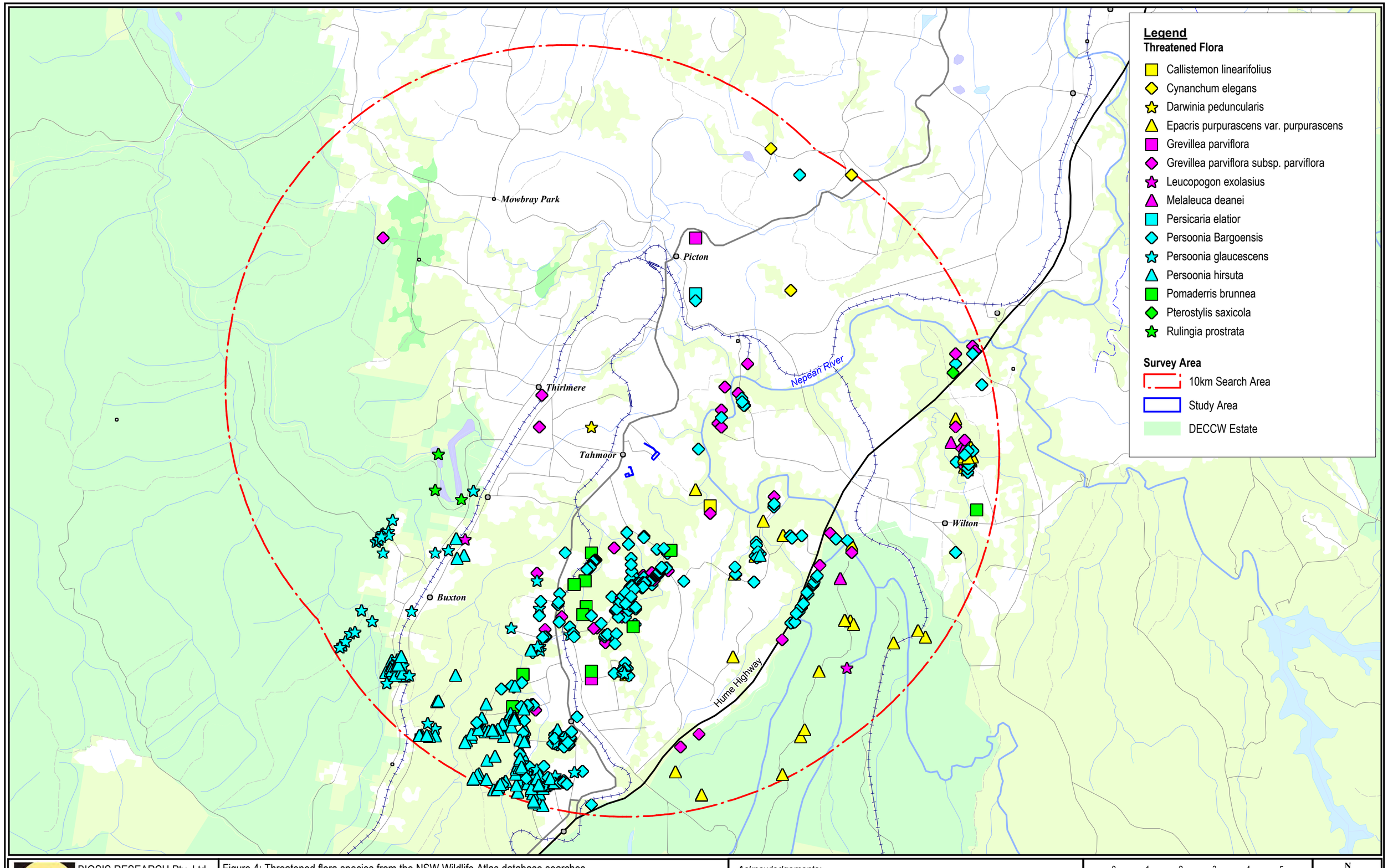

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Figure 4: Threatened flora species from the NSW Wildlife Atlas database searches.

Date: 23 February 2011	Drawn by: ANP
File number: 12711	Checked by: BC
Location:-..P:\12700s\12711\Mapping\12711 F4_Flora.WOR	

Acknowledgements:
Species data DECCW/NPWS and Biosis Research Pty Ltd

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Figure 4

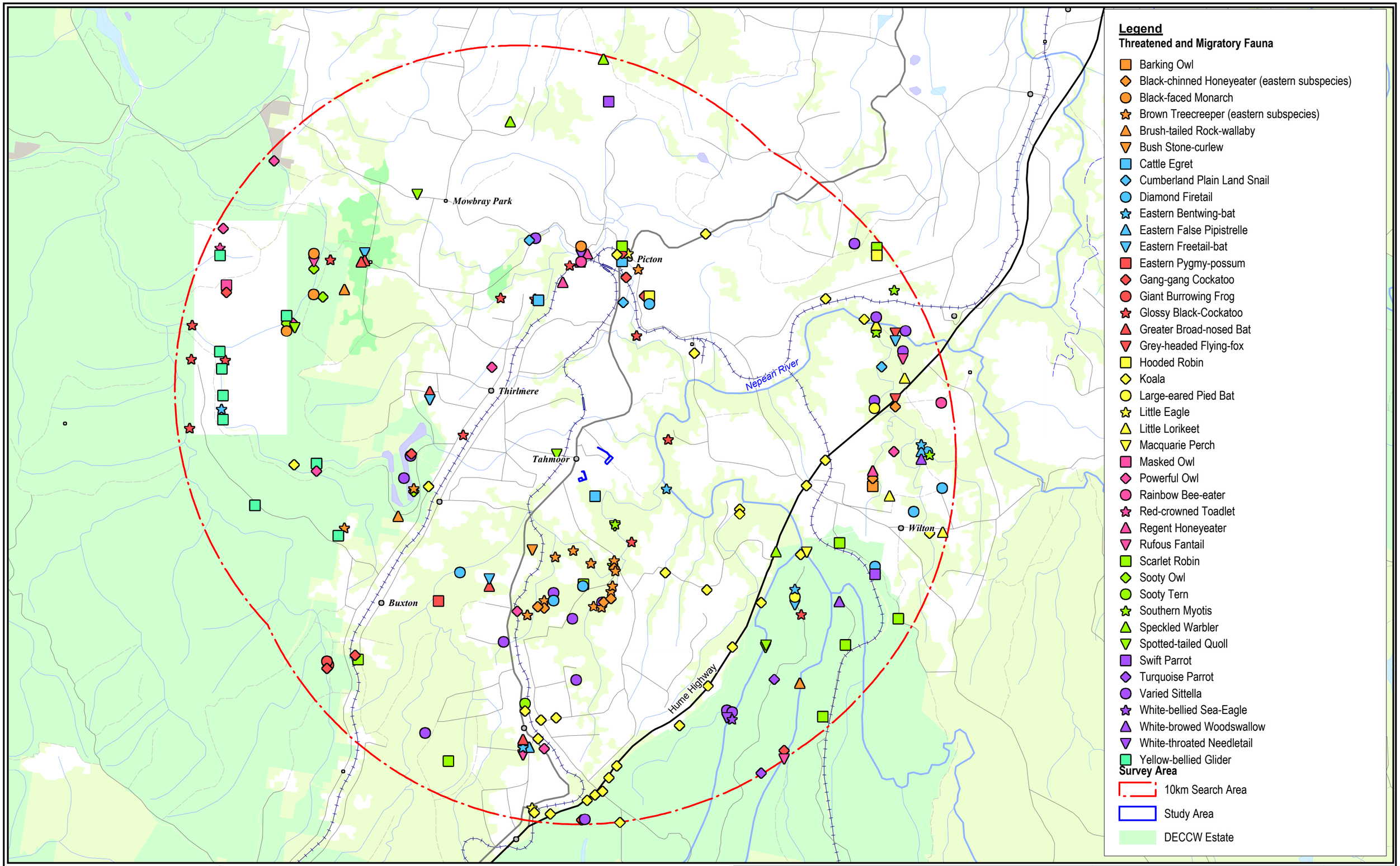

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Figure 5: Threatened and migratory fauna species from the NSW Wildlife Atlas database searches.

Date: 23 February 2011	Drawn by: ANP
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Acknowledgements:
Species data DECCW/NPWS and Biosis Research Pty Ltd

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Figure 5

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Figure 6a: Vegetation mapping of the current Biosis Research surveys.

Date: 24 February 2011	Drawn by: ANP
File number: 12711	Checked by: BC
Location:-..P:\12700s\12711\Mapping\12711 F6a_Biosis Vegetation.WOR	

Acknowledgements:
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Scale: 1:2,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Figure 6a

Legend

Vegetation Community

- Shale Sandstone Transition Forest
- Closed Exotic Grassland

Survey Area

- Proposed Pumping Stations
- Rising Main
- Study Area
- Cadastre
- Watercourse
- 10m Contours

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Figure 6b: Vegetation mapping of the current Biosis Research surveys.

Date: 24 February 2011	Drawn by: ANP
File number: 12711	Checked by: BC
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Acknowledgements:
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Scale: 1:2,000 at A3
Map Projection: Transverse Mercator
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Grid: Map Grid of Australia, Zone 56

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Figure 6b

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Figure 6c: Vegetation mapping of the current Biosis Research surveys.

Date: 24 February 2011	Drawn by: ANP
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Scale: 1:2,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Figure 6c

APPENDICES

APPENDIX 1

Flora Species Inventory Study Areas A, B and C

Latin Name	Common Name	EPBC Act	TSC Act	Nox Weed & Class	Site A	Site B	Site C
Native Species							
Acacia decurrens	Black Wattle				*	*	*
Acacia implexa	Hickory Wattle				*		
Alocasia brisbanensis	Cunjevoi						*
Alternanthera sp.							*
Bothriochloa macra	Red Grass					*	
Brachychiton populneus	Kurrajong					*	
Bursaria spinosa	Native Blackthorn				*	*	
Callistemon sp. hybrid							*
Calotis dentex						*	
Cassytha sp.						*	
Casuarina sp.						*	
Centella asiatica	Pennywort					*	
Chloris truncata	Windmill Grass					*	
Dichondra repens	Kidney Weed				*	*	
Echinochloa colona	Awnless Barnyard Grass					*	
Echinopogon caespitosus						*	
Echinopogon ovatus	Forest Hedgehog Grass					*	
Einadia hastata	Berry Saltbush					*	
Einadia trigonos	Fishweed				*		*
Entolasia marginata	Bordered Panic					*	
Eucalyptus fibrosa	Red Ironbark					*	
Eucalyptus globoidea	White Stringybark				*	*	
Eucalyptus microcorys	Tallowwood					*	
Eucalyptus moluccana	Grey Box				*	*	
Eucalyptus punctata	Grey Gum					*	
Eucalyptus sp.						*	
Eucalyptus tereticornis	Forest Red Gum				*	*	*
Glycine clandestina						*	
Glycine tabacina						*	*
Grevillea robusta e	Silky Oak						*
Hardenbergia violacea	False Sarsaparilla				*	*	
Juncus sp.						*	
Melaleuca linariifolia						*	
Melia azedarach	White Cedar					*	
Microlaena stipoides					*	*	*
Persicaria decipiens	Slender Knotweed				*		
Pittosporum undulatum	Sweet Pittosporum						*
Pseuderanthemum	Pastel Flower					*	

variabile							
Latin Name	**Common Name**	**EPBC Act**	**TSC Act**	**Nox Weed & Class**	**Site A**	**Site B**	**Site C**
Rumex brownii	Swamp Dock				*		*
Setaria sp.					*	*	
Sigesbeckia orientalis					*		
Solanum prinophyllum	Forest Nightshade					*	
Themeda australis	Kangaroo Grass				*	*	
Introduced Species							
Araujia hortorum					*		*
Bidens pilosa	Cobbler's Pegs				*		
Centaurium erythraea	Common Centaury					*	*
Chenopodium album	Fat Hen						
Conyza bonariensis	Flaxleaf Fleabane				*		
Cynodon dactylon	Common Couch				*	*	*
Cyperus eragrostis	Umbrella Sedge					*	*
Digitaria sanguinalis	Crab Grass				*		
Ehrharta erecta	Panic Veldtgrass					*	
Lactuca serriola	Prickly Lettuce					*	*
Ligustrum lucidum	Large-leaved Privet				*		
Ligustrum sinense	Small-leaved Privet					*	
Liquidambar styraciflua	Liquid Amber					*	
Lonicera japonica	Japanese Honeysuckle				*		*
Modiola caroliniana	Red-flowered Mallow				*		
Onopordum acanthium							*
Oxalis corniculata	Creeping Oxalis				*	*	*
Paspalum dilatatum	Paspalum					*	*
Pennisetum clandestinum	Kikuyu Grass				*	*	*
Phalaris aquatica	Phalaris				*	*	*
Rubus fruiticosus (aggregate)	Blackberry complex			N4			*
Senecio madagascariensis	Fireweed						*
Sida rhombifolia	Paddy's Lucerne				*	*	*
Solanum nigrum	Black-berry Nightshade				*	*	*
Solanum pseudocapsicum	Madeira Winter Cherry					*	*
Sporobolus africanus	Parramatta Grass				*	*	
Trifolium repens	White Clover						*
Verbena bonariensis	Purpletop						*

APPENDIX 2

Fauna inventory

Fauna species recorded during the field surveys and known from the Locality from database records

Key: Observation Type: O – observed, W – Heard, P – scats; F =- Indirect evidence (sap-feeding incisions, diggings, tracks);
TSC Act, EPBC Act status E – Endangered V – Vulnerable; M – migratory under; * - Introduced species.

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Amphibians	*Crinia signifera*	Common Eastern Froglet						26
Amphibians	*Limnodynastes peronii*	Brown-striped Frog						2
Amphibians	*Litoria fallax*	Eastern Dwarf Tree Frog						3
Amphibians	*Litoria jervisiensis*	Jervis Bay Tree Frog						3
Amphibians	*Litoria peronii*	Peron's Tree Frog						1
Amphibians	*Litoria verreauxii*	Verreaux's Frog						7
Birds	*Acanthiza lineata*	Striated Thornbill						14
Birds	*Acanthiza nana*	Yellow Thornbill						14
Birds	*Acanthiza pusilla*	Brown Thornbill				O (adjacent)		16
Birds	*Acanthiza reguloides*	Buff-rumped Thornbill						3
Birds	*Acanthorhynchus tenuirostris*	Eastern Spinebill				O (adjacent)		29
Birds	*Accipiter fasciatus*	Brown Goshawk						2
Birds	*Aegotheles cristatus*	Australian Owlet-nightjar						8
Birds	*Alisterus scapularis*	Australian King Parrot				O		12
Birds	*Anas gracilis*	Grey Teal						3
Birds	*Anas superciliosa*	Pacific Black Duck						10
Birds	*Anthochaera carunculata*	Red Wattlebird					OW	5
Birds	*Anthochaera chrysoptera*	Little Wattlebird				W	O	17
Birds	*Anthus novaeseelandiae*	Australian Pipit						3
Birds	*Aquila audax*	Wedge-tailed Eagle						2

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Birds	*Ardea ibis*	Cattle Egret						3
Birds	*Artamus cyanopterus*	Dusky Woodswallow						7
Birds	*Burhinus grallarius*	Bush Stone-curlew	E1					1
Birds	*Cacatua galerita*	Sulphur-crested Cockatoo					W	13
Birds	*Cacatua sanguinea*	Little Corella						4
Birds	*Cacatua tenuirostris*	Long-billed Corella						3
Birds	*Cacomantis flabelliformis*	Fan-tailed Cuckoo						8
Birds	*Cacomantis pallidus*	Pallid Cuckoo						3
Birds	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V					3
Birds	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo						4
Birds	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V					7
Birds	*Carduelis carduelis**	European Goldfinch						4
Birds	*Ceyx azureus*	Azure Kingfisher						2
Birds	*Chalcites lucidus*	Shining Bronze-Cuckoo						3
Birds	*Chenonetta jubata*	Australian Wood Duck					O	14
Birds	*Climacteris picumnus*	Brown Treecreeper	V					12
Birds	*Colluricincla harmonica*	Grey Shrike-thrush						23
Birds	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike						13
Birds	*Coracina papuensis*	White-bellied Cuckoo-shrike						6

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Birds	*Corcorax melanorhamphos*	White-winged Chough						1
Birds	*Cormobates leucophaea*	White-throated Treecreeper						34
Birds	*Corvus coronoides*	Australian Raven					W	31
Birds	*Cracticus nigrogularis*	Pied Butcherbird						2
Birds	*Cracticus tibicen*	Australian Magpie				W	O	22
Birds	*Cracticus torquatus*	Grey Butcherbird					W	19
Birds	*Dacelo novaeguineae*	Laughing Kookaburra						18
Birds	*Daphoenositta chrysoptera*	Varied Sittella	V					3
Birds	*Egretta novaehollandiae*	White-faced Heron			O		O	4
Birds	*Elanus axillaris*	Black-shouldered Kite						5
Birds	*Eolophus roseicapillus*	Galah					O	12
Birds	*Eopsaltria australis*	Eastern Yellow Robin						24
Birds	*Eurystomus orientalis*	Dollarbird						1
Birds	*Falco berigora*	Brown Falcon						3
Birds	*Falco cenchroides*	Nankeen Kestrel						2
Birds	*Falco peregrinus*	Peregrine Falcon						5
Birds	*Falcunculus frontatus frontatus*	Eastern Shrike-tit						1
Birds	*Fulica atra*	Eurasian Coot						1
Birds	*Gallinula tenebrosa*	Dusky Moorhen						5
Birds	*Geopelia striata*	Peaceful Dove						9
Birds	*Gerygone albogularis*	White-throated Gerygone			W	W		4
Birds	*Gerygone mouki*	Brown Gerygone						2
Birds	*Grallina cyanoleuca*	Magpie-lark			W	O	W	24

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Birds	*Haliastur sphenurus*	Whistling Kite						1
Birds	*Hieraaetus morphnoides*	Little Eagle	V					1
Birds	*Hirundapus caudacutus*	White-throated Needletail						1
Birds	*Hirundo neoxena*	Welcome Swallow				O	O	11
Birds	*Lichenostomus chrysops*	Yellow-faced Honeyeater						40
Birds	*Lichenostomus fuscus*	Fuscous Honeyeater						7
Birds	*Lichenostomus leucotis*	White-eared Honeyeater						13
Birds	*Lichenostomus melanops*	Yellow-tufted Honeyeater						33
Birds	*Macropygia amboinensis*	Brown Cuckoo-Dove						3
Birds	*Malurus cyaneus*	Superb Fairy-wren			O			14
Birds	*Malurus lamberti*	Variegated Fairy-wren						7
Birds	*Manorina melanocephala*	Noisy Miner			O	O	OW	34
Birds	*Manorina melanophrys*	Bell Miner			W	W	W	13
Birds	*Melanodryas cucullata*	Hooded Robin	V					1
Birds	*Meliphaga lewinii*	Lewin's Honeyeater						4
Birds	*Melithreptus brevirostris*	Brown-headed Honeyeater						7
Birds	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V					5
Birds	*Melithreptus lunatus*	White-naped Honeyeater						17
Birds	*Menura novaehollandiae*	Superb Lyrebird						6
Birds	*Microcarbo melanoleucos*	Little Pied Cormorant						

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)	
					Site A	Site B	Site C (all fauna recorded on adjacent property)		
Birds	*Microeca fascinans*	Jacky Winter						8	
Birds	*Monarcha melanopsis*	Black-faced Monarch						1	
Birds	*Myiagra inquieta*	Restless Flycatcher						9	
Birds	*Myzomela sanguinolenta*	Scarlet Honeyeater						3	
Birds	*Neochmia temporalis*	Red-browed Finch						19	
Birds	*Ninox novaeseelandiae*	Southern Boobook						3	
Birds	*Ninox strenua*	Powerful Owl	V					2	
Birds	*Ocyphaps lophotes*	Crested Pigeon			O	O	O	10	
Birds	*Origma solitaria*	Rockwarbler						12	
Birds	*Oriolus sagittatus*	Olive-backed Oriole						4	
Birds	*Pachycephala pectoralis*	Golden Whistler						21	
Birds	*Pachycephala rufiventris*	Rufous Whistler						13	
Birds	*Pardalotus punctatus*	Spotted Pardalote						46	
Birds	*Pardalotus striatus*	Striated Pardalote						16	
Birds	*Passer domesticus**	House Sparrow						3	
Birds	*Petrochelidon nigricans*	Tree Martin						2	
Birds	*Petroica boodang*	Scarlet Robin	V					2	
Birds	*Petroica rosea*	Rose Robin						4	
Birds	*Phaps chalcoptera*	Common Bronzewing				O		11	
Birds	*Philemon corniculatus*	Noisy Friarbird						2	
Birds	*Phylidonyris novaehollandiae*	New Holland Honeyeater						7	

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Birds	*Platycercus elegans*	Crimson Rosella						12
Birds	*Platycercus eximius*	Eastern Rosella			O	OW	O	22
Birds	*Podargus strigoides*	Tawny Frogmouth						6
Birds	*Porphyrio porphyrio*	Purple Swamphen						3
Birds	*Psephotus haematonotus*	Red-rumped Parrot					O	10
Birds	*Psophodes olivaceus*	Eastern Whipbird				W		17
Birds	*Ptilonorhynchus violaceus*	Satin Bowerbird						8
Birds	*Pycnonotus jocosus**	Red-whiskered Bulbul						5
Birds	*Pycnoptilus floccosus*	Pilotbird						7
Birds	*Rhipidura albiscapa*	Grey Fantail			W	O		21
Birds	*Rhipidura leucophrys*	Willie Wagtail				O	O	11
Birds	*Scythrops novaehollandiae*	Channel-billed Cuckoo						1
Birds	*Sericornis frontalis*	White-browed Scrubwren						14
Birds	*Smicrornis brevirostris*	Weebill						18
Birds	*Stagonopleura guttata*	Diamond Firetail	V					4
Birds	*Strepera graculina*	Pied Currawong						24
Birds	*Streptopelia chinensis**	Spotted Turtle-Dove						4
Birds	*Sturnus tristis**	Common Myna			OW	OW	O	21
Birds	*Sturnus vulgaris**	Common Starling						10
Birds	*Tachybaptus novaehollandiae*	Australasian Grebe						3
Birds	*Taeniopygia bichenovii*	Double-barred Finch						9
Birds	*Todiramphus sanctus*	Sacred Kingfisher						4
Birds	*Trichoglossus haematodus*	Rainbow Lorikeet						2

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Birds	*Turdus merula**	Eurasian Blackbird				O		7
Birds	*Turnix varius*	Painted Button-quail						5
Birds	*Vanellus miles*	Masked Lapwing					O	6
Birds	*Xanthomyza phrygia*	Regent Honeyeater	E1					3
Birds	*Zosterops lateralis*	Silvereye						17
Birds	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill						4
Invertebrates	*Meridolum corneovirens*	Cumberland Plain Land Snail	E1					3
Mammals	*Acrobates pygmaeus*	Feathertail Glider						2
Mammals	*Bos taurus**	European cattle				O		1
Mammals	*Canis lupus familiaris**	Dog			O (adjacent)		O	4
Mammals	*Capra hircus**	Goat						6
Mammals	*Chalinolobus gouldii*	Gould's Wattled Bat						4
Mammals	*Dasyurus maculatus*	Spotted-tailed Quoll	V					2
Mammals	*Equus caballus**	Horse			O (adjacent)	O (adjacent)	O	1
Mammals	*Felis catus**	Cat						2
Mammals	*Lepus capensis**	Brown Hare						1
Mammals	*Macropus giganteus*	Eastern Grey Kangaroo						6
Mammals	*Macropus robustus*	Common Wallaroo						4
Mammals	*Macropus rufogriseus*	Red-necked Wallaby						3
Mammals	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V					1
Mammals	*Mormopterus norfolkensis*	Eastern Freetail-bat	V					1
Mammals	*Mus musculus**	House Mouse						3

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Mammals	*Myotis macropus*	Southern Myotis	V					2
Mammals	*Nyctophilus geoffroyi*	Lesser Long-eared Bat						2
Mammals	*Ornithorhynchus anatinus*	Platypus						7
Mammals	*Oryctolagus cuniculus**	Rabbit						13
Mammals	*Petauroides volans*	Greater Glider						2
Mammals	*Petaurus breviceps*	Sugar Glider						12
Mammals	*Phascolarctos cinereus*	Koala	V					5
Mammals	*Pseudocheirus peregrinus*	Common Ringtail Possum						19
Mammals	*Rattus fuscipes*	Bush Rat						3
Mammals	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V					1
Mammals	*Tachyglossus aculeatus*	Short-beaked Echidna						17
Mammals	*Tadarida australis*	White-striped Freetail-bat						3
Mammals	*Trichosurus vulpecula*	Common Brushtail Possum						6
Mammals	*Vespadelus darlingtoni*	Large Forest Bat						2
Mammals	*Vespadelus regulus*	Southern Forest Bat						1
Mammals	*Vespadelus vulturnus*	Little Forest Bat						3
Mammals	*Vombatus ursinus*	Common Wombat						33
Mammals	*Vulpes vulpes**	Fox						34
Mammals	*Wallabia bicolor*	Swamp Wallaby			O	P		18
Reptiles	*Amphibolurus muricatus*	Jacky Lizard						5
Reptiles	*Cryptophis nigrescens*	Eastern Small-eyed Snake						3
Reptiles	*Ctenotus taeniolatus*	Copper-tailed Skink						4

Group	Scientific Name	Common Name	TSC Act	EPBC Act	Biosis (2011)			DECCW Database records from the Locality (2011)
					Site A	Site B	Site C (all fauna recorded on adjacent property)	
Reptiles	*Eulamprus quoyii*	Eastern Water-skink						6
Reptiles	*Furina diadema*	Red-naped Snake						3
Reptiles	*Lampropholis delicata*	Dark-flecked Garden Sunskink				O		6
Reptiles	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink						3
Reptiles	*Phyllurus platurus*	Broad-tailed Gecko						2
Reptiles	*Physignathus lesueurii*	Eastern Water Dragon						2
Reptiles	*Pseudechis porphyriacus*	Red-bellied Black Snake						4
Reptiles	*Pseudonaja textilis*	Eastern Brown Snake						1
Reptiles	*Ramphotyphlops nigrescens*	Blackish Blind Snake						2
Reptiles	*Tiliqua scincoides*	Eastern Blue-tongue					Anecdotal	3
Reptiles	*Varanus varius*	Lace Monitor					Anecdotal	1
Reptiles	*Pogona barbata*	Bearded Dragon					Anecdotal	-

APPENDIX 3

Terrestrial flora and fauna listed on the TSC and/or EPBC Acts previously recorded in the locality and likelihood to occur Within the Study Areas.

Terrestrial flora listed on the TSC and/or EPBC Acts or their potential habitats recorded in the locality and likelihood to occur within the Study Areas.

Key: 1) Listed on the EPBC Act as Critically Endangered (Z) Endangered (E), Vulnerable (V) or Extinct (X)
2) Listed on the TSC Act as Endangered (E1), Vulnerable (V) or Presumed Extinct (E4), Preliminary Determination (PD)

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
Acacia bynoeana	E1	V	*Acacia bynoeana* is found in central eastern NSW, in the following catchment regions – Hawkesbury/Nepean, Hunter/Central Rivers, Southern Rivers, and Sydney Metropolitan. More specifically it is found from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra(DEC 2005a). It seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and recently burnt patches(DEC 2005a). It grows in sandy clay soils often containing ironstone gravels(Fairley 2004). Main vegetation types include heath or dry sclerophyll forest on sandy soils(DEC 2005a). Associated overstorey species include *Corymbia gummifera, Corymbia maculata, Eucalyptus parramattensis, Banksia serrata* and *Angophora bakeri*(DEC 2005a). Flowering period is mainly summer	East Thirlmere, West Tahmoor and South Tahmoor support preferred soils and associated vegetation types and species	Low. Although habitat for the species may occur there are no records in the locality.

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
Acacia flocktoniae	V	V	*Acacia flocktoniae* is found only in the Southern Blue Mountains (at Mt Victoria, Megalong Valley and Yerranderie)(DECC 2005). It grows in dry sclerophyll forest on low nutrient soils derived from sandstone. Associated species include *A. stricta and Podolobium ilicifolium.* The species occurs within the Hawkesbury/Nepean and Hunter/Central Rivers (NSW) Natural Resource Management Regions. The distribution of *Acacia flocktoniae* overlaps with the following EPBC Act-listed ecological communities: Shale/Sandstone Transition Forest, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, Cumberland Plain Woodlands, Turpentine-Ironbark Forest in the Sydney Basin Bioregion, and Temperate Highland Peat Swamps on Sandstone. Flowers usually June to September, also recorded March, April, October, December.	East Thirlmere, South Thirlmere, West Tahmoor, South Tahmoor and East Tahmoor support associated vegetation communities.	Low. Although habitat for the species may occur there are no records in the locality with nearest known location at Yerranderie.
Caladenia tessellata	E1	V	*Caladenia tessellata* is found in the Sydney Metropolitan, Southern Rivers, Hawkesbury/Nepean, and Hunter/Central Rivers Catchment Management Regions. Currently known from three disjunct areas: Braidwood on southern tablelands, Ulladulla on the south coast and three populations in Wyong area on the Central Coast(DEC 2005c). It is generally found in grassy, dry sclerophyll forests/woodland, particularly those associated with clay loam, or sandy soils. However, there is one population at Braidwood in lowland on stony soil(DEC 2005c). This species only grows in very dense shrubbery in coastal areas(Bishop 1996). Flowers appear between September and November, but	East Thirlmere, South Thirlmere, West Tahmoor, South Tahmoor and East Tahmoor support preferred soils and vegetation types.	Low. Although habitat for the species may occur there are no records in the locality.

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
			generally late September or early October in extant southern populations(DEC 2005c).		
Cynanchum elegans	E1	E	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. Catchment Management Regions include Hawkesbury/Nepean , Hunter/Central Rivers, Northern Rivers, Southern Rivers and Sydney Metropolitan(DEC 2005o). *Cynanchum elegans* usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; *Leptospermum laevigatum, Banksia integrifolia* subsp. *integrifolia; Eucalyptus tereticornis* open forest and woodland; *Eucalyptus maculata* open forest and woodland; and *Melaleuca armillaris* scrub to open scrub(DEC 2005o). Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific(DEC 2005o).	Although some associated flora species are present on the Subject SiteAssociated vegetation type is absent.	Low. Although habitat for the species may occur there are no records in the locality.
Grevillea parviflora ssp. *parviflora*	V	V	Located in Hawkesbury/Nepean, Hunter/Central Rivers and Sydney Metropolitan Catchment. Sporadically distributed throughout the Sydney Basin with the main occurrence centred in Picton, Appin, Wedderburn and Bargo. Northern populations are found in the Lower Hunter Valley. To the west of Sydney, small populations occur at Kemps Creek & Voyager Point(DEC 2005e). *Grevillea parviflora* ssp. *parviflora* grows on sandy clay loam soils, often with ironstone gravels. Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones(NPWS 2002b). The species is found on crests, upper slopes or flat plains in both low-lying	East Thirlmere, West Tahmoor and South Tahmoor support preferred soils and associated vegetation types and species.	Low. Although habitat for the species may occur there are no records in the locality.

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
			areas and on higher topography. The plant prefers open habitat conditions with the largest populations in open woodland and along exposed roadside areas(NPWS 2002b). *G. parviflora* subsp. *parviflora* has been recorded in a range of vegetation types from heath and shrubby woodland to open forest. Canopy species vary greatly with community type but generally are species that favour soils with a strong lateritic influence including *Eucalyptus fibrosa, E. parramattensis, Angophora bakeri* and *Eucalyptus sclerophylla*(NPWS 2002b).. Flowering has been recorded between July to December as well as April-May(NPWS 2002b).		
Melaleuca deanei	V	V	*Melaleuca deanei* occurs in the Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan Catchment Management Regions. Distinctly it occurs in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas(DEC 2005g). The species grows in wet heath on sandstone (Harden 1991). Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate(DEC 2005g).	Nil	Low. However records of the species occur in the eastern area of the locality.
Persoonia acerosa	V	V	The Needle Geebung has been recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area. The Needle Geebung occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils (DEC 2005h).	East Thirlmere, South Thirlmere, West Tahmoor, South Tahmoor and East Tahmoor support associated	Low. Although habitat for the species may occur there are no records in the locality.

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
				vegetation communities.	
Persoonia bargoensis	E1	V	Found in the Sydney Metropolitan and Hawkesbury/Nepean Catchment Authority Regions. Restricted to a small area south-west of Sydney on the western edge of the Woronora Plateau. Its entire range falls between Picton, Douglas Park, Yanderra, Cataract River and Thirlmere(DEC 2005i). *P. bargoensis* grows in woodland to dry sclerophyll forest on sandstone and clayey laterite on heavier, well drained, loamy, gravelly soils of the Hawkesbury Sandstone and Wianamatta Shale(NPWS 2000). More specifically, P.bargoensis seems to prefer the interfaces between shale-derived soils such as the Blacktown Soil Landscape, the complex soils of the Mittagong Formation (Lucas Heights Soil Landscape), and the underlying sandstone (Hawkesbury and Gymea Soil Landscapes). Some of the vegetation in which *P. bargoensis* occurs can be recognised as the endangered Shale/Sandstone Transition Forest(NPWS 2000). This species seems to benefit from the reduced competition and increased light available on disturbance margins including roadsides(DEC 2005i). Flowering occurs mainly in summer but can extend into autumn(NPWS 2000).	East Thirlmere, South Thirlmere, West Tahmoor, South Tahmoor and East Tahmoor support associated vegetation communities.	Low. However there is a high concentration of records of the species in the south eastern sector of the locality.
Persoonia glaucescens	E1	V	The Mittagong Geebung's historical distribution places the northern and eastern limit at Couridjah (Thirlmere Lakes), the southern limit at Fitzroy Falls and the western limit at High Range. However, it is suggested that the species no longer extends to Fitzroy Falls or Kangaloon and that the present southern limit is near Berrima. The northern limit appears to have contracted a few kilometres south to Buxton. Grows in woodland to dry sclerophyll forest on	East Thirlmere, South Thirlmere, West Tahmoor and South Tahmoor and support associated vegetation	Low. However there is a high concentration of records of the species in the south western sector of the locality.

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
			clayey and gravely laterite. More specifically this species prefers clayey and gravelly laterites with ridgetops, plateaus and upper slopes being preferred topography [NPWS, 2000]	communities and soil types.	
Persoonia hirsuta	E1	E	Occurs from Gosford to Royal NP and in the Putty district from Hill Top to Glen Davis where it grows in woodland to dry sclerophyll forest on sandstone (Harden 2002) or rarely on shale(NSW Scientific Committee 1998). Two subspecies are recognised, *P. hirsuta* ssp. *hirsuta* (Gosford to Berowra and Manly to Royal NP) and *P. hirsuta* ssp. *evoluta* (Blue Mountains, Woronora Plateau and Southern Highlands). Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone and shale-sandstone transition areas(DEC 2005j).	East Thirlmere, South Thirlmere, West Tahmoor, South Tahmoor and East Tahmoor support associated vegetation communities and soil types.	Low. However there is a high concentration of records of the species in the southern sector of the locality.
Pomaderris brunnea	V	V	*Pomaderris brunnea* is found in a very limited area around the Nepean and Hawkesbury Rivers, including the Bargo area. Occurs in the Central West, Hawkesbury/Nepean, Hunter/Central Rivers Catchments. Occurs on clay & alluvial soils(Fairley and Moore 1995). In the Hawkesbury/Nepean region, the species is known to be associated with Dry sclerophyll forests (Cumberland, Upper Riverina, Sydney Coastal, Sydney Hinterland, Sydney Sand Flats), Coastal Floodplain Wetlands and Coastal Valley Grassy Woodlands(DEC 2005k). Flowers appear in September and October.	East Thirlmere, South Thirlmere, West Tahmoor, South Tahmoor and East Tahmoor support associated vegetation communities and soil types in places.	Low. However there are records of the species in the southern and eastern sectors of the locality.

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
Pterostylis saxicola	E1	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south (Hawkesbury/Nepean and Sydney Metropolitan Catchment)(DEC 2005p). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils(DEC 2005p). All species of Pterostylis are deciduous and die back to fleshy, rounded underground tuberoids. The time of emergence and withering has not been recorded for this species, however flowering occurs from October to December and may vary due to climatic conditions. The above ground parts of the plant whither and die following seed dispersal and the plant persists as a tuberoid until the next year(DEC 2005p).	Although associated vegetation types occur on the Subject Site physiographic habitat features are absent.	Low. Although habitat for the species may occur there is one record of the species in the eastern margin of the locality.
Pultenaea glabra	V	V	Found in dry sclerophyll forest on sandstone in the higher Blue Mountains and Glen Davis area(Harden 1991). Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Flowers September to November, fruit matures October to December. All known populations occur within the Blue Mountains Local Government Area (NPWS 2005).	Although associated vegetation types occur on the Subject Site physiographic habitat features are absent.	Low. Although habitat for the species may occur in the locality the species is highly geographically restricted.

Latin Name	TSC Act	EPBC Act	Habitat	Potential habitat	Likelihood of occurrence
Thelymitra sp*. Kangaloon*		Z	*Thelymitra* sp. Kangaloon is a terrestrial orchid endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands. The swamp habitat in which the species occurs has an extent of occurrence of 300 km2 and an area of occupancy of 10 km2. The three swamps are Butlers Swamp, Stockyard Swamp and Wildes Meadow Swamp, and are all located above what is known as the Kangaloon aquifer. It flowers in late October and early November. The species grows amongst tall sedges and rushes in seasonally swampy sedgeland on grey silty clay loam at 600-700 m above sea level (Threatened Species Listing Advice, 2008 20176 /id).	Nil	Nil. Although habitat for the species may occur in the locality the species is highly geographically restricted.

Terrestrial fauna listed on the TSC and/or EPBC Acts or their potential habitats recorded in the locality and likelihood to occur within the Study Areas.

Key: 1) Listed on the EPBC Act as Critically Endangered (Z) Endangered (E), Vulnerable (V), Extinct (X), Migratory (M)

2) Listed on the TSC Act as Endangered (E1), Vulnerable (V), Presumed Extinct (E4 or, Preliminary Determination (PD)

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
Birds					
Haliaeetus leucogaster	White-bellied Sea-eagle	M		A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive (Marchant and Higgins 1993). Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees (Marchant and Higgins 1993).	Low. Species may occasionally fly over the Study Areas.
Hieraaetus morphnoides	Little Eagle		V	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species (NSW Scientific Committee 2009a). It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests (Marchant and Higgins 1993).	Low. Species may occasionally fly over the Study Areas.
Lophoictinia isura	Square-tailed Kite		V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia (Marchant and Higgins 1993). In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata, E. elata*, or *E. smithii* (NPWS 1999e). Individuals appear to occupy large hunting ranges of more than 100 km^2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or	Low. Species may occasionally fly over the Study Areas.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				near watercourses, in a tree fork or on large horizontal limbs (Marchant and Higgins 1993).	
Apus pacificus	Fork-tailed Swift	M		Almost exclusively aerial (foraging). The fork-tailed swift breeds in Asia but migrates to Australia from September to April (Higgins 1999). Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 metres high (Boehm 1944).	Low. Species may occasionally fly over the Study Areas.
Hirundapus caudacutus	White-throated Needletail	M		An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breed in Asia (Pizzey and Knight 1997).	Low. Species may occasionally fly over the Study Areas.
Ardea alba	Great Egret	M		Terrestrial wetlands, estuarine and littoral habitats and moist grasslands. Inland, prefer permanent waterbodies on floodplains; shallows of deep permanent lakes (either open or vegetated), semi-permanent swamps with tall emergent vegetation and herb dominated seasonal swamps with abundant aquatic flora. Also regularly use saline habitats including mangrove forests, estuarine mudflats, saltmarshes, bare saltpans, shallows of salt lakes, salt fields and offshore reefs. Breeding requires wetlands with fringing trees in which to build nests including mangrove forest, freshwater lakes or swamps and rivers (Marchant and Higgins 1990).	Low.
Ardea ibis	Cattle Egret	M		Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands (Marchant and Higgins 1990).	Low.
Artamus superciliosus	White-browed Woodswallow		PD	Mainly inhabits open eucalypt, sheoak and Acacia woodland; forest; riparian zones; and, grasslands with few or no trees and sparsely scattered shrubs (including farmland) (Higgins *et al.* 2006). In NSW the species is widespread on the inland slopes of the Great Divide and western plains;	Moderate. Cleared and disturbed areas adjacent to

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				occurs more sparsely east of the Great Divide (Higgins *et al.* 2006). The species eats arthropods, including insects that swarm above vegetation, plus some nectar and small native fruits (NSW Scientific Committee 2009c). Will nest in a tree fork, tree crevice, foliage, vine, stump or artificial structure (NSW Scientific Committee 2009c).	moderate to good condition open woodland.
Burhinus grallarius	Bush Stone-curlew		E1	Lightly timbered open forest and woodland, or partly cleared farmland with remnants of woodland, with a ground cover of short sparse grass and few or no shrubs where fallen branches and leaf litter are present (Marchant and Higgins 1993).	Low.
Callocephalon fimbriatum	Gang-gang Cockatoo		V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (Higgins 1999). Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest (Forshaw and Cooper 1981). In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome 1992). It requires tree hollows in which to breed (Gibbons and Lindenmayer 1997).	Low.
Calyptorhynchus lathami	Glossy Black-cockatoo		V	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types (NPWS 1999b). Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead (Higgins 1999).	Low.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)		V	Lives in eucalypt woodlands, especially areas of relatively flat open woodland typically lacking a dense shrub layer, with short grass or bare ground and with fallen logs or dead trees present (Traill and Duncan 2000).	Low.
Monarcha melanopsis	Black-faced Monarch	M		A migratory species found during the breeding season in	Low.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				damp gullies in temperate rainforests. Disperses after breeding into more open woodland (Pizzey and Knight 1997).	
Myiagra cyanoleuca	Satin Flycatcher	M		Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies (Pizzey and Knight 1997).	Low.
Rhipidura rufifrons	Rufous Fantail	M		Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas (Pizzey and Knight 1997).	Low.
Sterna fuscata	Sooty Tern		V	The Sooty Tern is a pelagic species found over tropical waters were it feeds offshore far away from land. It breeds off the coast of WA and QLD rarely venturing to the south-east of Australia (Morcombe 2003; Higgins and Davies 1996).	Low.
Anthochaera phrygia	Regent Honeyeater	E	E1	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests (NPWS 1999c; Pizzey and Knight 1997). Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: E. microcarpa, E. punctata, E. polyanthemos, E. mollucana, Corymbia robusta, E. crebra, E. caleyi, C.maculata, E.mckieana, E. macrorhyncha, E. laevopinea, and Angophora floribunda. Nectar and fruit from the mistletoes A. miquelii, A. pendula, A. cambagei are also eaten during the breeding season (DEC 2005m).Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and sheoaks. Also nest in mistletoe haustoria. An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female (DEC 2005m).	Moderate. Species may utilise parts of Study Areas B & C as a movement corridor to more preferable and quality habitats.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)		V	Found mostly in open forests and woodlands dominated by box and ironbark eucalypts (Higgins *et al.* 2001). It is rarely recorded east of the Great Dividing Range (Higgins *et al.* 2001).	Moderate. Species may utilise parts of Study Areas B & C as a movement corridor to more preferable and quality habitats.
Merops ornatus	Rainbow Bee-eater	M		Usually occurs in open or lightly timbered areas, often near water. Nest in embankments, including banks of creeks and rivers, in sand dunes, in quarries and in roadside cuttings. Breeding occurs from November to January. It has complex migratory movements in Australia. NSW populations migrate north for winter (Higgins 1999).	Low.
Daphoenositta chrysoptera	Varied Sittella		V	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts (Higgins and Peter 2002; NSW Scientific Committee 2010). The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It 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 2010).	Moderate. Species may utilise parts of Study Areas B & C as a movement corridor to more preferable and quality habitats.
Stagonopleura guttata	Diamond Firetail		V	Found in a range of habitat types including open eucalypt	Moderate.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				forest, mallee and acacia scrubs (Pizzey and Knight 1997). Often occur in vegetation along watercourses (Higgins *et al.* 2006).	Species may utilise parts of Study Areas B & C as a movement corridor to more preferable and quality habitats.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)		V	This species lives in a wide range of temperate woodland habitats, and a range of woodlands and shrublands in semi-arid areas (Traill and Duncan 2000).	Moderate.
Petroica boodang	Scarlet Robin		V	During the breeding season the Scarlet Robin is found in eucalypt forests and temperate woodlands, often on ridges and slopes. During autumn and winter it moves to more open and cleared areas. It has dispersive or locally migratory seasonal movements. The Scarlet Robin forages amongst logs and woody debris for insects which make up the majority of its diet (NSW Scientific Committee 2009b). The nest is an open cup of plant fibres and cobwebs, sited in the fork of a tree (often a dead branch in a live tree, or in a dead tree or shrub) which is usually more than 2 m above the ground (NSW Scientific Committee 2009b). It is conspicuous in open and suburban habitats (Morcombe 2003).	Low. Species may utilise parts of the Study Areas on occasion.
Glossopsitta pusilla	Little Lorikeet		V	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the	Low. Species may utilise parts of the Study Areas on

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes (NSW Scientific Committee 2008).	occasion.
Lathamus discolor	Swift Parrot	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects (Forshaw and Cooper 1981). The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW (Shields and Crome 1992). Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Mugga Ironbark E. sideroxylon, and White Box E. albens. Commonly used lerp infested trees include Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis (DEC 2005n). This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability (Pizzey and Knight 1997).	Low.
Neophema pulchella	Turquoise Parrot		V	Occurs in open woodlands and eucalypt forests with a ground cover of grasses and understorey of low shrubs (Morris 1980). Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies (Higgins 1999). Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies that are moist (Higgins 1999).	Moderate. Species may utilise parts of Study Areas B & C as a movement corridor to more preferable habitats.
Rostratula australis	Australian Painted Snipe	VM	E1	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged	Low.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				grassland. They prefer freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters (Marchant and Higgins 1993).	
Gallinago hardwickii	Latham's Snipe	M		Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams (Pizzey and Knight 1997).	Low.
Ninox connivens	Barking Owl		V	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country (Pizzey and Knight 1997). Territories range from 30 to 200 ha (DEC 2005b).	Moderate. Species may utilise parts of Study Areas B & C as a movement corridor to more preferable habitats.
Ninox strenua	Powerful Owl		V	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas (Debus and Chafer 1994b; Debus and Chafer 1994a). Large mature trees with hollows at least 0.5 m deep are required for nesting (Garnett 1992). Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials (Gibbons and Lindenmayer 1997). Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm (Gibbons and Lindenmayer 1997). It has a large home range of between 450 and 1450 ha (DEC 2005l).	Moderate. Species may utilise parts of Study Areas B & C as a movement corridor to more preferable habitats.
Invertebrates					

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
Meridolum corneovirens	Cumberland Plain Land Snail		E1	Most likely restricted to Cumberland Plain, Castlereagh Woodlands and boundaries between River-flat Forest and Cumberland Plain Woodland. It is normally found beneath logs, debris and amongst accumulated leaf and bark particularly at the base of trees. May also use soil cracks for refuge (NPWS 1999a).	Moderate. Key fauna habitat elements required by this species are highly disturbed in Study Areas B & C and do not exist at Study Area A.
Mammals					
Cercartetus nanus	Eastern Pygmy-possum		V	Patchily distributed from the coast to the Great Dividing, and as far as Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Soft fruits are eaten when flowers are unavailable and it also feeds on insects (DEC 2005d; Ward and Turner 2008). Will often nest in tree hollows, but can also construct its own nest (Turner and Ward 1995). Because of its small size it is able to utilise a range of hollow sizes including very small hollows (Gibbons and Lindenmayer 1997). Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5 ha area over a 5 month period (Ward 1990). It is mainly solitary, and each individual uses several nests. Home ranges of males are generally less than 0.75 ha, and those of females are smaller (Ward and Turner 2008).	Low.
Dasyurus maculatus	Spotted-tailed Quoll	E	V	Occurs along the east coast of Australia and the Great	Low.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
maculatus	(southeastern mainland)			Dividing Range (Belcher *et al.* 2008). Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests (Dickman and Read 1992). Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas (NPWS 1999k). Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage (Edgar and Belcher 1995). 70% of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage (NPWS 1999d). The home range of a female is between 180 – 1000 ha, while males have larger home ranges of between 2000 – 5000 ha. Breeding occurs from May to August (Belcher *et al.* 2008).	
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E1	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices, particularly where these have a northerly aspect. Individuals defend a specific rock shelter, emerging in the evening to forage on grasses and forbs, as well as browse in drier months. Home sizes range from 2-30 ha (Eldridge and Close 1995).	Low.
Mormopterus norfolkensis	Eastern Freetail Bat		V	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney (Churchill 1998). Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although	Moderate.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				individuals have been recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites (Churchill 2008; Hoye *et al.* 2008).	
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E1	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time (Braithwaite 1995). A mosaic of post fire vegetation is important for this species (Maxwell *et al.* 1996).	Low.
Petaurus australis	Yellow-bellied Glider		V	Restricted to tall native forests in regions of high rainfall along the coast of NSW. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows. Critical elements of habitat include sap-site trees, winter flowering eucalypts, mature trees suitable for den sites and a mosaic of different forest types (NPWS 1999f). Live in family groups of 2-6 individuals which commonly share a number of tree hollows. Family groups are territorial with exclusive home ranges of 30-60 ha. Very large expanses of forest (>15,000 ha) are required to conserve viable populations (Goldingay 2008)	Low.
Phascolarctos cinereus	Koala		V	In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region (DEC 2005f). Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally (Martin *et al.* 2008). Primary feed trees include Eucalyptus robusta, E. *tereticornis*, *E. punctata, E. haemostoma* and *E. signata* (DoP 1995). They are solitary with varying home ranges. In high quality habitat home ranges may be 1-2 ha and overlap, while in semi-arid country they are usually discrete and around 100 ha (Martin *et al.* 2008).	Moderate. Primary feed trees are present within Study Areas B & C.
Potorous tridactylus	Long-nosed Potoroo	V	V	Occurs from Queensland to Victoria, normally within 50 km of the coast (Claridge *et al.* 2007). Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas	Low.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue. It is solitary and sedentary, buts tends to aggregate in small groups. It has two breeding seasons, one in late winter-early spring and the other in late summer (Johnston 2008). This species appears to benefit from a lack of recent disturbance (Claridge *et al.* 2007).	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies (camps), commonly in dense riparian vegetation. Bats commute daily to foraging areas, usually within 15 km of the day roost (Tidemann 1995) although some individuals may travel up to 70 km (Augee and Ford 1999).	Moderate. May fly over Study Area on occasion. Marginal foraging habitat present in the Study Area.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley (van dyck and Strahan 2008). Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands (Churchill 2008; Hoye and Schulz 2008). Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months (Churchill 2008). The only known existing maternity roost is in a sandstone cave near Coonabarabran (Pennay 2008).	Low.
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	Distribution extending east of the Great Dividing Range	Moderate.

Latin Name	Common Name	EPBC Act	TSC Act	Habitat	Likelihood of occurrence
				throughout the coastal regions of NSW, from the Queensland border to the Victorian border. Prefers wet high-altitude sclerophyll and coastal mallee habitat, preferring wet forests with a dense understorey but being found in open forests at lower altitudes (Churchill 2008). Apparently hibernates in winter. Roosts in tree hollows and sometimes in buildings in colonies of between 3 and 80 individuals. Often change roosts every night. Forages for beetles, bugs and moths below or near the canopy in forests with an open structure, or along trails (Law *et al.* 2008). Has a large foraging range, up to 136 ha (Churchill 2008; Law *et al.* 2008). Records show movements of up to 12 km between roosting and foraging sites (Menkhorst and Lumsden 1995).	Marginal foraging habitat present in the Study Area.
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat		V	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways (Churchill 2008; Hoye and Hall 2008).	Moderate. Marginal foraging habitat present in the Study Area.
Myotis macropus	Large-footed Myotis		V	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects ((Richards *et al.* 2008)).	Moderate. Marginal foraging habitat present in the Study Area.

APPENDIX 4

Picton Sewerage Scheme Modifications - Assessment of Significance, under EP&A Act: Shale Sandstone Transition Forest.

Picton Sewerage Scheme Modifications - Assessment of Significance, under EP&A Act: Shale Sandstone Transition Forest.

The Threatened Ecological Community (TEC) Shale Sandstone Transition Forest (SSTF) as listed as endangered on the Threatened Species Conservation Act (1995) occurs within Study Areas A and B and is the subject of this Assessment of Significance.

As this proposal is a modification to a project that will be assessed under Part 3A of the Environment and Planning Assessment Act 1979 this assessment addresses the six questions set out in Appendix 3 of the Draft Guidelines for Threatened Species Assessment (DEC & DPI 2005). The considerations described in Appendix 3 for each question are addressed where relevant to SSTF. The 'Key Thresholds' described in step 5 of the guidelines have been referred to in assessing the significance of potential impacts.

The proposed works include the installation of three new sewage pumping stations and rising mains at three separate sites within the Wollondilly Local Government Area (LGA), referred to in this report as Study Areas A, B and C. Study Areas A and B are the focus of this assessment and are located in Tahmoor. Figure 1 of this report shows the general locality of the Study Areas. The proposed pumping station locations occur on private land and are located in primarily cleared paddocks with scattered remnant trees. The proposed rising mains run from the pumping stations out to the road and along the road verge adjacent to each site. The proposed positions of the pumping stations and rising mains for each of the three Study Areas is shown in Figures 2a, 2b & 2c.

SSTF occurs at the edges of the Cumberland Plain on the transition between shale and sandstone derived soils and where shale caps overlay sandstone. The species composition varies according to soil influences. Typical tree species include *Eucalyptus tereticornis*, *E. punctata, E. globoidea*, *E. eugenioides*, *E. fibrosa* and *E. crebra.*

SSTF occurs on Study Areas A and B. The vegetation at Study Areas A and B represents a degraded form of the community characterised by remnant trees typical of SSTF with a cleared understory dominated by exotic grasses with native grasses and groundcovers sparsely scattered throughout.

Study Area A is dominated by *E. tereticornis* with *E globoidea* and *E moluccana* also present and includes small clumps of trees with connected canopies. The abundance of exotic grasses and lack of native mid story and understory species indicate a recent history of grazing at Study Area A.

Study Area B includes a mix of canopy species including *E tereticornis*, *E.fibrosa*, *E.punctata*, *E.moluccana* and *E.globoidea*. The understorey is dominated by exotic grasses as described for Study Area A. There are two dense clumps of Acacia decurrens forming an understorey of 200m2 in area. Directly adjacent to Study Area B to the south is approximately 4 hectares of bushland in good condition with native species dominant in all strata.

Detailed vegetation descriptions for Study Areas A and B are included in section 4 of this report.

How is the proposal likely to affect the lifecycle of a Threatened Species and / or population?

Not applicable, SSTF is not a species or population.

How is the proposal likely to affect the habitatat of a threatened species, population or ecological community?

The potential impacts of the proposal are described in section 6 of this report. In summary the potential impacts are; tree removal to allow for the installation and construction of the pumping station at Study Area A, root disturbance to native trees resulting from trenching required for the installation of rising mains at Study Areas A and B and likely disturbance and possible removal to trees within the construction footprint of pumping stations A1 and A2 at Study Area A. as well as one tree and the edge of a stand of *Acacias* at Sudy Area B. Impacts from the ongoing operation of the pumping stations is expected to minimal however there is the potential for overflow from pumping stations to enter the Subject Site.

In regard to tree removal; two possible pumping locations, A1 and A2 are given in the project brief for Study Area A. The approximate construction footprint for the pumping station is 2100 square meters and the actual footprint of the pumping station is approximately 500 square meters. The pumping station at location A1 would be installed within a group of approximately 15 *E. tereticornis*. This will require up to eight trees to be removed. A further seven trees would be within the construction footprint. A worst case scenario may require up to 15 trees to be removed to allow for construction. The15 trees are 15 to 20m tall with a diameter at breast height (DBH) of approximately 20 - 40 centimetres and appear to be in good health. The removal and disturbance of these trees would result in a reduction in the extent and condition of the SSTF TEC at this location.

A pumping station at proposed location A2 is unlikely to require the removal of trees however up to four *E. tereticornis* occur within the construction footprint. Thesee trees will potentially be impacted by construction activities and may require removal.

Tree removal and impacts to trees resulting from construction activities would reduce the biodiversity value of the site due to reduced habitat and foraging opportunities for birds, insects and arboreal mammals, reduced habitat within the Study Area and increased fragmentation of a group of trees currently with connected canopies.

The removal of canopy trees generally increases the risk of weed invasion and leads to a loss of soil stability. However the under-storey at location A1 is currently dominated by exotic grasses and annual weeds and the removal of trees therefore will not cause significant change in this regard.

In regard to potential root disturbance; Trenching is required for the installation of 150mm and 225mm rising mains at Study Areas A and C and at Study Area B respectively. The rising main at Study Area B would be laid parallel to the edge of bushland occurring to the south of the Study Area for approximately 143m and is potentially within the root zone of trees in this area. The root systems of the native trees along Progress Street at Study Area B may also be affected by trenching. These trees are likely to have been planted however they are locally native species and are mature trees and have been assessed as having the same value as naturally occurring native trees. At Study Area A there is a risk of root damage to trees for both proposed pumping station locations. This risk is less than for Study Area B as the distance to the road verge is less than 40m from each possible location. For location A1 there are trees along the rising main route between the pumping station and the road verge potentially affected. For location A2 there is one tree between the pumping station location and the road verge. There is no risk of root damage along the road verge for Study Area A.

Trenching within the root zone of native trees poses a risk of damage and severance of roots which can affect the health and longevity of the trees.

In regard to potential overflow from pumping stations; Potential overflow from pumping stations poses a risk of impact to SSTF present within the Subject Sites for Study Area A and Study Area B. Overflow from pumping stations may result in excess soil nutrients potentially causing adverse affects to the health and longevity of native flora species. In terms of habitat for SSTF this would reduce the ability for affected areas to support the community and is likely to benefit exotic species and exacerbate weed invasion. There are no drainage lines within the Subject Sites for Study Area A and Study Area B. Overflow from pumping stations is expected to be localised and will remain well within the construction footprint for the pumping stations.

The extent of potential impacts of the proposal on SSTF in square metres has been calculated based on the construction footprint of 2100 square meters and that vegetated areas within 5m either side of required trenching will potentially be affected by root disturbance.

GIS calculations have found;

- The area of SSTF within Study Area A as mapped in figure 6a is 0.48 hectares.

- The area of SSTF mapped within Study Area B as mapped in figure 6b is 0.25 hectares.

- The area of SSTF mapped by NPWS (2002) within the Locality (10km radius around Study Areas) is 2142.89 hectares.

The area of potential impact to SSTF from the proposal at Study Area A, pumping station location A1 is 2350 square meters. This includes the construction footprint and 20 metres of rising main with the potential to disturb native tree roots. For location A2 the area of potential impact to SSTF is 600 square meters. This includes the approximate area of SSTF occurring within the construction footprint and 20 metres of rising main with the potential to disturb native tree roots. The area of potential impact for location A1 represents 49% of the SSTF mapped within Study Area A and 0.011% of the SSTF mapped within the Locality. The area of potential impact for location A2 represents 12.5% of the SSTF mapped within Study Area A and 0.0028% of the SSTF mapped within the Locality.

The area of potential impact to SSTF from the proposal at Study Area B is 1375 square meters. This includes the area potentially affected by root disturbance as well as the approximate area of canopy of one tree occurring within the construction footprint. The area of root disturbance has been calculated allowing for five metres of potential impact either side of the rising main. The proposed route of the main passes potentially affected vegetation on one side only for 170 metres and vegetation on either side for 30 meters. The area of potential impact to SSTF represents 55% of the SSTF mapped within Study Area B and 0.0064% of the SSTF mapped within the Locality.

The total area of SSTF potentially impacted by the proposal is 3725m2 where possible pumping station A1 is considered. This figure represents 0.01738% of the SSTF mapped within the Locality. Considering possible pumping station A2 the total area of SSTF potentially impacted by the proposal is 1975m2 which represents 0.00921% of the SSTF mapped within the Locality.

Given the limited area of disturbance the proposal is unlikely to significantly affect SSTF and its habitat as a result of the current proposal.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Not applicable, SSTF is not a species or population.

How is the proposal likely to affect current disturbance regimes?

Identified threats to SSTF from the Final Determination (NSW Scientific Committee 1998) include:

- Continuing clearing for urban or rural development, and the subsequent impacts from fragmentation
- Grazing, slashing and mowing
- Weed invasion
- Inappropriate fire regimes that alter the floristic and structural integrity
- Rubbish dumping
- Physical damage from recreational activities

The proposal will contribute to the clearing of SSTF to some degree. The possible location pumping station A1 will require tree removal if this option is taken. All trees within the construction footprints for Study Area A and Study Area B have been assessed as potentially requiring removal.

The proposal may contribute to weed invasion within SSTF at Study Area A and Study Area B resulting from soil disturbance from trenching and excavation for pumping stations as well as increased nutrients from potential overflow events.

The proposal is unlikely to contribute to any of the other threats identified above.

How is the proposal likely to affect habitat connectivity?

In regard to the likely removal of trees at Study Area A for pumping station location A1 as well as potential removal of trees within the costruction footprint at Study Area A and Study Area B; Tree removal would reduce habitat and affect habitat connectivity at a local scale. However, in the context of the broader landscape this potential impact is minimal given the relatively small scale of the impact and the already fragmented nature of the surrounding vegetation. The surrounding area is characterised by cleared, paddocks with small clumps of trees between sparsely scattered larger bushland remnants occurring on private land.

The potential impact of root disturbance at both Study Areas A and B may impact native vegetation and have an adverse effect on habitat connectivity. This impact however will be minimal as the risk of impact to trees by root disturbance is low. This report has recommended the Australian Standard AS 4373 - 2007 Pruning of amenity trees (Standards Australia, 2007) be followed for any required pruning of roots to allow

for trenching. Assuming the Australian Standard is applied to pruning roots the impact to native trees is likely to be minimal. Given this and the fragmented nature of the surrounding vegetation, as described above, the effect of the proposal on habitat connectivity will be minimal at both Study Areas A and B.

How is the proposal likely to affect critical habitat?

Not applicable. There is no listed critical habitat occurring within or adjacent to the Study Areas.

Step 5 of the *Draft Guidelines for Threatened Species Assessment* (DEC & DPI 2005

Step 5 requires the development application to contain a justification of the preferred option based on four key thresholds listed in the Draft Guidelines for Threatened Species Assessment (DEC, DPI 2005). Sydney Water will not be submitting a develop application for the proposal however to ensure all criteria are addressed within this assessment the four 'Key Thresholds' are addressed below in relation to the potential impact of the proposal

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

The recommendations in this report (section 7) include measures to avoid and mitigate the potential impacts of the proposal.

The potential impacts of the proposal on SSTF are tree removal root disturbance caused by trenching and overflow from pumping stations as described above. Recommendations to avoid/mitigate these impacts include; positioning pumping stations to avoid the need to remove native trees; and positioning rising mains to minimise trenching required within the tree protection zone. The application of Australian Standards for amenity tree pruning is recommended to mitigate the impact of root disturbance for any pruning of tree roots required to allow for trenching. Planting of native trees and under-storey species to replace native vegetation removed is recommended as well as a weed control program to suppress weeds that colonise disturbed soil resulting from the proposal.

Measures recommended to mitigate impacts on SSTF resulting from the construction phase of the proposal include; tree protection measures in accordance with the Australian Standards; sediment and erosion controls; and storage and parking to be within cleared areas of the site.

The pumping stations will be designed to minimise the potential for any overflow and will be designed with some emergency storage to reduce overflow in the event of a power failure.

The recommendations summarised above are considered adequate to avoid and / or mitigate the potential impacts of the proposal and therefore maintain the biodiversity values of SSTF in Study Areas A and B.

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

Given the small scale of the potential impacts on SSTF in relation to the extent of the community within the locality, as documented above, and the degraded state of the native vegetation at each of the Study Areas the proposal is not considered likely to reduce the long-term viability of the TEC.

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.

Given the small scale of the potential impacts on SSTF in relation to the extent of the community within the locality, as documented above, and the degraded state of the native vegetation at each of the Study Areas the proposal is not considered likely to accelerate the extinction of the TEC or place it at risk of extinction.

Whether or not the proposal will adversely affect critical habitat.

Not applicable as there is no listed critical habitat occurring within or adjacent to the Study Areas.

Conclusion

The potential impacts of the proposal on SSTF occurring on Study Area A and B have been assessed. The questions and factors of consideration included in Appendix 3 of the *Draft* Guidelines for Threatened Species Assessment (DECC 2005) have been addressed specifically in relation to the impacts of the proposal.

This assessment concludes that the proposal will not have a significant impact on the habitat or habitat connectivity of the TEC SSTF occurring at Study Areas A and B and will not represent a significant affect on the current disturbance regime.

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