

Species Impact Statement

ELLERTON DRIVE EXTENSION



JUNE 2014



www.nghenvironmental.com.au

Document Verification

Project Title: Ellerton Drive Extension				Ellerton Drive Extension SIS
Project Nu	umber:	4733		
Project File Name:		Ellerton Drive SIS Final v1.	2.docx	
Revision	Date	Prepared by (name)	Checked by (name)	Approved by (name)
Final v1.0	16/12/13	Dave Maynard Deb Frazer	Nick Graham-Higgs	Nick Graham-Higgs
Final v1.1	01/04/14	Dave Maynard	Deb Frazer	
Final v1.2	04/06/14	Dave Maynard Deb Frazer	Nick Graham-Higgs	Nick Graham-Higgs

nghenvironmental prints all documents on environmentally sustainable paper including paper made from bagasse (a byproduct of sugar production) or recycled paper.

suite 1, 216 carp st (po box 470) bega nsw 2550 australia t 61 2 6492 8333

www.nghenvironmental.com.au engh@nghenvironmental.com.au

suite 102, 63-65 johnston st (po box 5464) wagga wagga nsw 2650 australia t 61 2 6971 9696 f 61 2 6971 9693

unit 18, level 3, 21 mary st surry hills nsw 2010 australia t 61 2 8202 8333 f 61 2 9211 1374

unit 17, 27 yallourn st (po box 1037) fyshwick act 2609 australia t 61 2 6280 5053 f 61 2 6280 9387

> suite 7, 5/18 griffin dr (po box 1037) dunsborough wa 6281 australia t 61 8 9759 1985

CONTENTS

1	CONTEXTUAL INFORMATION	1
1.1	INTRODUCTION	1
1.	1.1 Matters which have been limited or modified	1
1.2	DESCRIPTION OF THE PROPOSAL	2
1.	2.1 Types of impacts expected	3
1.3	SUBJECT SITE	3
1.4	STUDY AREA	3
1.5	LAND USE, ZONING AND TENURE OF THE STUDY AREA	6
1.	5.1 Land use	6
1.	5.2 Zoning	6
1.	5.3 Tenure	7
1.6	THE LOCALITY	9
2	INITIAL ASSESSMENT	11
2.1	SUBJECT SPECIES AND POPULATIONS	11
2.	1.1 Director General Requirements (DGRs)	.11
2.	1.2 Potential for other threatened species	.12
3	SURVEY EFFORT AND TECHNIQUES	14
3 3.1	SURVEY EFFORT AND TECHNIQUES	14 14
3 3.1 3.2	SURVEY EFFORT AND TECHNIQUES SURVEY REQUIREMENTS FLORA	14 14 14
3 3.1 3.2 3.	SURVEY EFFORT AND TECHNIQUES SURVEY REQUIREMENTS FLORA	14 14 14
3 3.1 3.2 3. 3.	SURVEY EFFORT AND TECHNIQUES	14 14 14 .14
3 3.1 3.2 3. 3. 3.	SURVEY EFFORT AND TECHNIQUES SURVEY REQUIREMENTS FLORA	14 14 14 .14 .14
 3.1 3.2 3. 3. 3. 3. 	SURVEY EFFORT AND TECHNIQUES SURVEY REQUIREMENTS FLORA	14 14 14 .14 .14 .14
 3.1 3.2 3. 3. 3. 3. 3. 	SURVEY EFFORT AND TECHNIQUES SURVEY REQUIREMENTS FLORA	14 14 14 .14 .14 .14 .15 .15
 3.1 3.2 3. 3. 3. 3.3 3.3 	SURVEY EFFORT AND TECHNIQUES SURVEY REQUIREMENTS FLORA 2.1 Survey personnel 2.2 Site reconnaissance 2.3 Detailed surveys 2.4 Vegetation classification, mapping and nomenclature 2.5 Survey effort FAUNA	14 14 14 .14 .14 .14 .15 .16 18
 3.1 3.2 3. 3. 3.3 3.3 3.3 3.3 3.3 	SURVEY EFFORT AND TECHNIQUES SURVEY REQUIREMENTS FLORA 2.1 Survey personnel 2.2 Site reconnaissance 2.3 Detailed surveys 2.4 Vegetation classification, mapping and nomenclature. 2.5 Survey effort FAUNA 3.1 Survey personnel.	 14 14 .14 .14 .14 .15 .16 .18 .18
 3.1 3.2 3. 3. 3.3 3.3 3.3 3. 3. 	SURVEY EFFORT AND TECHNIQUES	14 14 14 .14 .14 .15 .16 18 .18 .18
 3.1 3.2 3. 3.3 3.3 3.3 3.3 3.3 3.3 3.3 	SURVEY EFFORT AND TECHNIQUES. SURVEY REQUIREMENTS FLORA 2.1 Survey personnel. 2.2 Site reconnaissance. 2.3 Detailed surveys 2.4 Vegetation classification, mapping and nomenclature. 2.5 Survey effort FAUNA 3.1 Survey personnel. 3.2 Site reconnaissance. 3.3 Survey types	14 14 14 14 14 14 15 15 16 18 18 18 18
 3.1 3.2 3. 3.3 	SURVEY EFFORT AND TECHNIQUES	14 14 14 14 14 14 14 15 16 18 .18 .18 .18 .18 .23
 3.1 3.2 3. 3.3 	SURVEY EFFORT AND TECHNIQUES	14 14 14 14 14 14 14 15 16 18 18 18 18 18 23 27
 3.1 3.2 3. 3.3 3.3 3.3 3.3 3.3 3.3 3.4 	SURVEY EFFORT AND TECHNIQUES	14 14 14 14 14 14 14 15 16 18 18 18 18 18 23 23 27 28



4	ડા	URVEY RESULTS	30
4.	1 FL	ORA	30
	4.1.1	Vegetation communities	30
	4.1.2	Vegetation condition	32
	4.1.3	Conservation status of vegetation communities within the study area	32
	4.1.4	Weeds and disturbance	33
	4.1.5	Threatened species	34
4.	2 F.4	AUNA	35
	4.2.1	Fauna habitats	35
	4.2.2	Habitat connectivity	38
	4.2.3	Fauna species recorded	38
	4.2.4	Threatened species	39
5	A	SSESSMENT OF LIKELY IMPACTS ON SUBJECT SPECIES, POPULATIONS AND COMMUNITIES	41
5.	1 DI	ETERMINATION OF AFFECTED SPECIES	41
5.	2 AS	SSESSMENT OF SPECIES AND COMMUNITIES LIKELY TO BE AFFECTED	42
	5.2.1	Box-Gum Woodland	42
	5.2.2	Hoary Sunray	47
	5.2.3	Pink-tailed Worm-Lizard	51
	5.2.4	Rosenberg's Goanna	53
	5.2.5	Brown Treecreeper	56
	5.2.6	Scarlet Robin and Hooded Robin	59
	5.2.7	Diamond Firetail	62
	5.2.8	Painted Honeyeater	64
	5.2.9	Gang-gang Cockatoo	66
	5.2.10	0 Speckled Warbler	69
	5.2.12	1 Koala	72
	5.2.12	2 Microbats (Eastern False Pipistrelle, Eastern Bent-wing Bat)	75
	5.2.13	3 Golden Sun Moth	79
6	IN	IPACT AMELIORATION	88
6.	1 A'	VOIDANCE OF IMPACTS	88
	6.1.1	Timing of vegetation clearance	88
	6.1.2	Pre-clearance fauna surveys	88
	6.1.3	Relocation of habitat features	89
	6.1.4	Soil and drainage	89



6.3	1.5	Weed introduction and spread	89
6.3	1.6	Site rehabilitation	90
6.3	1.7	Induction program	90
6.2	Mľ	IITIGATION OF OPERATIONAL IMPACTS	90
6.2	2.1	Vegetation/habitat management	90
6.2	2.2	Barrier fencing and fauna underpasses	91
6.2	2.3	Advisory road signs	92
6.3	CO	OMPENSATORY STRATEGY	92
6.4	ON	NGOING MONITORING	92
6.4	4.1	Fauna monitoring	92
7	FE/	ASIBLE ALTERNATIVES AND JUSTIFICATION FOR THE PROPOSAL	93
7.1	DO	O NOTHING APPROACH	93
7.2	AL	LTERNATIVES	93
7.3	JUS	JSTIFICATION FOR THE PREFERRED APPROACH	94
8	AS	SSESSMENT OF SIGNIFICANCE	96
9	AD	DDITIONAL INFORMATION	
9.1	QU	UALIFICATIONS AND EXPERIENCE	98
9.2	ОТ	THER APPROVALS REQUIRED FOR THE DEVELOPMENT	100
9.3	LIC	CENSING MATTERS RELATING TO FLORA AND FAUNA SURVEYS	
10	RE	EFERENCES	103
APPE	NDI	IX A DGRS FOR THE PROPOSAL	A-I
APPE			
	NDI	IX B THREATENED SPECIES EVALUATION	B-I
APPE		IX B THREATENED SPECIES EVALUATION IX C FIELD SURVEY RESULTS	B-I
APPE APPE	NDI) NDI) NDI)	IX B THREATENED SPECIES EVALUATION IX C FIELD SURVEY RESULTS IX D SURVEY EFFORT MAPS	B-I C-I D-I
APPE APPE APPE	NDI) NDI) NDI) NDI)	IX B THREATENED SPECIES EVALUATION IX C FIELD SURVEY RESULTS IX D SURVEY EFFORT MAPS IX E SURVEY RESULTS MAPS	B-I C-I D-I E-I
APPE APPE APPE APPE	NDIX NDIX NDIX NDIX NDIX	IX B THREATENED SPECIES EVALUATION IX C FIELD SURVEY RESULTS IX D SURVEY EFFORT MAPS IX E SURVEY RESULTS MAPS IX F THREATENED SPECIES RECORDS	B-I C-I D-I E-I F-I
АРРЕ АРРЕ АРРЕ АРРЕ АРРЕ	NDIX NDIX NDIX NDIX NDIX	IX B THREATENED SPECIES EVALUATION IX C FIELD SURVEY RESULTS IX D SURVEY EFFORT MAPS IX E SURVEY RESULTS MAPS IX F THREATENED SPECIES RECORDS IX G PLATES	B-I C-I D-I E-I F-I G-I
APPE APPE APPE APPE APPE APPE	NDIX NDIX NDIX NDIX NDIX NDIX	IX B THREATENED SPECIES EVALUATION IX C FIELD SURVEY RESULTS IX D SURVEY EFFORT MAPS IX E SURVEY RESULTS MAPS IX F THREATENED SPECIES RECORDS IX G PLATES IX H OFFSET STRATEGY	B-I C-I E-I F-I G-I



TABLES

Table 1-1 Objectives of the zones in which the subject site is located as stated in the QLEP
Table 2-1 Subject species and communities identified in the DGRs
Table 3-1 Summary of flora survey effort
Table 3-2 Description of fauna habitat quality categories 20
Table 3-3 Fauna survey effort undertaken in the study area and locality and comparison with DGRs 24
Table 3-4 Daily weather observations over the survey periods showing daily minimum and maximum temperatures (Queanbeyan Bowling Club weather station - BOM 2013) as well as temperature ranges during specific targeted surveys
Table 4-1 Conservation of natural vegetation types occurring within the study area. 32
Table 5-1 Results of the quantitative understorey quality assessments 44
Table 5-2 Summary of clearance impacts on threatened fauna species that could be affected by the proposal 83
Table 5-2 Summary of clearance impacts
Table 8-1 Summary of the conclusions of assessments of significance 96
Table 9-1 Approvals, legislation and policy applicable to the proposal

FIGURES

Figure 1-1	Location of the study area and subject site	5
Figure 1-2	QCC land zoning within the study area and surrounds	8
Figure 1-3	Study area within the context of the locality1	0



EXECUTIVE SUMMARY

This Species Impact Statement (SIS) has been prepared by **ngh**environmental for Queanbeyan City Council (QCC) to assess the potential impacts on threatened species, populations and communities that would result from the construction and operation of the extension of Ellerton Drive, between East Queanbeyan and Karabar. The total development footprint (the subject site) is approximately 26 ha in area, 4.6km long, and ranges in width from approximately 40 m to 110 m.

This SIS evaluates in detail the potential impacts to flora and fauna species and communities listed as threatened in NSW. In addition, this report also considers the potential for impacts to species and communities listed at the Commonwealth level to avoid duplication of the assessment process. The Director-General of the NSW Department of Premier and Cabinet (which includes the Office of Environment and Heritage) provided assessment requirements (Director General's Requirements; DGRs) for the Species Impact Statement on 22 June 2012. These requirements directed that five species of flora, 15 species of fauna, all threatened microchiropteran bats (including the Greater Long-eared Bat) and one ecological community would be the subjects of the SIS. An initial assessment, including database and literature reviews was conducted by nghenvironmental to identify the potential for other threatened species, populations and communities to be impacted by the proposal. This assessment identified one additional flora species, the Hoary Sunray, that also had the potential to be impacted. This species was also included as subject species of the SIS.

Each of the 'subject species' and communities was considered as to whether it would be likely to be affected by the proposal, using existing information from previous assessments and surveys conducted in the locality, threatened species databases, peer-reviewed journals as well as additional surveys and assessments, specific to this proposal and undertaken after the receipt of the DGRs. As a result, one threatened flora species, one Endangered Ecological Community and 13 threatened fauna species were determined to be likely to be 'affected' and were subjected to detailed species impact assessment:

- Hoary Sunray (Leucochrysum albicans var. tricolor)¹
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Box-Gum Woodland)²
- Pink-tailed Worm-lizard (Aprasia parapulchella)²
- Rosenberg's Goanna (Varanus rosenbergi)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)
- Scarlet Robin (Petroica boodang)
- Hooded Robin (south eastern form) (Melanodryas cucullata cucullata)
- Diamond Firetail (*Stagonopleura guttata*)
- Painted Honeyeater Painted Honeyeater (*Grantiella picta*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Speckled Warbler (Pyrrholaemus saggitatus)
- Koala (*Phascolarctos cinereus*)
- Eastern False Pipistrelle (Falsistrellus tasmaniensis)
- Eastern Bent-wing Bat (Miniopterus schreibersii)



¹ Listed Federally under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

² Listed under both the NSW Threatened Species Conservation Act 1995 (TSC Act) and Federal EPBC Act

• Golden Sun Moth (Synemon plana)²

In accordance with the DGRs, the potential effects of the proposal were assessed for each of these species based on known and potential local occurrences, local and regional abundance, habitat utilisation, distribution and condition of local and regional habitat, corridors and conservation status. The assessment identified that potential effects include the removal of habitat, degradation of local corridors and linkages and the reduction in the availability of important habitat features, such as hollow-bearing trees and termite mounds. Of the 26 ha within the subject site, approximately 19 ha of native vegetation and habitat will be impacted with the remainder consisting of highly disturbed, exotic or planted vegetation., This includes 4ha of Box-Gum Woodland (as defined by the TSC Act and EPBC Act) in moderate to good condition, approximately 13ha of habitat for Rosenberg's Goanna, approximately 11ha of habitat for the Speckled Warbler and Gang-gang Cockatoo and approximately 8ha of habitat for the Eastern False Pipistrelle. Smaller areas of potential habitat will be removed for other subject fauna species. Forty-one hollow-bearing trees and 16 termite mounds would be removed.

Operational impacts, after construction is complete, would include indirect impacts from 'edge effects' such as weed invasion and pollution. There is the potential for increased fauna injury or mortality from the introduction of traffic into the area and the presence of the road corridor has the potential to adversely affect a range of terrestrial fauna, including Rosenberg's Goanna as it presents a barrier to movement and fragments existing habitat.

A package of ameliorative measures has been developed to mitigate the potential impacts of the proposal on subject species and communities and compensate for the residual impacts that cannot be avoided or mitigated; this includes the development of an offset strategy. These measures will also reduce the level of impact to a broader range of flora and fauna species, not specifically considered in this SIS. Ameliorative measures include:

- Specific timing of works to avoid fauna breeding periods
- Pre-clearance fauna surveys
- Relocation of habitat features
- Best practice soil and water management
- Fauna fencing and underpasses
- Advisory signage alerting drivers to the presence of fauna
- Maintenance of an 80km speed limit
- A vegetation management plan for the site, including weed management and site rehabilitation sub-plans
- Long-term monitoring and adaptive management
- Offsetting of residual impacts

Assuming the effective implementation of the proposed ameliorative measures, an assessment of significance of likely effects was undertaken for each subject species and community to characterise the resulting impacts. The assessments concluded that, of the one Endangered Ecological Community (Box-Gum Woodland EEC) and 13 fauna species assessed, the proposal is considered to have a significant impact on the Box-Gum Woodland EEC community and two threatened fauna species: the Rosenberg's Goanna and Speckled Warbler. One individual of the Speckled Warbler was recorded during the survey and is considered to be a permanent resident of the study area, specifically in an area north of the Queanbeyan River. The Rosenberg's Goanna was not detected during the survey program but is known to occur in the locality and it is considered that the study area includes habitat that forms part of the home range for this species. Significant impacts are not expected for any of the other subject species and communities assessed.



PREFACE

This Species Impact Statement has been prepared by **ngh**environmental Pty Ltd in accordance with the requirements of Sections 109 and 110 of the NSW *Threatened Species Conservation Act 1995* and with regard to the requirements as notified by the Director General of the Department of Premier and Cabinet, Office of Environment and Heritage, in correspondence dated 22 June 2012.

Mayord

Dave Maynard Senior Ecologist **ngh**environmental Pty. Ltd. ACN: 124 444 622

DECLARATION

I, Eli Ramsland, of Queanbeyan City Council, being the applicant for the development consent for the proposed Ellerton Drive extension within the Queanbeyan LGA, have read and understood this Species Impact Statement. I understand the recommendations made in the statement and accept that they may be imposed as conditions of consent or concurrence for the action proposed.

Eli Ramsland

Contracts Engineer



ngn environmental

ACRONYMS AND ABBREVIATIONS

ACT	Australian Capital Territory
CBD	Central Business District
CEEC	Critically Endangered Ecological Community
СМА	Catchment Management Authority
DECC	Department of Environment and Climate Change (NSW – until early 2009)
DECCW	Department of Environment, Climate Change and Water (NSW – early 2009 to April 2011)
DEWHA	Department of Environment, Water, Heritage and the Arts (Commonwealth – until late 2010)
DGRs	Director-General Requirements for this Species Impact Statement
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth – since late 2010)
EEC	Endangered Ecological Community
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
GPS	Global Positioning System
ha, m, km	Hectares, metres, kilometres
КТР	Key Threatening Process
LGA	Local Government Area
NR	Nature Reserve
NSW	New South Wales
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage (NSW – since April 2011)
QCC	Queanbeyan City Council
QLEP	Queanbeyan Local Environmental Plan 2012
REF	Review of Environmental Factors
RMS	Roads and Maritime Services (NSW – since early 2012)
RTA	Roads and Traffic Authority (NSW – until early 2012)
SCIVI	South Coast – Illawarra Vegetation Integration (a vegetation mapping project)
SF	State Forest
SIS	Species Impact Statement
SPRAT	Species Profile and Threats Database, managed by DSEWPC
TSC Act	Threatened Species Conservation Act 1995 (NSW)
VMP	Vegetation management plan
~	Approximately



DEFINITIONS

Affected species	Subject species determined by ngh environmental as species <i>likely</i> to be affected by the proposal.
Assessments of Significance	Refers collectively to impact assessments made under the TSC Act's <i>Threatened Species Assessment Guidelines: The Assessments of Significance</i> (DECCW 2007) and the EPBC Act's <i>Significant Impact Guidelines</i> (DEH 2006) to characterise the significance of impacts on specific entities.
Threatened entity	A species, population or ecological community listed under the NSW TSC Act or Commonwealth EPBC Act.
Key Threatening Processes	Listed under the TSC Act, Key Threatening Processes are defined as "the things that threaten - or could threaten - the survival or evolutionary development of species, populations or ecological communities".
Known habitat	An area where a species has been recorded.
Locality	The area within a 10km radius of the Subject site (Euclidean distance).
Local population	The population that occurs within the study area or that is contiguous or interconnected with the population within the study area.
Potential habitat	An area of habitat consistent with the characteristics of known habitats, usually supported by local records, of the entity in question.
Study area	Includes the 'subject site' and any additional areas which are likely to be affected indirectly by the proposal; defined for this SIS as the area 80m either side of the centre line of the proposed road.
Subject site	Follows the definition provided by OEH in the 2007 <i>Threatened species assessment guidelines: The Assessment of Significance</i> ; that area subject to direct impact as a result of the proposal.
Subject species	Species identified by OEH in the DGRs to have <i>potential</i> to be affected by the proposal. Additionally, nghenvironmental have included an entity considered to have potential to be affected.



1 CONTEXTUAL INFORMATION

1.1 INTRODUCTION

This Species Impact Statement (SIS) has been prepared to assess the impacts of the proposed Ellerton Drive Extension (the Proposal) on threatened species, populations and communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). It also provides a pathway for assessing impacts to threatened species and communities listed at a Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The inclusion of Commonwealth listed entities avoids duplication of the assessment process.

The purpose of this SIS is:

- to identify the issues pertaining to threatened species, populations, ecological communities or their habitats, and provide appropriate amelioration for adverse impacts resulting from the action; and
- to assist the consent or approval authorities in the assessment of the proposal pursuant to the Environmental Planning and Assessment Act 1979 (EP&A Act).

The list of subject species to be considered, along with specific requirements for survey and assessment, have been provided in the SIS Director General's Requirements (DGRs) for this Proposal, issued to Queanbeyan City Council on 22 June 2012 (Appendix A).

1.1.1 Matters which have been limited or modified

Requirements for the content of the SIS are provided by Sections 109 and 110 of the TSC Act. The SIS does not need to address Sections 110(2)(g) and 110(3)(d) of the TSC Act, as these are clarified by the DGRs. The DGRs identify the following matters from Section 110 that need only be addressed where relevant:

Section 110 Matter	Requirement	
Key Threatening Processes	 The following Key Threatening Processes are relevant to this proposal: Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands Bushrock removal Clearing of native vegetation Invasion of native plant communities by exotic perennial grasses Removal of dead wood and dead trees Loss of Hollow-bearing trees 	
Threat abatement plans	There are no threat abatement plans relevant to the Key Threatening Processes associated with the proposal.	
Recovery plans	There are draft recovery plans relevant to the subject species listed in Tables 1 and 2 and the subject ecological community listed in Section 3.2 of the DGRs. However, if other entities should be deemed as subject species, populations or ecological communities by analysis in accordance with the DGRs, then any relevant recovery plans pertaining to these entities will need to be addressed in the SIS.	



1.2 DESCRIPTION OF THE PROPOSAL

Queanbeyan City Council (QCC) is proposing to construct a 4.6 kilometre extension of Ellerton Drive, Queanbeyan, which would provide a link between East Queanbeyan and Karabar. This section of road would form an important link in the regional transport corridor and is considered necessary by Queanbeyan's Transport Plan, The Googong and Tralee Traffic Study 2031 (Gabites Porter 2010). The works would be undertaken in two stages. Stage 1 would consist of earth works and the construction of a single carriage way (two lane road) with provisions for cyclists. Earthworks conducted during Stage 1, would be completed to the extent that would accommodate a dual carriage way (four lane road).Stage 2 would involve the construction of the additional two lanes within the area that would be cleared and stabilised during Stage 1.

The Queanbeyan Transport Plan considers that the extension is required to be in service by 2017. It is estimated that the earthworks and construction of Stage 1 would take approximately two years to complete, therefore it is anticipated that construction work would commence in 2015. Stage 2 works are anticipated to be required by 2031.

The proposed construction works would involve:

- Clearing of native vegetation
- Soil disturbance from excavation, filling and compaction
- Importation and stockpiling of materials
- Establishment of construction compounds and facilities
- The use of various vehicles, plant and machinery

The extent of the proposed clearing and potential locations of stockpiles and construction compounds is shown on Figure 1-1. Stockpiles would be sited in areas that would be cleared during the Stage 1 works for the future Stage 2 duplication of the road (within the development footprint). Potential construction compounds are proposed in existing cleared, highly disturbed areas.

There is no requirement to relocate the communication or electrical infrastructure that crosses the site. An 1800mm diameter water main (owned and operated external to council) located within the electricity easement would remain without modification. It is possible that there may be a need to relocate some of the QCC's 300mm diameter water main, however this is considered unlikely. Some services may require relocation on Barracks Flat Drive, within the study area just south of the Queanbeyan River. However, these services are located in previously disturbed areas that do not support habitat for subject species or communities.

The development footprint (the subject site) is approximately 26 ha in area, 4.6km long, and ranges in width from approximately 40 m to 110 m. The areas of wider impact are due to the steep topography requiring more extensive cut and fill operations to accommodate the ultimate dual carriage (four lane) road in these areas.

The Proposal would involve landscaping works, including stabilisation and rehabilitation of disturbed areas following construction.

A commitment to the implementation of a biodiversity offset forms part of the Proposal, to compensate for residual impacts that cannot be avoided or mitigated. An Offset Strategy, to guide the selection of a preferred offset pathway, is included with this SIS.



1.2.1 Types of impacts expected

Potential impacts on biodiversity would be associated with the construction and operational phase of the project and include:

Construction impacts

- Direct loss of native flora and fauna habitats. This includes an area of a listed Endangered Ecological Community (EEC) and habitat resources (such as hollow-bearing trees and termite mounds) suitable for threatened fauna species.
- Noise and dust generation (construction machinery and activities) that may disturb local fauna and inhibit the function of plant species and communities.
- Barrier effects (fragmentation of habitat) which restricts the ability of fauna to move across the landscape.

Operational impacts

- Noise (traffic noise may influence the use of adjacent habitat by fauna)
- Collision risks (fauna may collide with traffic)
- Barrier effects (lighting, fencing and road infrastructure may influence the use of adjacent habitat by fauna)
- Edge effects (ingress of weeds and potential for pollutants to enter habitats along the boundary of the development)
- Human activity (increased dumping of rubbish and weed spread may result from increased access)

1.3 SUBJECT SITE

The subject site is located at the south-eastern extremity of the current Queanbeyan residential area adjacent to the suburbs of Karabar, Gale and Dodsworth. It occupies approximately 26 ha in area and extends for approximately 4.6 km from East Queanbeyan at the termination point of the existing Ellerton Drive to Karabar at Old Cooma Road (Figure 1-1).

The 'development footprint' is defined as the final formed extent of the earth works required for the Proposal, including all cut and fill batters. The 'subject site' is defined by the development footprint plus a 5m buffer to allow for additional construction impacts (e.g. establishment of sediment and erosion controls and machinery movements). It also includes additional areas proposed for construction compounds.

1.4 STUDY AREA

For the purposes of this assessment, the study area is defined as the subject site and any additional areas that may be indirectly affected. This includes 80 metres either side of the proposed road centre line and any additional adjacent areas that contain habitat for subject species that may be directly or indirectly affected (Figure 1-1). Generally, the study area is limited to the west by residential development and extends, on average, approximately 300 metres to the south and east where less disturbed habitats are present.

The study area encompasses an area of approximately 165 ha however, this area also encompasses some private residential areas on the northern and western edges and a small stretch of the Queanbeyan River. In addition there are some areas that have been cleared and heavily disturbed. Excluding these modified areas, the study area equates to approximately 155 ha.



The study area occupies disturbed open grassy woodland in the far south with some areas more extensively cleared, including a power line and water main easement. The area within the road reserve just south of the Queanbeyan River (where residential areas occur on both sides) is completely cleared and consists largely of introduced (exotic) grasses. North of the Queanbeyan River, there are more heavily disturbed areas of woodland and dry forest vegetation, with large areas completely cleared and supporting extensive weed infestations. North of these areas, the study area is located mostly within relatively undisturbed dry forest, up to the junction with the eastern end of the existing Ellerton Drive. Further details of the values of the study area are discussed in Section 4.





Figure 1-1 Location of the study area and subject site



1.5 LAND USE, ZONING AND TENURE OF THE STUDY AREA

1.5.1 Land use

Excluding the residential areas, there are no specific land uses occurring within the study area. The woodland areas in the south have numerous vehicle and walking tracks which cross through them suggesting that the areas are currently being used for recreational purposes or for vehicle access to areas west of the study area. In the north, the dry forest is relatively undisturbed. There are two tracks which cross the study area from west to east, one which appears to be an access to a dwelling to the east of the study area and another which provides access to some water tanks east of the study area. There are also a number of narrow tracks which are likely the result of trail bike activities. Minor rubbish dumping was also observed in the vicinity of the existing Ellerton Drive.

The study area would provide value with regard to visual amenity for adjacent residential areas.

1.5.2 Zoning

The study area is located entirely within the Queanbeyan LGA. Zoning within and surrounding the study area, according to the Queanbeyan Local Environmental Plan 2012 (QLEP) are shown in Figure 1-2. To the south-west of the Queanbeyan River, the subject site is within land zoned SP2 Infrastructure (Roads). North of the river, the subject site crosses an area zoned E4 Environmental Living for approximately 700m, with the remainder within land zoned E2 Environmental Conservation until the intersection with the existing Ellerton Drive. The bulk of the subject site falls within land zoned as E2 Environmental Conservation. The objectives of these zones as defined in the QLEP are stated in Table 1-1. The development of roads is permitted with consent within zones E2 and E4.

Zone	Objectives
E2 (Environmental conservation)	 To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values. To prevent development that could destroy, damage or otherwise have an adverse effect on those values. To protect threatened species and rivers, creeks and gully ecosystems within Queanbeyan. To identify and protect escarpment areas that enhance the visual amenity of Queanbeyan and possess special aesthetic or conservational value. To protect water quality by preventing inappropriate development within catchment areas.

Table 1-1 Objectives of the zones in which the subject site is located as stated in the QLEP



Zone	Objectives
E4 (Environmental living)	 To provide for low-impact residential development in areas with special ecological, scientific or aesthetic values. To ensure that residential development does not have an adverse effect on those values. To encourage development that is designed to recognise the bushland character of the locality where appropriate and to minimise the impact of urban development, particularly on the edge of the urban area. To ensure that rural residential development provides for integrated rural residential communities in its design.
SP2 Infrastructure (Roads)	 To provide for infrastructure and related uses. To prevent development that is not compatible with or that may detract from the provision of infrastructure

Within the study area and additional to the subject site, there are some small areas of land zoned R1 General Residential, south of the Queanbeyan River adjacent to the area zoned SP2. These areas have been subject to residential development South of the area zoned SP2, there are also additional areas zoned E2 and E4.

Within the north of the study area, developed land zoned E4 occurs to the west of the E2 land in which the subject site is located.

1.5.3 Tenure

Council owns approximately half of the land in the road corridor and has begun the process of acquiring the rest of the land under the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW). Specifically, the land owned by Council between Old Cooma Road and the Queanbeyan River includes: Lot 49 DP754907, Lot 3 DP 1097427, Lot 2 and Lot 3 DP 869386, and the road corridor between Lot 2 DP 8669386 and the Queanbeyan River. Between the Queanbeyan River and the existing extent of Ellerton Drive, Council owns the road corridor west of Lot 174 DP 793880 and Lot 4, 5, 6 DP 872684, and Lot 1, 2, 3 DP 872684.





Figure 1-2 QCC land zoning within the study area and surrounds

Zones within the study area include: SP2 Infrastructure (Roads), E4 Environmental Living and E2 Environmental Conservation.



1.6 THE LOCALITY

For the purposes of this assessment, the 'locality' has been defined as the area within a 10km radius of the centre of the study area (Figure 1-3). The majority of this area (43%) is within the ACT Local Government Area (LGA) in the north and west. Approximately 36% is within the Queanbeyan LGA and 21% extends into the Palerang LGA, to the south-east.

Much of the land within the locality has been subject to urban or rural development however, reserves and State Forests also occur. Reserves within the locality include Queanbeyan Nature Reserve (NR), Mount Jerrabomberra NR, Cuumbuen NR, Stoney Creek NR and Wanna Wanna NR. The locality includes Googong Dam, in the south, and the majority of Kowen State Forest (SF), in the north. Kowen SF is mostly comprised of pine plantation. Additionally, Fairbairn Pine Plantation occurs to the west. These latter areas do not contribute to the native vegetation within the locality.





Figure 1-3 Study area within the context of the locality



2 INITIAL ASSESSMENT

2.1 SUBJECT SPECIES AND POPULATIONS

2.1.1 Director General Requirements (DGRs)

The DGRs identify four flora species, one Endangered Ecological Community, 14 fauna species and additionally the fauna group microbats, including the Greater Long-eared Bat (Table 2-1) as subject species/communities to be considered in this assessment.

Table 2-1 Subject species and communities identified in the DGRs

Species/Community	Status
Flora	
Pale Pomaderris (Pomaderris pallida)	V TSC
Button Wrinklewort (Rutidosis leptorrhynchoides)	E TSC / E EPBC
Small Purple Pea (Swainsona recta)	E TSC / E EPBC
Silky Swainson-pea (Swainsona sericea)	V TSC
Doubletail Buttercup (Diuris aequalis)	E TSC
Community	
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	EEC TSC / CEEC EPBC
Fauna	
Little Whip Snake (Suta flagellum)	V TSC
Golden Sun Moth (Synemon plana)	E TSC / CE EPBC
Pink-tailed Worm Lizard (Aprasia parapulchella)	V TSC / V EPBC
Rosenberg's Goanna (Varanus rosenbergi)	V TSC
Brown Treecreeper (eastern subspecies) (<i>Climacteris picumnus victoriae</i>)	V TSC
Diamond Firetail (Stagonopleura guttata)	V TSC
Hooded Robin (South eastern form) (Melanodryas cucullata cucullata)	V TSC
Speckled Warbler (Pyrrholaemus saggitatus)	V TSC
Scarlet Robin (Petroica boodang)	V TSC
Gang-gang Cockatoo (Callocephalon fimbriatum)	V TSC
Little Eagle (Hieraaetus morphnoides)	V TSC
Painted Honeyeater (Grantiella picta)	V TSC
Eastern False Pipistrelle (Falsistrellus tasmaniensis)	V TSC





Species/Community	Status
Striped Legless Lizard (Delma impar)	V TSC / V EPBC
Koala (Phascolarctos cinereus)	V TSC
Threatened Microchiropteran bats (including the Greater Long-eared Bat)	V TSC

2.1.2 Potential for other threatened species

Database searches

Prior to undertaking a specific field survey program, background searches were carried out to identify any additional threatened species and communities known to, or potentially occurring in the locality, that were not covered by the DGRs. This approach increases the probability of considering the presence of, and possible impacts on, all known and likely native species, particularly any species that are of regional, state or national conservation significance that have not been identified as subject species within the DGR's and that may not be detected during the field surveys. The background searches included the following:

- Database search using the OEH Wildlife Atlas database (including records from the Australian Museum, NSW State Forests and Royal Botanic Gardens) for threatened flora and fauna species and populations within the Murrumbidgee Catchment Management Authority (CMA) catchment, Monaro sub-catchment and Queanbeyan City Local Government Area (LGA) (11 September 2012 and updated search conducted 23 November 2012).
- A search of the EPBC Protected Matters search tool to determine which threatened species and populations have potential habitat within a 10 km radius of the site (11 September 2012 and updated search conducted 23 November 2012).

The above database lists were filtered to identify threatened species known from, or considered likely to occur within the study area. A threatened species evaluation was undertaken on the presence of habitat and the likelihood of occurrence and impact from the proposal development for each species and community returned from database searches. The potential for these entities to occur in the locality was evaluated post field work based on the habitat characteristics of the study area, results from other flora and fauna studies and habitat information presented in current literature (refer to Appendix B). The results of the threatened species evaluation were used to identify other potential species and communities that may warrant consideration us subject species within the SIS not previously specified in the DGRs.

Literature review

Available literature regarding the threatened species, populations and communities considered likely to occur in the locality was reviewed. This included reference texts (e.g. Strahan 1995, Cogger 2000, Pizzey & Knight 2003, and Harden 1990-2002) and key web-based databases including NSW Threatened Species database, Birdlife Australia Birdata database and the Commonwealth Species Profile and Threats (SPRAT) database were consulted in the preparation of this report.

Previous biodiversity studies conducted in the locality were also reviewed as part of the initial assessment. Literature reviewed included:

 Biosis (2003a) Final Draft: Flora and fauna habitat assessment at 300 Lanyon Drive (Poplars). Biosis.



- Biosis (2003b) Natural Heritage Assessment of 'Tralee' Queanbeyan, NSW. Biosis.
- Bushfire and Environmental Service (BES). 2007. Flora and Fauna Assessment Proposed Deviation of Old Cooma Road, Googong. A report for Canberra Investment Corporation Ltd on behalf of Queanbeyan City Council.
- Bushfire and Environmental Services (BES). 2008. Biodiversity Study Findings Report Queanbeyan Local Government Area. A report for Queanbeyan City Council.
- Ecological Australia (2010a) Draft Species Impact Statement Old Cooma Road Realignment and Duplication Queanbeyan. Report prepared for Brown Consulting and Queanbeyan City Council.
- Ecological Australia (2010b) Draft Flora and Fauna Assessment Rezoning Investigations, Jumping Creek Estate, Queanbeyan. A report for Canberra Investment Corporation Ltd on behalf of Queanbeyan City Council.
- Fallding, M. 2002. A Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands. Natural Heritage Trust, NSW National Parks and Wildlife Service and Land & Environment Planning.
- Gellie, N.J.H. 2005. Native vegetation of the southern forests: South-east Highlands, Australian Alps, South-west Slopes and South-east Corner bioregions. Cunninghamia 9, 219-254.
- GHD. (2009). Species Impact Statement, Report for Edwin Land Parkway Extension, Queanbeyan. Report prepared for Queanbeyan City Council.
- Hogg, D. (2008). Scoping Assessment Old Cooma Road Realignment Review of Environmental Factors. Report for Queanbeyan City Council.
- Nash, K. and Hogg, D. (2010) Review of Environmental Factors Old Cooma Road Realignment. Report to Queanbeyan City Council in association with Brown Consulting.
- nghenvironmental (2010). Offset Plan Old Cooma Road Duplication. Report prepared for Brown Consulting and Queanbeyan City Council.
- OEH (2012) Biometric vegetation types database. NSW Office of Environment and Heritage, May 2012.
- Thomas, V. Gellie, N. and Harrison, T. (2000) Forest Ecosystem Classification and Mapping for the Southern CRA Region. NSW National Parks and Wildlife Service Southern Directorate, Queanbeyan.

The results of these reviews were used to identify other potential species and communities that my warrant consideration us subject species within the SIS not previously specified in the DGRs.

Additional species to be considered

The review of previous biodiversity studies and database searches indicated that in addition to the subject species and communities listed in the DGRs, the Hoary Sunray (*Leucochrysum albicans* var. *tricolor*, listed as Endangered under the EPBC Act) could potentially occur within the study area. This species has been considered as an additional subject species in this SIS.



3 SURVEY EFFORT AND TECHNIQUES

3.1 SURVEY REQUIREMENTS

The minimum survey requirements for subject species and communities have been given in the DGRs (Appendix A). The actual survey effort and techniques are detailed below.

3.2 FLORA

3.2.1 Survey personnel

All flora surveys, including the site reconnaissance, were conducted by experienced botanists. Survey personnel included:

- Jackie Miles (BSc (Hons), senior botanist)
- Dave Maynard (BSc (Hons), botanist)
- Brenton von Takach Dukai (

3.2.2 Site reconnaissance

A brief reconnaissance of the subject site was conducted by a single botanist on the 18 September 2012. This involved walking the length of the proposed alignment on foot and recording dominant vegetation types, potential threatened flora habitat and the locations of all threatened species detected. Points of interest were recorded using a handheld GPS. A total of four person hours was spent on this survey.

3.2.3 Detailed surveys

Detailed flora surveys targeting both the study area and the locality ,were conducted on 6 - 9 November 2012, using standardised 20m x 20m quadrats, informal transects (random meander after Cropper 1993), inspection points and targeted threatened species transects. Additional targeted threatened species transects were conducted within the study area on the 14 November 2013 along the Queanbeyan River. A total of 66 person hours was spent on the flora component of the survey. Floristics, structural data, vegetation condition and site physical values were recorded. The field survey targeted areas of potential habitat for significant or sparsely distributed plant species. The detailed survey methodologies are outlined below.

Quadrats

Standard 20m x 20m (400m²) quadrats were conducted in all vegetation types within the study area recording all species that occurred within the quadrat and their relative abundance. Quadrats were also conducted within the locality, focusing on communities of conservation significance (refer to Table 3-1 for survey effort).

Quadrats within grassy woodland within the study area and locality were conducted applying the method of assessing grassy ecosystem site quality developed by Rehwinkel (2007). This assessment method applies a 'floristic value score' to grassy sites based on the number, density and significance of species recorded in 400m² quadrats. A modified Braun-Blanquet cover scoring system was used to survey quadrats. This approach allows for a direct comparison to be made between the qualities of grassy woodland to be



impacted by the development compared to similar vegetation within the locality. The results of the quadrat based surveys are recorded in full in Appendix C.1.

Random meander surveys

It is possible to miss rare or sparsely distributed plant species by solely employing a quadrat based survey methodology. Therefore, random meanders (after Cropper 1993) were conducted within the vicinity of quadrats to record additional flora species within each vegetation type. Random meanders consisted of random transects across an area up to 1ha in size around quadrat sites, recording all species opportunistically encountered. These species are recorded by vegetation type in the species list included as Appendix C.1.

Inspection points

In addition to the plot-based and traverse surveys, the majority of the study area was inspected on foot to confirm vegetation types, map the distribution of vegetation communities and search for threatened species. Areas of natural vegetation in better condition were given particular attention. Inspection points were established where dominant species occurring at the sites were recorded to adequately confirm the vegetation type and condition where necessary.

Candidate areas of heavily disturbed habitats or areas carrying mainly exotic species were surveyed to record general species composition. Because of their low likely conservation significance, these highly modified areas were not inspected in detail.

Within the locality, inspection points were utilised to gather a broader understanding of the distribution of vegetation types surrounding the study area. Throughout the assessment of the locality, the locations of threatened species that were opportunistically encountered were also recorded.

Threatened species transects

A transect approach was also considered to be more robust than that of a random meander although both are considered appropriate under the guidelines (DEC 2004). This method was also specified by the DGRs. Targeted transect searches were conducted for subject species of the SIS in all areas of suitable habitat within the study area, in accordance with the methodology specified in the Draft Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004). The length and duration of transects is given in Table 3-1. Searches were conducted on foot by experienced botanists who were familiar with the targeted species. Higher quality habitat was present in the south of the study area and transects in this area were spaced approximately 5m apart. In general, habitat in the north of the study area was considered to be more marginal for the species being targeted. Transects within this area were spaced approximately 10 - 20m apart, excluding features such as drainage lines and the banks of the Queanbeyan River where the potential for threatened species was higher and which were therefore investigated in detail.

3.2.4 Vegetation classification, mapping and nomenclature

The vegetation of the study area has been classified using the Native Vegetation of the Southern Forests: South-east Highlands, Australian Alps, South-west Slopes, and SE Corner bioregions (Gellie 2005). This is a more up to date version of the Forest Ecosystem Classification and Mapping for the Southern CRA Region completed by Thomas *et al.* (2000). The closest equivalent Biometric vegetation types have also been included. Vegetation condition was determined based on the definitions provided in the Biometric Operations Manual (DECC 2008).



Vegetation mapping within the study area is based on the results of the field surveys conducted by **ngh**environmental. Vegetation mapping within the broader locality has been mapped with reference to the revised Southern CRA Region mapping (Gellie 2005), Bushfire and Environmental Services mapping for the Queanbeyan LGA (BES 2008) in addition to field surveys conducted by **ngh**environmental for this Proposal (November 2012).

Botanical nomenclature follows Harden (1990-2002), except where recent taxonomic changes have occurred. In the body of this report, flora species are referred to by their common and also by their scientific name, when first mentioned. Where a species does not have a generally accepted common name, the scientific name only is used throughout the body of the report. Common and scientific names are included in the full species lists provided in Appendix C.1.

Noxious weeds identified are those declared for the Queanbeyan City Council control area under the *Noxious Weeds Act 1993*. The scientific names of all exotic plant species are proceeded by an * within this report.

3.2.5 Survey effort

Survey effort is summarised below in Table 3-1 and mapped for the study area and locality in Appendix D.1.



Date	Survey methodology	No. of plots/transect length	Survey effort (person hours) ³	Target species/ community	Deviation from methods specified in the DGRs
November 2012	Quadrat, random meander and inspections (study area)	Quadrats 6 Inspections 12	16.5	White Box Yellow Box Blakely's Red Gum Woodland	No. Surveys identified the extent and condition of the ecological community within the subject site and study area. Condition was determined based on a recognised methodology (Rehwinkle 2007).
November 2012	Quadrat, random meander and inspections (locality)	Quadrats 10 Inspections 46	37.5	White Box Yellow Box Blakely's Red Gum Woodlan	No. Existing datasets (Thomas <i>et. al.</i> 2000, Gellie 2005, BES 2008) were used to estimate the extent of the community in the locality. Surveys ground-truthed the extent and condition of the ecological community within the locality at sites selected to provide context. Condition was determined based on a recognised methodology (Rehwinkle 2007).
November 2012	Targeted threatened species transects (south of study area)	3.73km	5	Button Wrinklewort, Silky Swainson Pea, <i>Swainsona</i> <i>recta, Diuris</i> <i>aequalis,</i> Hoary Sunray	No. Systematic transect surveys (5m apart) were undertaken in all areas of woodland/grassland considered to be suitable for the target species. OEH were consulted regarding flowering and survey timing (A. Treweek, OEH, pers. comm. 6 November 2012).

Table 3-1 Summary of flora survey effort



³ Including random meanders.

Date	Survey methodology	No. of plots/transect length	Survey effort (person hours) ³	Target species/ community	Deviation from methods specified in the DGRs
November 2012	Targeted threatened species searches (north of study area)	4.11km	5.5	Pale Pomaderris, <i>Diuris</i> <i>aequalis</i> , Hoary Sunray	No. Systematic transect surveys were undertaken (10m) apart through riparian areas targeting the Pale Pomaderris. Transect surveys (10m – 20m apart) were undertaken through the dry forest community targeting <i>Diuris aequalis</i> and the Hoary Sunray.
November 2013	Targeted threatened species searches (Queanbeyan River)	1km	1.5	Pale Pomaderris	No. A random meander survey concentrated on the riparian zone and did not detect habitat suitable for this species. Transect surveys were not warranted.

3.3 FAUNA

3.3.1 Survey personnel

Survey personnel involved in the project included:

- Bianca Heinze (senior ecologist)
- Deb Frazer (senior ecologist)
- Freya Gordon (senior ecologist)
- Nathaniel O'Rourke (ecologist)
- Dave Cannon (technical assistant)

A specialist was consulted regarding some species:

- Kris Nash (sub-consultant Golden Sun Moth Surveys)
- Greg Richards (bat sub-consultant Anabat call analysis and advice)

3.3.2 Site reconnaissance

Habitat assessment was undertaken during the initial site reconnaissance in September. This involved walking the length of the proposed alignment on foot. A brief visual evaluation of the habitat values was undertaken, as outlined in the habitat assessment methodology (below). Points of interest were recorded using a handheld GPS. A total of four person hours was spent on this survey.

3.3.3 Survey types

Survey types included habitat assessment, detailed inspection of key habitat features (hollow-bearing trees, termite mounds), fauna census (for birds, microbats, amphibians, nocturnal birds of prey and



arboreal mammals) as well as targeted surveys for the Pink-tailed Worm-lizard, Little Whip Snake, Striped Legless Lizard, Koala Golden Sun Moth, and threatened microbats. **ngh**environmental conducted field surveys during September, November and December 2012, as well as March and November 2013.

Surveys were undertaken in accordance with the DGRs and Draft Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004). Fauna survey effort is summarised in Table 3-3, illustrated in Appendix D.2.

Habitat assessment

A total of 58 habitat assessments were undertaken using two methods of: 1) habitat quadrat assessment (100 m x 100 m search area); and 2) habitat transect assessment (100 m x 2 m search area). The habitat quadrat assessments were undertaken within or adjacent the area of direct impact (subject site) as this method covers a 1 ha search area allowing more detailed information to be collated in the area of most impact. The habitat transect assessments were undertaken further away from the subject site as this is a more rapid method than the quadrat assessments as the search area covers 0.02 ha; this method was particularly appropriate in the wider study area and locality as assessments could be completed quickly allowing a more areas to be surveyed so as to ensure the habitat values of the broader area were identified.

The habitat assessments were undertaken to identify and assess habitat features and fauna resources of the study area and locality, with focus on recording subject species habitat quality. Searches for species signs (scats, runways, feeding signs, etc.) and key feed species were undertaken. The habitat assessment included evaluation of:

- Type and abundance of rock
- Ground habitat structure
- Presence of native grass species (i.e. Kangaroo and Wallaby Grass)
- Vegetation structure
- Extent of weed invasion
- Type and extent of disturbance
- Surrounding habitat matrix and connectivity
- Foraging resources (i.e. abundance of mistletoe)
- Nesting resources (i.e. abundance of hollow-bearing trees)

An overall assessment of habitat quality was made, using the categories described in Table 3-2. For example, an area of good quality habitat would meet several or all of the criteria described below.





Table 3-2 Description of fauna habitat quality categories

Quality	Description
Good	• Diverse habitat structure: structural components present at a range of stratum levels (ground, understorey, midstorey, and canopy) and age classes.
	 Presence of shelter and refuge: low shrub or tussock, rocky outcrop, hollow logs (ground dwelling fauna).
	 If forest or woodland: moderate to high abundance of hollow-bearing trees, including mature trees with large internal dimensions.
	 Habitat complexity: areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic. This increases the range of foraging and shelter opportunities within a habitat.
	Presence of key foraging and microhabitat components for subject species.
	Little to no weed invasion.
	Good landscape connectivity.
Moderate	 Medium complexity of habitat structure appropriate to vegetation type. Ground litter layer intact or only slightly disturbed. More than one age class present for dominant trees.
	• Some shelter and refuge present for ground dwelling fauna.
	• If forest or woodland: hollow-bearing trees present in low to moderate abundance.
	• Habitat complexity, that is, areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic.
	Presence of key microhabitat components for subject species.
	If evidence of weed invasion, native flora species remain dominant.Moderate landscape connectivity.
Poor	• Habitat highly disturbed or simplified with little structural complexity. Ground litter layer absent or highly modified.
	Habitat complexity reduced (only one age class present for dominant trees).
	Little or no shelter and refuge for ground dwelling fauna.
	If forest or woodland: low abundance or no hollow-bearing trees.
	Lack of key foraging and microhabitat components for subject species.
	 Poor landscape connectivity (narrow, fragmented, or isolated from other patches of vegetation).

Hollow-bearing tree identification

All visible hollow-bearing trees within the subject site and within 100m buffer (approximately) of the subject site were recorded. All hollow-bearing trees were recorded in this zone to quantify the extent of impact within and nearby the subject site. Other hollow-bearing trees were recorded within the study area outside this 100m buffer as a result of habitat assessment surveys; however these surveys did not cover the entire length of the broader study area and were undertaken only to provide an indication of habitat values across the wider area.

All hollows were recorded via a handheld GPS. Information was collected on the location (trunk, branch or spout) and entrance size of each hollow and number of hollows per tree. Trees were searched for signs of wear such as smoothing around the hollow entrance or scratches along the trunks. Hollow sizes were classified as small (< 10 cm entrance diameter), medium (11 to 20 cm entrance diameter) or large (>20 centimetres entrance diameter). It is noted that ground based surveys have varying degrees of accuracy in



detecting hollows, depending on forest type (Koch 2008). If a marking appeared to be a hollow, but could not be verified from the ground (e.g. an upward facing hollow or spout), a precautionary approach was taken and these trees were marked as hollow-bearing, with a note made that the hollow was 'potential'.

An assessment of the availability of hollow-bearing trees was also undertaken in the locality during habitat assessments. Thirty-three 100 m x 2 m transects were walked and all observed hollow-bearing trees were marked via a handheld GPS and information collected as described above.

Termite mounds

The entire study area was searched for termite mounds. Each mound was marked via a handheld GPS for mapping. Each mound was physically marked with a small spot of paint to avoid double counting.

An assessment of the availability of termite mounds was also undertaken in the locality during habitat assessments in which 33 100 m x 2 m transects were walked and all observed termite mounds were marked via a handheld GPS.

Bird surveys

The two hectare area search method recommended by Birdlife Australia was used for bird census. Surveys undertaken during November 2012 and March 2013 had a duration of 45 minutes, as specified in the DGRs. Further follow-up surveys were undertaken in November 2013 after consultation with OEH; these surveys deviated from the original DGRs and had a duration of 20 minutes at the request of OEH.

Species present within the search area, flying overhead and outside the search area were recorded. As well as species observed, the following variables were recorded: observation type, microhabitat type and number of individuals.

Birds were recorded by sight and vocalisations using the following field guides:

- Simpson and Day (1999) Field Guide to the Birds of Australia (visual identification)
- Pizzey and Knight (2003) A Field Guide to the Birds of Australia (visual identification)
- Bird Observers Club of Australia (1998) *A Field Guide to Australian Birdsong* (aural identification)

The DGRs required that bird surveys avoid high-wind and/or rainy days. Surveys were predominantly undertaken early in the morning (dawn) in appropriate conditions (no wind or rain), with some afternoon (dusk) surveys conducted.

Microbat surveys (Anabat)

Microbats were surveyed using a ground mounted Anabat detector (passive survey) in all habitat types. The detector was left in place overnight in locations chosen to maximise the potential for detecting multiple species of bats, such as in likely flyways through vegetation and along drainage lines. The Anabat were set to record calls from approximately 30 minutes before sunset to daybreak the following morning. Surveys were undertaken throughout the survey period, targeting nights of no or little wind to maximise the chance of calls being recorded.

Targeted reptile surveys

Reptile surveys targeting the Pink-tailed Worm-lizard, Little Whip Snake and Striped Legless Lizard were undertaken in grassland, woodland and forest habitat targeting potential habitat for these species (i.e. presence of rocks and native grass species). Rocks and logs were scanned for basking individuals prior to



active searching. Active searching was then undertaken under rocks, fallen timber (logs and branches), and leaf litter.

Depending on habitat extent and quality, searches varied between 20 and 60 minutes. For the Pink-tailed Worm-lizard, where rock habitat was extensive, a minimum of 150 rocks were rolled to obtain some level of confidence of the presence or absence of the species.

The DGRs specified that surveys for the Pink-tailed Worm-lizard be undertaken during mid-August and the end of October in temperatures below 25°C. Due to unsuitable weather conditions of cold temperatures and high rainfall within October 2012, the Pink-tailed Worm-lizard was targeted during the first week of November 2012 during reptile searches when conditions were considered more suitable for detecting the species. While this was just outside the timing specified within the DGRs (mid-August to end of October) the timing was considered appropriate as the weather was not too hot and searches were conducted in the morning to avoid high temperatures. The temperature during searches ranged from 12 to 20°C (refer to Table 3-4 for weather conditions during surveys). Subsequent Pink-tailed Worm-lizard surveys were undertaken in March 2013 to supplement results, despite the surveys being conducted outside the specified DGR survey dates, as conditions during March were also considered appropriate (weather was warm, but not hot and > 11 mm of rainfall was recorded 2 days prior to the survey).

During November 2012, one nocturnal reptile survey (including rock-rolling and spotlighting) was undertaken after dusk for the Little Whip Snake within Box Gum Woodland.

Golden Sun Moth survey

Four traverse surveys were completed within potential habitat for the Golden Sun Moth (Box Gum Woodland in the southern section of the study area) during December 2012 (Appendix D.2). A linear distance of between 2.5 and 3 km in length was walked each survey (4 person-hours). The observer kept a steady pace across the site, stopping and turning at suitable locations for several minutes to check for flying moths. Moths flying up to a radius and/ or linear distance of 25 metres were visible at most locations.

A meandering traverse approach was adopted because of the patchy nature of the habitat within the study area and to ensure thorough coverage of all areas containing potential habitat. Cool, overcast and/or windy conditions during November 2012 delayed the emergence of Golden Sun Moth until mid-November. Golden Sun Moths were observed flying in various locations within the ACT region under suitable conditions from 14 November until at least the end of December 2012. The current survey was undertaken within this latter period.

Weather conditions on each of the survey days were suitable for the detection of flying Golden Sun Moth (warm-hot days with little or no wind) (Table 3-4). There was no rain recorded in the three days prior to any of the surveys.

Amphibian survey

Frogs were surveyed in the study area on the south side of Queanbeyan River by listening for 15 minutes and 5 minutes of spotlighting. Frogs were identified by vocalisations using David Stewart (2002) *Australia Frog Calls: Subtropical East* (aural identification).

Koala RapSAT (scat) survey

Koala surveys were undertaking using the field aspects of Rapid Spot Assessment Technique (RapSAT) as described by Phillips and Callaghan (2011). Scats, tracks and diggings were identified with the assistance of Triggs (1996). All surveys in the study area were undertaken under trees "known or considered to be



potentially important for Koalas, or for other assessment purposes", as no Koala sightings or pellets had been attributed directly to the site (Australian Koala Foundation 2009 p. 3).

The RapSAT method involves searching for scats or evidence of Koalas at the base of 30 trees per site (Phillips and Callaghan (2011). It is recommended that surveys are undertaken at 500m intervals to ascertain the presence or absence of Koalas, or 30 trees are searched every 25 ha. A total of seven RapSAT searches were completed within the subject site equating to a search of 30 trees every 3 ha. The surveys were spread across the study area and are considered representative of the major habitat types on site.

Nocturnal fauna surveys

Nocturnal surveys consisted of stagwatching for the Gang-gang Cockatoo, listening for vocalisations of nocturnal animals at dusk, call playback for the Koala, and spotlighting for microbats.

Stag watch for Gang-gang Cockatoo and microbats

In November 2012 two individual trees with large hollows were monitored at dusk on separate occasions to observe any utilisation by birds or microbats. In particular, hollows were watched for nesting Gang-gang Cockatoos or emergence of microbats. During November 2012 stagwatches were undertaken for 30 minutes before sunset and 20 minutes after dark, followed by 30 minutes of spotlighting. Spotlighting was conducted on foot using hand-held 12v 50w spotlight.

In November 2013 targeted stag watches for the Gang-gang Cockatoo were undertaken at 12 hollowbearing trees supporting hollows appropriate for nesting by the species; all trees monitored are located just north of Queanbeyan River, with a couple south of the river. Hollows were monitored at dusk over two survey nights and surveys were undertaken in the known breeding season of this species. Hollows were monitored for 1-2 hours prior to dusk while listening for the characteristic vocalisations typical of the Ganggang Cockatoo. Due to the close proximity of several hollow-bearing trees, one stag watching survey could include observation of several trees at one time.

Koala call playback

In March 2013, call playback for the Koala was undertaken on two separate nights. A pre-recorded digital call was broadcast from a 15W megaphone for a period of five minutes, followed by a listening period of approximately ten minutes. Listening for vocalisations continued during subsequent spotlighting surveys for a further period of 30 minutes.

Spotlighting

Spotlighting was undertaken to gauge the use of the area by microbats, specifically in areas of hollowbearing trees, and for the presence of fauna in general. Spotlighting was undertaken within three separate locations of the study area. In particular, the March 2013 surveys targeted the middle section of the study area where high densities of hollow-bearing trees are located. Spotlighting surveys were undertaken for approximately 30 minutes.

Opportunistic surveys

Opportunistic observations of fauna or evidence of fauna activity were recorded throughout the survey period. Opportunistic observations of threatened species were recorded using a hand-held GPS.

3.3.4 Survey effort

The fauna survey effort for the study area is detailed in Table 3-3. Appendix D.2 illustrates the locations of all surveys undertaken.



Table 3-3 Fauna survey effort undertaken in the study area and locality and comparison with DGRs

Date	Method	Survey Effort	Target Species	Deviation from methods specified in DGRs
Habitat				
September 2012	Habitat Inspection	27 inspection surveys in study area	Target DGR species. All habitat features including	No. Note: Locality habitat assessments used to
November 2012	Habitat Quadrat Assessment (100 m x 100 m)	9 surveys in study area 3 surveys in locality	hollow-bearing trees and termite mounds.	determine availability of hollows and termites in the locality.
March 2013	Habitat Transect Assessment (100 x 2 m transect)	30 surveys in locality		
November 2013	Habitat Transect Assessment (100 x 2 m transect)	16 surveys in study area		
Hollow-bearing Trees				
November 2012	HBT mapping	Within 100m boundary	Hollow dependent fauna,	No. DGRs specify mapping HBT for potential Gang-
March 2013	HBT mapping	of subject site (direct impact)	particularly Gang-gang Cockatoo and microbats.	gang Cockatoo nest sites and microbat roost sites.
Birds (diurnal surveys)				
November 2012	Diurnal bird survey	5 surveys in study area 3.75 person-hours	All bird species, particularly Brown Treecreeper,	No. Bird surveys were primarily undertaken at dawn, with some dusk surveys completed.
March 2013	Diurnal bird survey	12 surveys in study area2 surveys Cuumbuen N.R9 person-hours	Robin, Speckled Warbler, Scarlet Robin, Little Eagle, Painted Honeyeater, Gang-	
November 2013	Diurnal bird survey	16 surveys 5.30 person –hours		Yes. Additional bird surveys requested by OEH at 20 minute duration (deviation from 45 minute surveys requested in 2012).

4733 Final v1.2

24



Species Impact Statement Ellerton Drive Extension

Date	Method	Survey Effort	Target Species	Deviation from methods specified in DGRs
Birds (stag watch surveys)				
November 2012	Stag Watch	Stag watch at 2 trees 1.75 person-hours	Gang-gang Cockatoo	No.
November 2013	Stag Watch	Stag watch at 12 trees 16.75 person-hours	Gang-gang Cockatoo	No.
Microbats				
November 2012	Stagwatching & Spotlight	2 survey nights 2 person-hours	Hollow-dependent fauna, particularly microbats	No.
November 2012	Anabat surveys in woodland and forest areas, including targeting	6 overnight surveys in study area 1 overnight survey in Cuumbuen NR	Microbats, in particular Eastern False Pipistrelle	No.
March 2013	of hollow bearing trees.	4 overnight surveys		
Reptiles and amphibians				
November 2012	Active searching (rock, log, branch rolling)	5 surveys in study area 3 person-hours	All reptile species, particularly Pink-tailed Worm-lizard	Yes. Survey just outside specific timing as conducted first week of November, just after end of October. However, the timing was still considered appropriate as preceding temperatures and those experienced during the survey week were not too hot for detection of this species.
November 2012	Nocturnal rock rolling in Box Gum Woodland	1 survey in study area 0.70 person-hours	Little Whip Snake	Yes. Nocturnal survey additional to specified survey requirements.
November 2012	Mapping termite mounds	N/A	Rosenberg's Goanna	No.
November 2012	Nocturnal aural and spotlight survey (Queanbeyan River)	1 survey in study area 0.30 person-hours	All frog species	Not applicable.

4733 Final v1.2

ngh environmental

25
Date	Method	Survey Effort	Target Species	Deviation from methods specified in DGRs
March 2013	Active searching (rock, log, branch rolling)	2 surveys in study area 2 person-hours	All reptile species, particularly Pink-tailed Worm-lizard	Yes. Outside specified survey timing, but these surveys additional to the November 2012 reptile search and specified survey requirements.
March 2013	Mapping termite mounds in locality (100 x 2 m transects)	Conducted as part of Habitat Assessment (refer to March 2013 Habitat Assessment)	Rosenberg's Goanna	No.
Golden Sun Moth				
December 2012	4 x transects in Box Gum Woodland in southern end of study area	4 person-hours	Golden Sun Moth	Yes. Surveys undertaken in accordance with Significant impact guidelines for the critically Endangered Golden Sun Moth (DEWHA 2009). It was proposed if species found, counts would be taken as per DEWHA (2009) rather than hand netting. Searches for pupal casing were not considered appropriate (pers. comm. A. Treweek 06.11.12).
Koala				
November 2012	Spot Assessment Technique (RapSAT)	4 plots in study area 6 person-hours	Koala	No.
March 2012	pious in secondary habitat areas.	3 plots in study area 4.5 person-hours	Koala	No.
March 2013	Nocturnal call playback and Spotlighting.	2 survey nights 1.5 person-hours	Koala	Yes. Call playback additional to specified survey requirements. Call playback conducted during breeding season of Koalas.
Other Mammals				
March 2013	Spotlighting	2 survey nights 1.5 person-hours	Hollow dependent fauna	Yes. Spotlighting additional to specified survey requirements.

4733 Final v1.2

ngh environmental

26

3.3.5 Fauna survey conditions

Weather conditions during all survey events are detailed in Table 3-4 and specific limitations are discussed above for each target species. Overall, conditions during the survey period were considered appropriate for detecting the target DGR species.

Table 3-4 Daily weather observations over the survey periods showing daily minimum and maximum temperatures (Queanbeyan Bowling Club weather station - BOM 2013) as well as temperature ranges during specific targeted surveys.

Date	Survey Type	Temperature range during target surveys	Temperature (min-max for the day)	Rainfall (mm)	Wind (km/h)
November 2012					
4 Nov 2012	N/A	N/A	6 - 25°C	0	17
5 Nov 2012	Stagwatch / spotlight	20°C	8 - 30°C	0	24
6 Nov 2012	Bird	17-22°C	14 20%	0	20
6 NOV 2012	Reptile	17-20°C	14 - 30 C	0	30
7 Nov 2012	Bird	17-18°C (no rain during am survey)	16 - 19°C	8 (only in	17
	Reptile	16-18°C		arternoon)	
8 Nov 2012	Bird	17-18°C (no rain during am survey)	11 - 25°C	9	20
0 Nov 2012	Bird	17-22°C	10 22%	0.2	20
9 NOV 2012	Reptile	17-20°C	10 - 22°C	0.2	28
December 2012					
6 Dec 2012	Golden Sun Moth	21 – 22°C	N/A	0	9 – 15
8 Dec 2012	Golden Sun Moth	24 – 27°C	N/A	0	8 - 11
19 Dec 2012	Golden Sun Moth	29 – 31°C	N/A	0	11 - 14
22 Dec 2012	Golden Sun Moth	28 – 30°C	N/A	0	17 - 19
March 2013					
5 March 2013	Bird	11 - 16°C	11-27°C	0	< 1
6 March 2013	Bird	12 - 18°C		0	5
	Reptile	12 -17°C	11-28°C		
	Spotlight	21°C			
7 March 2013	Bird	12 - 18°C		0	
	Reptile	11 - 19°C	11-31°C		5
	Spotlight	21°C			
8 March 2013	Bird	12 - 20°C	12-29°C	0	12



Date	Survey Type	Temperature range during target surveys	Temperature (min-max for the day)	Rainfall (mm)	Wind (km/h)
November 2013					
13 Nov 2013	Bird	10 - 16°C	E 01°C	0	15
	Stag watch	~ 15°C	5-21 C		
14 Nov 2013	Bird	8 - 18°C	6 22%	0	12
	Stag watch	~ 16°C	0-22 C	0	

3.4 LIMITATIONS (FLORA AND FAUNA)

Survey timing was considered suitable for the detection of all target flora species. Flowering of subject species that are only identifiable during specific periods was confirmed at the time of the survey by OEH (A. Treweek, OEH, pers. com. 06/11/12). The majority of other flora species detected were identifiable during the survey. Some summer and winter flowering species may have been overlooked but it is considered unlikely that any threatened species were present and not detected.

The rainy weather contributed to some fauna survey limitations including affecting one morning bird and reptile survey (only on 7 November 2012), by reduced visibility due to drizzle. However, these limitations are not considered likely to have substantially affected the viability of these surveys. Overall the weather conditions in which results were collected and the methods employed are considered adequate to assess the impact of the proposal on the subject species.

Due to time constraints, all hollow-bearing trees and termite mounds could not be marked across the entire study area. Instead all hollows and termite mounds were mapped within the subject site plus a 100m buffer. This allowed an assessment of the direct impact of the proposal on these habitat features while also understanding the extent to which hollows and termite mounds would remain within the immediate area. Habitat assessment surveys were undertaken outside this 100m buffer zone in which hollows and termite mounds were features that would remain in the wider area and if densities were similar to that within the subject site.

Hollow-bearing trees have been identified from the ground using binoculars, based on features such as dark holes in the bark or broken branches and some inaccuracy is expected; some features assumed to be hollow may not actually be present and some hollows may be have been overlooked. By including 'potential' hollows, on the balance, it is considered that the hollow-bearing trees counted realistically represent the availability of the resource in the study area (Koch 2008).

Extensive trapping surveys involving pitfall traps or cage traps were not considered necessary, due to the types of threatened fauna likely to occur in the study area and the value of habitat present. In particular, habitat for the Pink-tailed Worm-lizard was highlighted as marginal during the reconnaissance surveys and pitfall trapping was not considered to be required. The Rosenberg's Goanna is known to occur within the study area as suitable habitat is present on site and therefore it was assumed to be present, although not detected. Cage trapping in this instance was not considered appropriate given their cryptic nature, which makes them hard to trap. Extensive nocturnal surveys were not undertaken as threatened nocturnal species are not known for the study area, apart from microbats. Microbats were targeted through passive survey and some spotlighting work.



It is noted that any survey represents a snapshot in time. As it is difficult to rule out the presence of any particular species without exhaustive survey, a precautionary approach has been adopted. That is, if suitable habitat is present and desktop assessment has determined the species could occur in the area, the species has been assumed to have potential to utilise habitat with the proposal area.

3.5 GIS MAPPING

Spatial data obtained during the survey using hand-held Garmin GPS units were plotted over aerial imagery (sourced from QCC and ESRI Online) using ESRI's ArcGIS software for mapping, planning and presentation. Vegetation and condition boundaries within the study area were extrapolated from point and traverse data and notes taken during the general site inspection. All map references are based on the GDA 94 datum.

Vegetation mapping presented for the locality is based on that provided by Gellie (2005). Area calculations however, were not possible using the layer dataset available (which is raster based) and areas calculated for the locality have been based on the polygon data by Thomas *et al.* (2000) which facilitated area calculations.



4 SURVEY RESULTS

4.1 FLORA

4.1.1 Vegetation communities

Three native vegetation communities were identified within the study area. These vegetation types are described below and mapped in Appendix E.1. Representative images of the vegetation at the site are included in Appendix G.2. A complete species list of all species encountered during the surveys, grouped by vegetation type and quadrat, is included as Appendix C.1.

Tablelands Dry Shrub/Tussock Grass Forest (Dry Forest)

This vegetation type occupies most of the northern half of the site between Ellerton Drive and a point about 400m north-east of Lonergan Drive on relatively steep and dissected terrain with skeletal soils derived from Ordovician metasiltstone. Approximately 107 ha of this community occurs within the study area, with approximately 14 ha within the subject site. The overstorey is dominated by Red Box (*E. polyanthemos*), Scribbly Gum (*E. rossii*), Red Stringybark (*E. macrorhyncha*) and Mealy Bundy (*E. nortonii*) with scattered occasional Yellow Box (*E. melliodora*). The understorey is primarily shrubby, with high shrub species diversity (35 species recorded). Dominant shrubs include Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*), *Pultenaea microphylla*, Peach Heath (*Lissanthe strigosa*), Grey Guinea Flower (*Hibbertia obtusifolia*) and Poverty Wattle (*Acacia dawsonii*). Native grass and forb diversity is high although density is generally low. Common species include Red-anther Wallaby Grass (*Rytidosperma pallidum*), *Rytidosperma monticola*, Corkscrew Grass (*Austrostipa scabra* subsp. *falcata*) and Wattle Mat-rush (*Lomandra filiformis* subsp. *coriacea*).

Dry Forest is a very common vegetation type within the locality. Vegetation mapping for the locality (refer to Appendix E.1) identifies approximately 7170 ha of this vegetation type within a 10 km radius of the site.

The closest equivalent Biometric vegetation type for this community is Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest on skeletal hills of the tablelands, South Eastern Highlands (MR595)

Tablelands Acacia/Grass/Herb Dry Forest

A vegetation type that somewhat resembles Tablelands Acacia/Grass/Herb Dry Forest occurs within the broader and flatter areas of gullies within the northern section of the study area. This vegetation does not conform comfortably with any of the described communities in Gellie (2005), the Biometric vegetation types database, or other recent vegetation classifications (e.g. OEH 2011). It has been classified as Tablelands Acacia/Grass/Herb Dry Forest here as it matches with regard to overstorey species and landscape position of this community and shares some common understorey species. Approximately 4.7 ha of this community occurs within the study area, with approximately 1.5ha within the subject site. It characteristically has an overstorey dominated by Yellow Box and Apple Box (*Eucalyptus bridgesiana*) however, the vegetation within the study area exhibits a shrubby midstorey which is not characteristic of Tablelands Acacia/Grass/Herb Dry Forest which generally has a predominately grassy understorey and sparser shrubs.

Within the northern most gully, the midstorey is dominated by exotic shrub species such as Hawthorn (**Crataegus monogyna*), Blackberry (**Rubus fruticosus*), Privets (**Ligustrum* spp.) and Firethorn (**Pyracantha angustifolia*). Within the southern gully in the northern part of the study area, a native shrub layer is present dominated in areas by Birch Pomaderris (*Pomaderris betulina*) and Burgan (*Kunzea*)



ericoides) with a high diversity of other shrub species also present. Based on observations within the southern gully, it is considered likely that a native shrub layer was also present within the northern most gully and that due to disturbance, has been replaced by invasive exotic species. This is further supported by the fact that the surrounding vegetation also contains a diverse native shrub layer.

A grassy groundcover is present and varies in diversity and density depending on the density of the shrub layer. In the northern gully, exotic species such as Chilean Needle Grass (**Nassella neesiana*) and Fescue (**Vulpia* sp.) are dominant in areas along with numerous exotic forb species including St John's Wort (**Hypericum perforatum*). A number of native groundcover species also occur in this area however, they are relatively low in abundance. Within the southern gully, the groundcover is generally sparser due to the dense cover of Birch Pomaderris. Groundcover species are typically those associated with the adjacent Dry Forest.

This community is not mapped as occurring elsewhere within the locality however, it is noted that the vegetation within the study area does not exactly conform to the description of this community (having a predominately shrubby not grassy understorey). It is considered likely that similar vegetation occurs within similar landscape positions (i.e. the lower end of drainage lines) and that existing broad scale mapping did not capture this vegetation type.

Although co-dominated by Yellow Box, due to the structure and floristic composition, this forest is not considered to be the White Box Yellow Box Blakely's Red Gum and derived native grassland EEC listed under the TSC or EPBC Act. The NSW Scientific Committee's final determination for this community (NSW SC 2002) states that *"shrubs are generally sparse or absent, though they may be locally common"*. The occurrences of this community within the study area are characterised by the presence of a distinct shrub layer consisting of species that are not typically associated with the EEC.

The closest equivalent Biometric vegetation type is Apple Box - Yellow Box - Argyle Apple dry open forest on undulating hills, South Eastern Highlands and South Western Slopes (MR512)

Tableland Dry Grassy Woodland (Box-Gum Woodland)

This community is predominant in the southern section of the study area and extends from Old Cooma Road to slightly north of the Queanbeyan River, excluding two highly disturbed areas dominated by exotic grasses. It can be highly variable but is generally an open woodland formation partially dominated by trees such as Apple Box and Yellow Box. Approximately 15 ha of this community occurs within the study area, with approximately 4 ha within the subject site. This community is a predominately grassy ecosystem with a sparse mid storey. Within the study area it is characterised by an overstorey dominated by Red Box and Yellow Box with a sparse midstorey comprising mostly species of *Acacia* such as Silver Wattle (*Acacia dealbata*), Black Wattle (*A. mearnsii*) and Red-stemmed Wattle (*A. rubida*). Within the drainage line that runs down to toward Old Cooma Road, Apple Box becomes more prominent and is co-dominant with Yellow Box. In this area, the groundlayer is more disturbed and predominately grassy with a sparse shrub layer. It is possible that the community within the drainage line was once more shrubby (similar to the Tablelands Acacia/Grass/Herb Dry Forest in the north) and that as a result of past management of the area, has lost the majority of the shrub layer. However, this cannot be conclusively determined and as the area currently exhibits a predominately grassy understorey, it is included within the Tableland Dry Grassy Woodland community.

The predominately grassy groundcover of this community exhibits a high diversity of forbs, grasses and sedges. Disturbance sensitive species such as the Bulbine Lily (*Bulbine bulbosa*), Blue Devil (*Eryngium ovinum*), Yellow Autumn Lily (*Tricoryne elatior*) and Scaly Buttons (*Leptorhynchos squamatus*) are common and widespread particularly north of the electricity easement.



Existing vegetation mapping (Gellie 2005) maps this community as South Eastern Tablelands Dry Shrub/Grass/Herb Forest. Field surveys at the study site and within the locality suggest that the distribution mapped for South Eastern Tablelands Dry Shrub/Grass/Herb Forest more accurately reflects the distribution of the Tableland Dry Grassy Woodland community. This is further supported by the mapping completed by BES as part of the Queanbeyan Biodiversity Study (BES 2008). Accepting this substitution, the mapping shows the community to be widespread in the locality on lower slopes within the landscape. However, a substantial amount of this area is likely to have been impacted to some degree by agricultural practices, as the Tableland Dry Grassy Woodland community often coincides with prime agricultural land.

This community is considered to comprise the White Box-Yellow Box-Blakely's Red Gum Woodland Endangered Ecological Community listed under the TSC Act and the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community listed under the EPBC Act (hereafter referred to as the Box-Gum Woodland EEC and CEEC respectively).

The equivalent Biometric vegetation type is Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (MR648).

4.1.2 Vegetation condition

The condition of vegetation within the study are has been assessed according to the Biometric guidelines (DECC 2008). The guidelines provide definitions for native vegetation in low condition. If native vegetation is not in low condition, then it is considered to be in moderate to good condition. According to the guidelines:

Native woody vegetation is in low condition if:

- The over-storey per cent foliage is <25% of the lower value of the over-storey per cent foliage cover benchmark for that vegetation type, <u>AND</u>
- <50% of vegetation in the ground layer is indigenous species or >90% ploughed or fallow.

Native grassland or herbfield is in low condition if:

• <50% of vegetation in the ground layer is indigenous species or >90% ploughed or fallow.

None of the native vegetation within the study area meets these definitions and as such is in moderate to good condition.

4.1.3 Conservation status of vegetation communities within the study area

The conservation status of each of the natural vegetation types present within the study area is summarised in Table 4-1, based on data presented in Gellie 2005 and more recent data from the Biometric vegetation types database.

Table 4-1 Conservation of natural vegetation types occurring within the study area.

Vegetation type	Former extent (ha) (pre 1750)	Current extent (ha)	Total area formally reserved (ha)	Estimated percent cleared in the CMA (OEH 2012)
Tablelands Dry Shrub/Tussock Grass Forest (Dry Forest)	208,700	94,600 (55% cleared)	16,800 (8% of former extent)	65%

Data is sourced from Thomas et al. 2000 unless otherwise noted



Vegetation type	Former extent (ha) (pre 1750)	Current extent (ha)	Total area formally reserved (ha)	Estimated percent cleared in the CMA (OEH 2012)
Tablelands Acacia/Grass/Herb Dry Forest	4,200	1,300 (69% cleared)	90 (2% of former extent)	80%
Tableland Dry Grassy Woodland (Box-Gum Woodland)	223,300	12,200 (95% cleared)	310 (<0.01% of former extent)	95%

Table 4-1 shows the high level of depletion and poor protection status of the majority of the natural vegetation types within the study site. Applying the general JANIS reservation target of 15% of the original extent for each forest type (JANIS 1997), all of the natural vegetation types within the study area are under-represented in the conservation reserve system. Under JANIS criteria, 60% of the remaining stands of vulnerable types and 100% of endangered types should be reserved or otherwise protected.

The impact of this depletion is compounded by the severe fragmentation and continuing degradation of remaining stands. The Tableland Dry Grassy Woodland community meets the definition of the Box-Gum Woodland EEC which is a subject species for this SIS. Remnants are threatened by a range of processes including further clearing, firewood cutting, livestock grazing, weed invasion, inappropriate fire regimes, soil disturbance, increased nutrient loads, soil acidification and salinisation and loss of connectivity (NSW SC 2002).

4.1.4 Weeds and disturbance

The majority of the study area has been subject to varying levels of disturbance. Disturbance appears to be generally lower in the north of the study area and more intensive in the south (as discussed in Section 1.5.1).

Common weed species are widespread throughout the study area. Noxious weeds listed for the Queanbeyan City Local Control Area detected during the surveys include:

- Tree of Heaven (**Ailanthus altissima*)
- Scotch Broom (**Cytisus scoparius*)
- Prickly Pear (**Opuntia* sp.)
- Sweet Briar (*Rosa rubiginosa)
- Blackberry (**Rubus fruticosus* spp. agg.)
- Paterson's Curse (*Echium plantagineum)
- St John's Wort (*Hypericum perforatum)
- Scotch Thistle (**Onopordum acanthium*)
- Chilean Needle Grass (*Nassella neesiana)
- Serrated Tussock (*Nassella trichotoma)

These weeds are particularly prevalent in the area within and surrounding the northern patch of Tablelands Acacia/Grass/Herb Dry Forest, and within the exotic dominated areas north of the Queanbeyan River. Species such as St John's Wort and Sweet Briar are also common within the Box-Gum Woodland community in the south of the study area.



4.1.5 Threatened species

The study area provides potential habitat for the following threatened flora species:

- Pale Pomaderris (Pomaderris pallida)
- Button Wrinklewort (Rutidosis leptorrhynchoides)
- Small Purple Pea (*Swainsona recta*)
- Silky Swainson-pea (*Swainsona sericea*)
- Doubletail Buttercup (*Diuris aequalis*)
- Hoary Sunray (Leucochrysum albicans var. tricolor)

Excluding the Hoary Sunray, all of the above species are included as subject species within the DGRs. Targeted searches were undertaken within the study area for each of these species and the results are discussed individually for each below.

Pale Pomaderris

The Pale Pomaderris has been recorded approximately 1.6km upstream of the study area within rocky riparian habitat (of which this species is generally associated) along the Queanbeyan River. Targeted searches were undertaken for this species within all areas of suitable habitat within the study area which focused on native dominated drainage lines, in particularly rocky areas, in the Dry Forest community within the northern section of the study area. The species was not detected however, the common Birch Pomaderris (*Pomaderris betulina*) was widespread and had densely colonised some areas (Appendix G.1). Targeted searches were also undertaken along both banks of the Queanbeyan River for a distance approximately 500m downstream of the subject site. Habitats in this area were highly disturbed and often dominated by exotic vegetation and/or consisted of mown areas of parkland. There were no rocky outcrops that are preferred by this species and the species was not detected during the survey. It is considered unlikely that Pale Pomaderris occurs within the study area. Impacts to this species are considered unlikely.

Button Wrinklewort

The Button Wrinklewort has been recorded approximately 3.5km west of the study area within Queanbeyan Nature Reserve. Advice from OEH (Allison Treweek, OEH, pers. com. 6 November 2012) suggested that survey timing was suitable for this species. The species was detected at the closest known location within Queanbeyan Nature Reserve (Appendix G.1) confirming the species was identifiable at the time of the survey. The high quality Box-Gum Woodland in the south of the study area provides suitable habitat for this species. Targeted searches within all areas of suitable habitat within the study area did not detect this species and it is considered unlikely that it occurs within the study area. Impacts to this species are considered unlikely.

Small Purple Pea and Silky Swainson-pea

The Small purple-pea has been recorded approximately 1.5km west of the study area and the Silky Swainson-pea approximately 5.5km south-west. Advice from OEH (Allison Treweek, OEH, pers. com. 6 November 2012) suggested that survey timing was suitable for this species as these species had been identified flowering within the Williamsdale area approximately 17km south of the site. Flowering of the Silky Swainson-pea was confirmed with the species being detected within the Royalla Swainsona Reserve at the time of the survey (Appendix G.1). The high quality Box-Gum Woodland in the south of the study area provides suitable habitat for this species. Targeted searches within all areas of suitable habitat within the study area did not detect these species. It is considered unlikely that these species occur within the study area. Impacts to these species are considered unlikely.



Doubletail Buttercup

This species has been recorded approximately 32km east of the study area. Advice from OEH (Allison Treweek, OEH, pers. com. 6 November 2012) suggested that survey timing was suitable for this species as the species had been identified flowering by David Keith (OEH) at a known location along the Kings Highway the week previous. The high quality Box-Gum Woodland in the south of the study area provides suitable habitat for this species. The Dry Forest community in the north of the study area may also provide habitat for this species however, it is not considered optimal. Targeted searches within all areas of suitable habitat within the study area did not detect this species although more common species of *Diuris (D. sulphurea* and *D. maculata*) were observed flowering within the dry forest in the north of the study area (Appendix G.1) and within Stoney Creek Nature Reserve respectively. It is considered unlikely that this species occurs within the study area. Impacts to this species are considered unlikely.

Hoary Sunray

The Hoary Sunray was identified as being present within the study area (Appendix G.1) during the initial reconnaissance survey undertaken in September 2012. The survey conducted in November 2012 mapped all populations of this species within the study area and all occurrences encountered during the survey of the locality (Appendix E.1). This species occupies both the Box-Gum Woodland and Dry Forest habitats. It is likely to be impacted by the proposal and it is included as a subject species within this SIS.

4.2 FAUNA

4.2.1 Fauna habitats

There are five broad habitat types present in the study area, and these are generally homogenous throughout the study area and include: 1) Dry Forest; 2) Woodland; 3) Shrubland; 4) Grassland; and 5) Riverine and/or drainage lines. Additionally, three important habitat features are present and include: hollow-bearing trees, termite mounds, and minor rock habitats.

Habitat quality in the study area is variable due to different soil types, disturbance histories (including type and intensity of land management) and ranges from poor to good quality. The northern half of the study area supports better quality habitat with approximately 7.6 ha of good quality habitat identified east of Severn Street. The southern end of the study area in close proximity to residential development is more disturbed resulting in predominantly poor-moderate habitat quality, with some patchy areas of good condition woodland habitat. The distribution of these habitat types (including habitat quality) in the study area is shown within Appendix E.2. The broad habitat types along with specific habitat features are described below.

Dry forest

The study area is dominated by dry forest which grades north to south from mostly single age-class regrowth forest through to multi age-class mature forest. The dry forest varies from smooth-barked eucalypts with a grass tussock understorey, to box dominated forest with a shrubby understorey. The forest is part of an extensive area of forest that extends east of the study area and includes some deeply incised gullies and steep slopes. Hollows occur in both mature and younger trees throughout the remainder of this habitat type; including relatively young trees (with a diameter-at-breast-height of approximately 40 centimetres). Hollows are absent in the northern end of the study area.

The midstorey is dominated by fauna food source species such as wattle, myrtaceous shrubs and mistletoe. The presence of mistletoe varies from absent to abundant. The structure of lower stratums has a moderate



to abundant litter layer with fallen timber and logs, including decaying logs in some areas. Rock is present throughout, generally as loose scattered or embedded small to medium rock on steep hillsides. Disturbance is present in the form of infrastructure (water reservoir), access tracks, informal foot tracks which are often used for dog walking, as observed during field surveys. Weed invasion appears to be low to moderate. The dry forest provides a diverse microhabitat for avifauna, loose rocky slopes for reptiles and abundant small to medium hollows for mammals and birds.

Woodland

Woodland in the study area occurs as open woodland (as sparsely as paddock with scattered trees) north of Queanbeyan River and in a more typical Box-Gum Woodland formation south of the river. Both areas contain large mature trees. Hollow-bearing trees occur in the patch south of the river. The southern patch of woodland provides potential habitat for habitat generalists such as Pied Currawong and Crimson Rosella. The southern patch of woodland includes a diverse understorey and ground habitat structure including areas of bare ground, sparse rocks, fallen timber, grasses, forbs and low shrubs. The northern patch of woodland is greatly simplified in structure with few hollows. There is a low abundance of loose scattered small to medium rocks, as well as dumped rubbish such as concrete blocks and windrows. Patches of wattle, myrtaceous shrubs and exotic berry producing shrubs are present in some areas.

Shrubland

Shrubland occurs in two areas north of Queanbeyan River. These areas provide habitat for small birds, such as Superb Fairy Wren and shelter for mammals; for example, wallabies, rabbits and foxes. The shrublands are likely to have formed in response to gross disturbance activities (i.e. clearing) and are dominated by introduced species such as Blackberry. In addition to providing habitat, these shrublands contribute to connectivity between habitat types dominated by trees.

Grassland

There are no areas of natural grassland in the study area, but several grassland areas derived from clearing of either forest or woodland occur. These grasslands are generally small, highly disturbed, dominated by exotic species and surrounded by residential development. They provide habitat for common species such as Australian Magpie and may provide low quality potential habitat for grassland species such as the Golden Sun Moth. Rocky habitat is present as scattered small rocks in highly disturbed areas. Grassland areas appear to be frequented most, by residents in nearby developments, as well as domestic animals (dogs and cats).

Riverine and drainage lines

The study area crosses the Queanbeyan River. The northern side is covered by dense shrubland on both the river's edge and immediately upslope. The southern side of the river supports fringing vegetation of reeds, grasses and shrubs (including Pampas Grass, *Cortaderia* sp.). There is a low abundance of woody debris within the river and aquatic vegetation was not clearly visible. The substrate is muddy and during the survey periods, the water was turbid. Overall the quality of the riverine habitat is considered to be low, with few microhabitat features available.

An ephemeral drainage line occurs generally within the northern section of the study area where it runs south towards Queanbeyan River. This drainage line would intermittently fill with water after heavy rainfall events, but would otherwise remain dry. The habitat value of this drainage line is not unique to the locality, with several other watercourses known for the locality (i.e. to the east of the study area).



Hollow-bearing trees

A total of 116 hollow-bearing trees were recorded within the study area (mapped in Appendix E.2). Hollows were recorded in trees with a diameter-at-breast-height (DBH) as small as 20 cm and as large as 200 cm. The majority of hollow-bearing trees contained just one hollow; some trees contained up to five and one up to nine, with an average of 1.9 hollows per tree. Thirty-four hollow-bearing trees supported at least one hollow of a large size and 105 supported at least one medium sized hollow. Hollows were recorded at a range of heights, from basal hollows close to ground through to spouts at the tops of trees. Evidence of use was recorded for 22 hollow-bearing trees, including trunk tracks and scratches, hollow entrance scratches, wear and smoothing. Raw data is given in Appendix C.2, which includes notes about potential hollows.

Forty-four hollow-bearing trees occur within the subject site and would be impacted and are located predominantly east of Severn Street, and to a lesser degree in the southern end of the study area. Of the 44 hollow-bearing trees to be removed, 12 trees supported at least one large hollow and 30 supported at least one medium sized hollow.

The hollow-bearing trees to be removed provide potential shelter and/or breeding habitat for a range of fauna, including the subject species Gang-gang Cockatoo, Eastern False Pipistrelle and Brown Treecreeper.

Eleven potentially suitable nesting trees for the Gang-gang Cockatoo would be removed within habitat suitable for this species. These trees had at least medium sized hollows, with some containing large hollows, were greater than 60 cm DBH and are located in the good condition Dry Grass Forest or Woodland. Stag watching surveys for the Gang-gang Cockatoo were undertaken at these hollow-bearing trees and no nesting birds were observed (refer Section 4.4.2).

Stags (dead standing trees) are often used as roosting or maternity sites for microbats. Four stags would be removed for the proposal and were generally considered marginal for bat species; three of the stages were below 50 cm DBH, while one was recorded at 90 cm DBH. None of these stags supported large hollows suitable for a maternity roost site.

Termite mounds

Termite mounds provide nesting habitat for the Rosenberg's Goanna, a subject species of this assessment. Fifty termite mounds were identified within the study area and were located predominantly in dry forest of better quality habitat (Appendix E.2). Sixteen termite mounds occur within the subject site and would be impacted by the proposal.

Rock habitats

The rock habitats throughout the study area varied from loose scattered surface rock to larger embedded rocks and provide shelter for reptile species, including the subject species Pink-tailed Worm-lizard and Little Whip Snake. Noticeable rock habitats are limited, but were more common within dry forested areas in the middle section of the study area and were associated with steeper slopes. These areas however, are considered marginal habitat for the Pink-tailed Worm-lizard and unsuitable for the Little Whip Snake, given that rock habitats were sparse and native grass species were mostly absent in these areas. The woodland habitat north and south of the study area is also considered unsuitable habitat for both these subject species as rock habitats consisted of loose scattered surface rock.



4.2.2 Habitat connectivity

Habitat connectivity exists north, east and south of the study area within both protected and private lands. There is no habitat connectivity to the west of the study area for the entire length of the proposed road due to residential development and existing dwellings. Strong connectivity is apparent in the northern section of the study area which links to a contiguous area of habitat that adjoins land zoned for Environment Conservation and Cuumbuen Nature Reserve. The south of the study area adjoins land that also connects to Mount Jerrabomberra.

BES (2008) identified regional and local biolinks for the Queanbeyan LGA which included areas that had the potential to provide linkages between larger or important areas of habitat (Appendix E.2). A large regional biolink is linked to the northern half of the study area and borders the eastern edge and southern end of the site. BES (2008) defined this biolink as supporting moderate to high fauna habitat, including threatened species habitat.

The Queanbeyan River Corridor, located at the southern section of the study area, north of River Drive, functions as part of an extensive riverine corridor that provides habitat for fauna species, primarily birds and microbats.

4.2.3 Fauna species recorded

One-hundred and fourteen fauna species were recorded during the survey periods comprising 10 microbats, a further 12 mammals, 80 birds, six reptiles and six frogs. Raw survey data and a full species list are given in Appendix C.2 and discussed below.

Birds

A range of woodland and forest bird species were detected during the surveys, with some riverine species detected nearby the Queanbeyan River.

Common forest species detected included the Eastern Yellow Robin (*Eopsaltria australis*), Bassian Thrush (*Zoothera lunulata*), Olive-back Oriole (*Oriolus sagittatus*), Grey Currawong (*Strepera versicolor*), Spotted Quail-thrush (*Cinclosoma punctatum*) and Shining Bronze-cuckoo (*Chrysococcyx lucidus*). Common woodland species included Australian Magpie (*Gymnorhina tibicen*), Crimson Rosella (*Platycercus elegans*) and Striated Pardalote (*Pardalotus striatus*). Riverine species included the Clamorous Reed Warbler (*Acrocephalus stentoreus*) and Australian Wood Duck (*Chenonetta jubata*).

Two threatened bird species, the Gang-gang Cockatoo and Speckled Warbler, were observed within the study area and within the locality during the surveys. The Scarlet Robin was observed in high numbers in Cuumbuen Nature Reserve during locality surveys.

Reptiles

Three reptiles were recorded during the survey, including three skinks and one dragon. The Grass Skink was the most common reptile observed in various habitats. Observations of reptiles during the survey periods were limited, with few observations of basking individuals on logs, rocks and ground strata indicating a low diversity and abundance of reptiles generally. Reptiles were primarily recorded during rock rolling and Koala scat searches, when searching through leaf litter.

No threatened reptiles were recorded for the study area however, termite mounds for the Rosenberg's Goanna are common and the species has been recorded north and east of the study area. The Pink-tailed Worm-lizard is known to occur west of the study area within rockier areas however, habitat for this species within the study area is considered marginal.



Mammals

The diurnal mammal species recorded during the survey period included common native species and feral species expected to occur. The Eastern Grey Kangaroo (*Macropus giganteus*) was in high abundance throughout the study area and regularly observed. The introduced Brown Hare (*Lepus capensis*), Rabbit (*Oryctolagus cuniculus*), and domestic Dog (*Canis familiaris*) were commonly recorded throughout the study area through direct observations and scats; their abundance was greater in the more disturbed open woodland areas in the south and north of the study area.

Nocturnal arboreal mammal species were low in abundance. Spotlighting within the good quality forest habitat supporting numerous hollow-bearing trees north of the Queanbeyan River returned few mammal observations; the Common Brushtail Possum (*Trichosurus vulpecula*) was the most commonly recorded species.

Amphibians

Apart from the Queanbeyan River the study area does not support aquatic habitats. Aquatic habitat of the Queanbeyan River is relatively poor, with little structural diversity and a high degree of disturbance. Given the limited aquatic habitat for threatened amphibians, targeted surveys were limited to one frog census on the southern bank of Queanbeyan River. Four amphibians were recorded during the survey. All species detected are common species expected to occur within the locality and are therefore unlikely to be adversely affected by the proposal at a population level.

Two frogs were identified from calls including the Smooth Toadlet (*Uperoleia laevigata*) and Southern Bullfrog (*Limnodynastes dumerilii*). The Smooth Toadlet appeared to be the most vocal and calling from the northern bank of the river. No frog species were seen despite searching with spotlight which reflects the low number of frog species recorded. No threatened species were detected during the survey.

Invertebrates

The Golden Sun Moth was the only invertebrate species targeted for survey during this assessment. This species was not detected during the transect surveys and is discussed in more detail below.

4.2.4 Threatened species

Based on the desktop assessment and field surveys, the study area is considered to provide suitable habitat for a number of threatened species. Appendix F depicts known records of threatened species in the locality; the Scarlet Robin, Gang-gang Cockatoo, Rosenberg's Goanna and Pink-tailed Worm-lizard are most commonly recorded within close proximity of the study area. The study area provides potential habitat for the following threatened fauna species:

- Pink-tailed Worm-lizard
- Rosenberg's Goanna
- Brown Treecreeper
- Scarlet Robin
- Hooded Robin
- Diamond Firetail
- Painted Honeyeater
- Gang-gang Cockatoo
- Speckled Warbler
- Koala



- Eastern False Pipistrelle
- Eastern Bent-wing Bat
- Golden Sun Moth

All of the above species are included as subject species within the DGRs. Targeted searches were undertaken within the study area for each of these species and the results are discussed individually for each in Section 5.2.

Threatened species recorded during survey

Four species listed as Vulnerable under the NSW TSC Act were recorded during the field surveys. These included the Gang-gang Cockatoo, Speckled Warbler, Eastern False Pipistrelle, and Eastern Bent-wing Bat.

The Gang-gang Cockatoo was recorded in several locations through opportunistic observation, but were not detected during targeted stag watch surveys:

- November 2012 survey:
 - Two adults and two juveniles were seen flying around the canopy and roosting in trees at the far southern end of the study area in the late afternoon and early morning during 5-6 November 2012.
 - Gang-gang Cockatoos were heard calling from a copse of trees downslope of a residential area to the west of the study area.
- March 2013 survey:
 - The species were observed in the locality especially within Cuumbuen Nature Reserve
- November 2013 survey:
 - Two adults were observed flying through the northern section of the study area.

One observation of the Speckled Warbler was recorded on the 13th November 2013 north of the Queanbeyan River in low shrub and grassland habitat.

A small number of Anabat files (two) were attributed to Eastern False Pipistrelle on 5 November 2012; recordings were made in shrubland at survey site A1. Two Anabat files were also recorded for the Eastern Bent-wing Bat on 5 March 2013; recordings were made in open woodland at survey site A8. Both bat species were detected from only one of the ten overnight surveys conducted.





5 ASSESSMENT OF LIKELY IMPACTS ON SUBJECT SPECIES, POPULATIONS AND COMMUNITIES

5.1 DETERMINATION OF AFFECTED SPECIES

In order to determine which species and communities may be affected by the proposal, consideration has been given to the following issues:

- The distribution and habitat preferences of subject species and communities
- Suitability of habitats to be affected for subject species and communities
- The movement patterns and home range sizes of subject species
- The likelihood of subject species and communities to occur in the habitats affected;
- The condition and quality of habitats to be affected;
- The nature of the development and extent of direct and indirect impacts;
- The results of current and previous field surveys in and around the study area; and
- The results of other flora and fauna studies in the locality.

The threatened species habitat evaluation included as Appendix B considers the above factors in determining 'affected species' for this proposal. Reference has also been made to the impact assessment presented within ELA (2010a, 2010b) and GHD (2009) for the same subject species considered in this report.

The threatened species and ecological communities that may be affected by this proposal are detailed below, and are the subject of detailed assessment in the following sections.

- Box-Gum Woodland
- Hoary Sunray
- Pink-tailed Worm-lizard
- Rosenberg's Goanna
- Brown Treecreeper
- Scarlet Robin
- Hooded Robin
- Diamond Firetail
- Painted Honeyeater
- Gang-gang Cockatoo
- Speckled Warbler
- Koala
- Eastern False Pipistrelle
- Eastern Bent-wing Bat
- Golden Sun Moth

Several of the threatened fauna species assessed below were not detected within the study area during recent survey for this proposal however, as these species are known from the area and potential habitat is available within the study area they have been considered as affected species. The detailed assessment below was used to evaluate in more detail the locations of other known populations in the locality, movement corridors and condition of potential habitat in the study area to come to a conclusion on the likelihood of these species occurring in the subject site and the severity of potential impact. After detailed analysis, several of the species were determined to be impacted by the proposal. Therefore, the outcome



of the assessment process was such that a species could fall into one of three categories of impact severity, which are:

- 1) Low The species is very unlikely to occur (at least not on a regular basis) within the study area and the proposal will not result in impact to this species;
- 2) Moderate There is a chance the species may occur and suitable habitat is present on-site which may result in some impact, but the impact is not significant and considered manageable; and
- 3) High The proposal will result in a significant impact for the species.

2 (at the end of the detailed assessment) summarises the impacts to affected species and communities.

5.2 ASSESSMENT OF SPECIES AND COMMUNITIES LIKELY TO BE AFFECTED

5.2.1 Box-Gum Woodland

Location, nature and extent of impact

The proposal will result in the permanent removal of approximately 4 ha of the Box-Gum Woodland community within the southern area of the subject site (refer to vegetation mapping in Appendix E.1). The area to be impacted contains Box-Gum Woodland of high quality supporting a high diversity of ground cover species and overstorey regeneration such that the community meets the definition of the Commonwealth listed CEEC.

In addition to the direct impacts associated with permanent 4 ha of habitat loss, there is also the potential for additional area to be affected by indirect impacts. These would predominately be associated with 'edge effects' resulting from bordering a major road. Edge effects are likely to include weed ingress and pollution from road runoff. Weed ingress is already occurring within the study area, due to its close proximity to residential development. Indirect impacts are considered to be highly manageable with the implementation of specific environmental controls.

The proposal is unlikely to impact upon groundwater levels in the vicinity of the Box-Gum Woodland community. Two bores associated with residential dwellings immediately north of the Queanbeyan River just to the west of the study area show standing water levels of approximately 22 - 32 meters (NRAtlas 2013). Given that the bores are elevated above the river, the standing water levels correspond generally with the level of the water in the Queanbeyan River. Given that the Box-Gum Woodland community occurs at a minimum of approximately 40 m above the level of the Queanbeyan River, it is unlikely that it is dependent on the local groundwater resource.

Alterations to local drainage patterns are likely as a result of the sealing and drainage structures that are part of the proposal. However, given that the landscape position the community predominately occurs in hill crests and adjacent slopes, it is considered unlikely that the community depends on any specific existing drainage patterns. Impacts to the community from alterations to local hydrology are therefore considered unlikely.

Local and regional abundance

Other known local populations

Combined vegetation mapping from that of BES (2008), Thomas *et al.* (2000) and field survey by **ngh**environmental (refer to Appendix E.1), estimate that approximately 3,121 ha of Box-Gum Woodland occurs within the locality. Of this, the mapping by BES (2008) estimates that approximately half (1,546 ha)



of this is in moderate-good Biometric condition. Four-hundred and seventy-six hectares are in low condition or have not been validated. The remaining 1,099 ha mapped by Thomas *et. al.* (2000) and Gellie (2005) was not assigned a condition class.

Field surveys within the locality by **ngh**environmental identified 187 ha of this community that is of high quality and which would meet the more stringent definition of the EPBC listed community. This includes 14 ha which occurs within the study area. Other high quality areas are located on the lower slopes of Cuumbuen NR along the Kings Highway and Captains Flat Road, and within Stoney Creek NR east of the study area. Another high quality area was identified further south on the eastern foreshore of Googong Dam. These known high quality areas outside of the study area are considered to be secure as they are already part of the reserve system or are being managed as part of the protected foreshore area around Googong Dam. It is possible that other high quality areas also exist on privately owned lands however, the extent of these was not able to be verified during this assessment.

The high quality area within and adjacent to the study area is important within the context of the locality as examples of the community in good condition outside of the reserve system are rare. The study area occurs within an area that is under intense development pressure and most of the existing examples of the community within the locality, not already reserved or being actively managed, have been degraded to some extent by development, particularly urban development and agricultural land use.

Regional abundance

Fallding (2002) estimates that there are more than 106,000 ha of Box-Gum Woodland within the NSW Southern Tablelands and ACT region. This does not include areas of secondary grassland that may also comprise the community. Keith (2006) estimates that there is 140,000 to 230,000 ha of the Southern Tablelands Grassy Woodland community within the South Eastern Highlands Bioregion. This community would also meet the definition of the Box-Gum Woodland EEC.

Habitat

Habitat values

The habitat values of the Box-Gum Woodland within the study area are variable, depending greatly on the levels of past and current disturbance. Generally, the Box-Gum Woodland south of the Queanbeyan River exhibits a high diversity of native grasses, sedges and forbs with some lower diversity areas where disturbance has been higher and weeds are more prevalent, particularly St John's Wort. Overstorey regeneration is evident across this area. The gulley in the far south of the study area (where Apple Box is more prevalent) has a greater proportion of exotic grasses and forbs and a lower diversity native ground cover than the drier areas on the upper slopes and hill crest. North of the Queanbeyan River disturbance has been greater and diversity is generally lower however, localised higher diversity patches occur and overstorey regeneration is evident. Weeds (including noxious and highly invasive weeds) are common throughout the Box-Gum Woodland in the study area and are likely to contribute to further degradation without proper management.

Quantitative understorey quality assessments were undertaken within Box-gum Woodland in the study area and locality following the Grassy Ecosystem Assessment Methodology of Rehwinkle (2007) to determine a 'floristic value score' for the habitat present. The results of these assessments are shown below in Table 5-1. The locations of quadrats are shown on the maps in Appendix D.1 and photos of each quadrat are included in Appendix G.2.



Quadrat ID	Date	Easting	Northing	Floristic value score
DS1	6/11/2012	703599	6082713	29
DS4	6/11/2012	704370	6083357	7
DS5	6/11/2012	703392	6082624	29
DS6	6/11/2012	703755	6082698	41
LC1	8/11/2012	699892	6084040	15
LC2	8/11/2012	700143	6084025	24
LC3	8/11/2012	707035	6084708	27
LC4	9/11/2012	707268	6085075	40
LC5	9/11/2012	707238	6086304	65
LC6	9/11/2012	706251	6086101	35
LC7	9/11/2012	707456	6086404	37
LC8	9/11/2012	709773	6084454	36
LC9	9/11/2012	710099	6084307	43
LC10	9/11/2012	704968	6077138	24

 Table 5-1 Results of the quantitative understorey quality assessments

Based on the methodology (Rehwinkle 2007), if the floristic value score of a plot is four or more, then the site can be considered to have a moderate to high conservation value. All of the plots conducted within the study area and locality scored well above this value indicating that high quality occurrences of the community occur both within the study area and the locality. The lowest value score of 7 (Plot DS4) was located within the more disturbed Box-gum woodland vegetation on the hill north of the Queanbeyan River.

The locality assessments were mostly undertaken within Nature Reserves that are protected from disturbances such as grazing. Similarly, the Box-Gum Woodland within the study area is not grazed and this is likely a contributing factor to the higher quality values recorded. Generally, the quality assessments indicate that the Box-Gum Woodland within the study area south of the Queanbeyan River, is of a quality comparable to that found within conservation reserves within the locality.

Distribution and condition of regional habitats

The condition of the Box-Gum Woodland in the region is unknown. Given that the community occurs largely in low lying agricultural or grazing lands on freehold tenure and leases (Fallding 2002) it would be reasonable to assume that much of the occurrence of the community in the region is degraded to some extent or at risk of degradation. Sites of high biodiversity value on a regional scale are rare, isolated and fragmented (Fallding 2002).

Conservation status

The Box-Gum Woodland community is listed as an EEC under both State and Commonwealth legislation. The definition and name of this community is slightly different under the TSC Act and EPBC Act and is further described below:

• White Box-Yellow Box-Blakely's Red Gum woodland (TSC Act)



• White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland (EPBC Act)

NSW TSC Act Endangered Ecological Community (EEC)

The White Box, Yellow Box, Blakely's Red Gum woodland EEC listed under the NSW *Threatened Species Conservation Act 1995* includes:

- Woodland areas which include Yellow Box or Blakely's Red Gum (with or without native understorey); and
- Grasslands and pastures dominated by native grasses that are derived from this community.

All areas of Box-gum woodland and derived grassland within the study area are considered to be part of this community.

EPBC Act Critically Endangered Ecological Community (CEEC)

The Commonwealth EPBC Act sets more stringent criteria for the recognition of the Box-gum woodland Critically Endangered Ecological Community (CEEC) listed under that Act.

Under the EPBC Act, Box-gum woodland remnants belong to the CEEC if:

- One of the most common overstorey species is/was Yellow Box, Blakely's Red Gum or White Box; AND
- The understorey is predominantly native; AND
- The patch is greater than 0.1 ha; AND
- either:
 - There are 12 or more non-grass species in the understorey including at least one important species (based on a list issued by the Commonwealth Government); *OR*
 - The patch is greater than 2 ha with an average of 20 or more mature trees per hectare, or natural regeneration of the dominant overstorey eucalypts is present.

All areas of Box-gum woodland within the study area also meet the definition of the EPBC listed community due to high floristic diversity in the understorey (including the presence of multiple important species) and the presence of overstorey regeneration. On the hill crest north of the Queanbeyan River, the community extends east of the study area however, the understorey in this area is highly degraded and the community would not meet the EPBC definition but would still qualify for the TSC Act listed community.

Key Threatening Processes

The following Key Threatening Processes (KTP's) apply to Box-Gum Woodland⁴:

- Clearing of native vegetation
- Invasion of native plant communities by exotic perennial grasses
- Removal of dead wood and dead trees
- Loss of hollow bearing trees



⁴ Only the KTP's relevant to this proposal as defined by the DGRs are included in this assessment.

The proposal has the potential to result in the exacerbation of some of these KTP's particularly clearing of native vegetation. Approximately 4 ha of the community would be permanently cleared as a result of the proposal. In addition, the importation and use of construction vehicles and machinery during construction has the potential to introduce and/or result in the spread of exotic perennial species, including grasses.

Recovery planning

A draft national recovery plan for the Box-Gum Woodland CEEC has been produced by DECCW (2010). The overall aim of the plan is to promote the recovery and prevent the extinction of the Endangered Ecological Community through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites in good condition;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
- Increasing transitional areas around remnants and linkages between remnants; and
- Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

The draft recovery plan lists 34 recovery actions for the community, under five strategies:

- Improve baseline information;
- Increase protection of Box-Gum Grassy Woodland;
- Improve community engagement;
- Continue ecosystem function and management research; and
- Improve compliance and regulatory activities.

An Offset Strategy is included as part of the proposal (Appendix H) which aims to address several of the objectives of the recovery plan in relation to no net loss of the community. These potentially include increased protection of sites in good condition and; increasing landscape functionality of the community through management and restoration of degraded sites.

Ameliorative measures

Where the proposed road passes through the Box-Gum Woodland community, the development footprint will be minimised to the greatest extent possible while still achieving the objectives of the proposal. The current subject site includes a 5 m buffer on the final road formation (to account for a worst case scenario of direct impact), however, this is unlikely to be the real on ground impact. Within the Box-Gum Woodland community, all works would be confined within the final road formation unless it is absolutely necessary to utilise the 5 m buffer area. Construction compounds, equipment storage areas and stockpile sites etc., would not be located within this community.

Residual impacts to the Box-Gum Woodland community will be mitigated through an offset developed by QCC in consultation with OEH. A strategy to develop this offset is included with this SIS as Appendix H and includes the following components:

- Pathways for offsetting
- Determining the suitability of proposed offset sites
- In perpetuity security of proposed offsets
- Management of proposed offsets



Proposed offsets will contribute to the long-term protection and improvement of the Box-Gum Woodland community in the locality or wider region.

During the works strict weed hygiene protocols would be required. Following the completion of works, the Box-Gum Woodland on the development perimeter would require ongoing management to reduce the potential for edge effects associated with weed invasion and human disturbance.

Assessment of significant impact

The proposal will result in the removal of up to 4 ha (30%) of the 14 ha local occurrence of this community. The remaining 10 ha is considered likely to remain viable following the proposed works and unlikely to be placed at risk of extinction. The proposal would not result in the further fragmentation or isolation of the community. In the context of similar habitats within the locality, the 4 ha of the community to be removed is not considered important to the long term survival of the community. In addition, an offset strategy has been proposed as part of the proposal that will result in the protection and management of an appropriate area of this community in perpetuity.

When assessed against the criteria, the Proposal would not result in the extinction or further fragmentation of the local occurrence or remove habitat important to the survival of the community in the locality, however, it is recognised that the permanent removal of 30% of the local occurrence is substantial. The local occurrence is of high quality, represents a viable patch within a highly modified and fragmented landscape and is considered to contain high conservation values. In the context of current and future development pressures and considering the high conservation value of the area to be impacted and advice received from OEH, the removal of 30% of the local occurrence would be considered to be significant. As such, the proposal is considered likely to have a significant impact on the White Box-Yellow Box-Blakely's Red Gum woodland EEC.

5.2.2 Hoary Sunray

Location, nature and extent of impact

Based on estimates of population sizes undertaken in the field (refer to map in Appendix E.1), the proposal would result in the removal of approximately 5,000 Hoary Sunray individuals. This estimation includes three groups of plants mapped as containing 1000+ individuals, so it is possible that more than the estimated number occur in these groups. It is also noted however, that these groups also extend beyond the development footprint and that not all individuals in these groups would be impacted by the proposal. The exact spatial extent of the groups was not mapped during the survey. For the purposes of this assessment, assuming that 1000 individuals within each of these three groups will be impacted is considered to be a reasonable estimation of the numbers to be impacted. The entire number of individuals in other groups within the subject site is included in the estimation. The majority of the individuals to be impacted are located within the Box-Gum Woodland community in the south of the site of which 4ha will be removed. Approximately 15 ha of the dry forest in the north of the site will also be impacted. This vegetation type also provides habitat for this species however, densities are much lower and the majority of areas do not contain the necessary levels of disturbance required by this species for successful propagation.

In addition to the direct impacts associated with permanent habitat loss, there is also the potential for indirect impacts to the groups of hoary sunray immediately adjacent to the subject site. Indirect impacts would predominately be associated with the potential for weed ingress and subsequent competition for resources. These impacts are considered to be highly manageable with the implementation of specific



environmental controls during construction works. Pollution from road runoff is considered unlikely to be an issue for this species, as it was regularly observed to be occupying roadsides within the locality.

The Hoary Sunray was observed to be growing in relatively dry habitats including hill tops and is unlikely to be dependent on local hydrological patterns or groundwater for survival. The proposal will not impact on groundwater availability within the study area and alterations to local hydrology as a result of the proposal, are therefore unlikely to impact upon this species.

Local and regional abundance

Other known local occurrences

Surveys by nghenvironmental within the study area and locality identified numerous occurrences of the Hoary Sunray. An estimated 7,000 individuals occur within the study area with at least another 6,000 individuals within 200m of the study area in the south of the site (refer to the map in Appendix E.1).

Recent surveys by BES ((BES 2007, BES 2008), GHD (GHD 2009) Ecological Australia (ELA 2010a, ELA 2010b) and **ngh**environmental, have recorded the Hoary Sunray at a number of locations within the locality. These include the northern and western slopes of Mount Jerrabomberra; at nine locations within the Stringybark Reserve; the Carwoola area in road reserves and less heavily grazed areas near the junction of Wanna Wanna Road and Captains Flat Road, to the south of Captains Flat road in the Stony Creek catchment, and adjacent to the Kings Highway; sporadically throughout the Gale Precinct south of Wickerslack Lane; on the lower eastern slopes of Mount Campbell adjacent to Old Cooma Road; in grassy woodland in the north of the Royalla Crown Lands; Queanbeyan Nature Reserve; Stony Creek Nature Reserve and; Cuumbuen Nature Reserves (ELA 2010). In addition, from the results of the surveys conducted within the locality by **ngh**environmental, the species is also found to be common within the Karabar residential area north of the Queanbeyan River particularly along Lonergan Drive and Severne Street, at the Queanbeyan Cemetery and at numerous locations adjacent to Captains Flat and Old Cooma Road. There is an extensive population at Bicentennial Park in Queanbeyan West and a number of groups of the species within bushland north of Wickerslack Lane. The surveys by nghenvironmental alone estimate approximately 36,500 individuals within the locality. These surveys did not capture all of the locations identified during the previous surveys by BES, ELA or GHD and the actual number is likely to be considerably higher.

Capacity for dispersal

It is unknown to what extent genetic material is being exchanged within the study area and locality. The Hoary Sunray is an obligate out-breeder that is entirely dependent on the transfer of pollen between individuals for successful reproduction (Sinclair 2011). Pollination is effected by many different insects, including bees and flies (Sinclair 2011). Seed is wind dispersed (DSEWPaC 2013), can probably disperse over many kilometres and will germinate fairly rapidly under a wide range of conditions remaining viable in the soil for at least a few months (Sinclair 2011). On this basis, it is considered likely that genetic exchange is occurring throughout the study area and potentially across the broader locality. In effect, the individual groups identified within the study area are likely part of a single larger interbreeding population. It is considered unlikely that the proposal would present a barrier to ongoing genetic exchange.

Regional abundance

The Hoary Sunray is still relatively widely distributed and can be locally common in places (such as Queanbeyan). The species is known from numerous other locations in the region to the north, south and east of the study area including Adaminaby, Cooma, Goulburn, Bungendore, Michelago, Braidwood, Breadalbane, Tuena, Dalton, and Jerrabomberra (ELA 2010a). Across broader NSW, the Hoary Sunray currently occurs on the Southern Tablelands and some adjacent areas (e.g. Tarcutta, Bega Valley) in an area



roughly bounded by Albury, Bega and Goulburn, in the South Eastern Highlands, Australian Alps and Sydney Basin bioregions (Sinclair 2011).

New South Wales and the ACT both have numerous populations likely to total >200,000 plants, Victoria has about 20 populations containing <40,000 plants and Tasmania has about 20 populations containing in excess of 100,000 plants (Sinclair 2011).

Habitat

Habitat values

The Hoary Sunray occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils (DSEWPaC 2013). Plants can be found in natural or semi-natural vegetation and grazed or ungrazed habitat. Bare ground is required for germination. The unpalatability of this species is likely to protect it in heavily grazed areas where patches of bare ground are likely to develop, favouring recruitment (DSEWPaC 2013).

Within the study area, the Hoary Sunray is found in a wide range of habitats. The majority of the occurrences are located within the Box-Gum Woodland community in the south of the study area including both disturbed and undisturbed sites. Groups of individuals also occur within the relatively undisturbed Dry Forest in the north of the site (although in lower densities) and a large group is colonising a heavily disturbed area of bare ground at the existing end of Ellerton Drive.

Within the locality, the species appears to occur within all common vegetation types and was observed to regularly occur on disturbed roadsides, in areas subject to regular mowing, as well as in the front yards of residential properties within the Karabar area north of the Queanbeyan River.

Distribution and condition of regional habitats

In NSW and ACT, Hoary Sunray occurs in grasslands, grassy areas in woodlands and dry open forests, and modified habitats, on a variety of soil types including clays, clay loams, stony and gravely soil (Sinclair 2011). Within all these habitats, the Hoary Sunray relies on the presence of bare ground for germination and establishment. In lowland areas, periodic disturbance such as fire creates these bare areas. The Hoary Sunray will also colonise roadsides that have been scraped (Sinclair 2011). The condition of the regional habitats for this species is likely to be broad ranging from relatively undisturbed high quality grasslands to heavily degraded, highly disturbed areas. The condition of habitat does not appear to be a determining factor in the successful propagation of this species.

Conservation status

The Hoary Sunray is listed as Endangered under the Commonwealth EPBC Act. The species is not listed as threatened under NSW legislation.

Threatening processes

A number of threats have been identified for the Hoary Sunray (Sinclair 2011) including:

- Habitat destruction from clearing
- Weed invasion
- Poor reservation status
- Lack of appropriate biomass reduction
- Inappropriate fire regimes
- Grazing by livestock
- Small population size

4733 Final v1.2



The proposal has the potential to contribute to these processes. In particular, approximately 19 ha of suitable habitat for this species will be permanently removed by the proposal. There is the potential for the proposal to exacerbate the threat of weed invasion and perpetuate inappropriate fire regimes that may not create the level of disturbance required for the successful propagation of this species.

Recovery planning

A national recovery plan has been prepared for this species (Sinclair 2011). The overall objective of recovery is to minimise the probability of extinction of the Hoary Sunray in the wild and to increase the probability of populations becoming self-sustaining in the long term. The specific objectives for recovery are to (Sinclair 2011):

- 1. Determine distribution, abundance and population structure
- 2. Determine habitat requirements
- 3. Ensure that key populations and their habitat are protected, monitored and managed appropriately
- 4. Manage threats to populations
- 5. Identify key biological characteristics
- 6. Determine growth rates and viability of populations
- 7. Build community support for conservation

Thirteen recovery actions have been identified to achieve these objectives. An Offset Strategy is included as part of the proposal (Appendix H) which will potentially contribute to the protection of habitat for this species. Weed control measures along the periphery of the development would contribute to recovery action 4.1 – Control threats from pest plants.

Ameliorative measures

Where there are unavoidable impacts on groups of Hoary Sunray, the development footprint will be minimised to the greatest extent possible while still achieving the objectives of the proposal. The current subject site includes a 5 m buffer on the final road formation (to account for a worst case scenario), however, this is unlikely to be the areal on ground impact. Where works impact upon groups of Hoary Sunray or in close proximity to groups of plants outside of the subject site, all works would be confined within the final road formation unless it is absolutely necessary to utilise the 5m buffer area. Construction compounds, equipment storage areas and stockpile sites etc., would not be located within 50m of Hoary Sunray groups.

During the construction works, strict weed hygiene protocols would be required. Following the completion of works, the development perimeter would require ongoing management to reduce the potential for weed invasion and human disturbance on remaining groups of Hoary Sunray.

Assessment of significant impact

The proposed action will result in the permanent removal of approximately 5,000 Hoary Sunray individuals, decreasing the size of the local population from an estimated 13,000 to 8,000 individuals. Approximately 19ha of suitable habitat for this species will be permanently removed however, not all of this habitat is ideal or currently being occupied by the species. Disturbance caused by the action may in fact create additional areas of habitat and opportunities for recruitment. The action is considered unlikely to fragment the local population or disrupt the breeding cycle and habitat to be impacted is not considered critical to the survival of the species. Measures are described in this SIS to control weeds harmful to the species and it is considered unlikely that the action will interfere with the species recovery beyond the initial direct



impact. The species is locally common within the Queanbeyan area and occupies a broad range of habitats. A significant impact to the Hoary Sunray as a result of the proposed action is considered unlikely.

5.2.3 Pink-tailed Worm-Lizard

Local and regional abundance

The species is not known to occur within the study area and no evidence of the species was detected during targeted surveys within potential habitat of the site. The species is known from the locality with most records south of the study area nearby Tralee or the Poplars, in which the species was identified in rock outcrops (Biosis 2003a; Biosis 2003b). Other records are noted west of Cooma Road nearby the Queanbeyan River on ridges (BES 2008), which is now predominantly surrounded by residential land (Appendix F). Several other studies have failed to locate the species within the locality during targeted searches (BES 2007; ELA 2010a; ELA 2010b; GHD 2009).

The regional abundance of the species is unconfirmed and the distribution of the Pink-tailed Worm-Lizard is patchy, with records known within the Queanbeyan and Canberra areas and further afar nearby Cooma, Yass and Bathurst.

Habitat

Habitat requirements

The Pink-tailed Worm-Lizard inhabits sloping, open woodland areas with predominantly native grass groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Typically these areas are well-drained, with rocky outcrops or scattered, partially-buried rocks. The species is commonly found beneath small, partially-embedded rocks in burrows; the burrows usually have been constructed by and are often still inhabited by small black ants and termites. This species feeds on the larvae and eggs of ants (DECCW 2010).

Study area habitat values

Location of habitat within study area: Dry Shrub Forest (Box Gum Woodland) and grassland south of study area (refer Appendix E.2).

The study area provides little potential habitat for the Pink-tailed Worm-lizard, with the exception of the southern end of the study area which supports potential low quality habitat for this species, covering approximately 4 ha. This area contains dry shrub forest (Box Gum Woodland) over an open grassy understory and disturbed grassland habitat. The potential habitat is marginal as the area is generally absent of rock habitat, with some sporadic loose scattered rock present, and is surrounded by degraded areas that have been subject to clearance and invasion by exotic grass species.

Grazing pressure by rabbits and predation pressures from domestic animals (cats and dogs) were clearly evident within the potential habitat. In particular, the grazing pressure of rabbits has substantially reduced the cover of native grass species. Known pressures that can affect the life cycle of the Pink-tailed Wormlizard include heavy grazing (rabbits) and predation pressures from domestic animals (Cats and Dogs). These pressures were clearly evident within the potential habitat and surrounds. Furthermore, the southern area of the study has been disturbed by clearing, roads, and walking tracks due to its close proximity to residential land. These pressures have reduced the suitability of the habitat for the Pink-tailed Worm-lizard.



The good condition dry forest habitat north of Queanbeyan River supports a greater density of embedded rock habitat, but is not considered available habitat for this species due to the absence of native grasses and a generally closed forest canopy which is atypical habitat for this species. Habitat in the north of the study area was not considered suitable for the species as surface rock was absent, the ground-cover was predominantly shrubby and where grasses were present, these comprised exotic species.

Movement corridors

The Pink-tailed Worm-lizard has largely been located south of the study area near Tralee; therefore the regional and local biolink south of the study area provides the most likely movement corridor for this species. It is expected the Box Gum Woodland areas of this biolink would provide the most suitable habitat due to the open nature of this community and its association with native grass species. However, habitat within the study area is isolated by road or residential barriers to existing populations and the species has little opportunity to move through these biolinks to habitat in the study area. These movement corridors will not be affected by the proposal.

Condition of regional habitats

The condition of the habitat in other areas of known regional records is unknown. Given that the habitat requirements of the species can coincide largely with low lying agricultural or grazing lands, it is expected that much of the habitat in the region is degraded to some extent, or at risk of degradation. Those areas supporting rockier outcrops are often better protected as the nature of the groundcover reduces grazing potential. However, the cryptic nature makes the species hard to detect and it is reasonable to assume there is also potential for undocumented populations to be present within the region.

Conservation status

The Pink-tailed Worm-Lizard is listed as Vulnerable under the NSW TSC Act and the Commonwealth EPBC Act. The majority of known records for the species are not protected and occur on freehold land and such habitat may be subject to disturbance or development pressure in the future.

Key Threatening Processes

The following KTPs apply to the Pink-tailed Worm-lizard:

- Clearing of native vegetation
- Invasion of native plant communities by exotic perennial grasses
- Removal of dead wood and dead trees
- Bushrock removal

The proposal will result in the removal of 4 ha of low quality potential habitat within the southern section of the study area supporting some areas of dead wood and trees and a limited amount of scattered rock in low densities. This area is already largely disturbed from surrounding development and current land uses associated with residential areas (clearing, walking tracks, predation and disturbance by domestic dogs, weed invasion). During the works strict weed hygiene protocols would be required. Following the completion of works, the Box-Gum Woodland on the development perimeter would require ongoing management to reduce the potential for edge effects associated with weed invasion and human disturbance.

The KTPs listed above are therefore unlikely to affect the Pink-tailed Worm-lizard.

Recovery planning

There is no recovery plan for the Pink-tailed Worm-lizard. However, OEH identify 17 priority actions to help recover this species:



- Develop and implement a site management plan for Googong Foreshore Reserve
- Develop guidelines for habitat identification, enhancement and management
- Implement habitat management guidelines in Buddigower NR and Goulburn River NP
- Provide incentive payments for protection and enhanced management of known sites
- Reserve or ensure long-term management of known populations
- Develop and implement a site management plan for Cooma North Ridge Reserve
- Develop and implement a site management plan for Eedy's New TSR
- Develop and implement a site management plan for Nail Can Hill Reserve
- Implement monitoring regime at six sites across the range of the species on a three year rotational basis
- Investigate the genetic differences between populations and determine if revisions of taxonomy and status are warranted
- Undertake research into biology, ecology and management
- Undertake surveys for the species in areas of identified potential habitat using survey guidelines
- Develop minimum disturbance survey and monitoring guidelines
- Undertake distribution modelling or remote sensing to identify potential distribution and habitat
- Undertake survey in Buddigower NR to determine presence and distribution of species in reserve
- Undertake survey in Goulburn River NP to determine presence and distribution of species in reserve
- Undertake a review of threats at known sites

The 17 priority actions were reviewed and the proposal is not considered to be at variance to these actions, given that the habitat to be disturbed is low-quality and very unlikely to be used by the species.

Ameliorative measures

In light of the detailed assessment, no specific ameliorative measures have been defined for the Pink-tailed Worm-Lizard given the species is not expected to occur within the study area and will therefore not be impacted by the proposal.

Assessment of Significant Impact

The proposal would result in the removal of 4 ha of low quality habitat in the southern parts of the study area. Given that no evidence of the species was detected during targeted surveys and the potential habitat within the study area lacks key habitat resources such as rock shelters and tussock forming grasses, it is unlikely the proposal would result in a significant impact to this species.

5.2.4 Rosenberg's Goanna

Local and regional abundance

The species has not been specifically recorded within the study area but records occur from the locality, primarily north, east and south of the site within Cuumbuen Nature Reserve, nearby Kings Highway, nearby the Queanbeyan River Corridor, and Old Cooma Road and Wickerslack Lane (OEH 2012; ELA 2010a). Additionally, ELA 2010a report anecdotal evidence of observations of individual animals near the junction of Wickerslack Lane and Old Cooma Road, suggesting the locality (including the study area) provides habitat for the species on a permanent basis. The species was not recorded during the survey period, but was not targeted directly due to the presence of suitable habitat and known records in the area; however termite



mounds (a critical breeding resource, as discussed below) were mapped. The study area adjoins contiguous vegetation to the east and south that supports known habitat for this species.

The regional abundance of the species is unconfirmed although several records are known from the region. Records are known nearby the study area within Queanbeyan and extend to Cooma. Several records are known from national parks, including Kosciusko National Park, Brindabella National Park, Morton National Park and Turon National Park in which substantial habitat for the species is available.

Habitat

Habitat requirements

Rosenberg's Goanna is found in heath, open forest and woodland habitat and shelters in logs, rock crevices and burrows where adequate foraging resources, shelter sits and terrestrial termite mounds are available (OEH 2012). The species forages on birds, eggs, reptiles, mammals and carrion. The species shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. Termite mounds are a critical habitat component for the species as Rosenberg Goanna's in which they lay their eggs. Observations of a related and similar species, Lace Monitor (*Varanus varius*), show that the animals move around each day within a large home range (~ 500 ha), regularly using a number of different roost sites (Weavers 1993).

Study area habitat values

Location of potential habitat within study area: Dry grass/shrub forest in north of study area (refer Appendix E.2). The more intact areas of moderate to good quality dry grass/shrub forest in the north of the study area provide 13 ha of suitable habitat for this species, including termite mounds (13 mounds) and fallen hollow logs for breeding and shelter.

Ground habitat structure is relatively complex in the area of good quality dry grass forest as it supports fallen logs of various sizes which have potential as roost sites. Diggings by echidnas and wombats were also found in this area, indicating suitability of the soil for burrowing. The increased structural diversity of the dry forest in this area would provide a greater diversity of foraging habitat in this area also. This habitat adjoins the western edge of a large extent of dry forest stretching east, which meets the criteria for large habitat areas to sustain a population of Rosenberg's Goanna. This primary habitat is likely to be used by resident individuals (possibly as breeding habitat); however it is expected the study area comprises part of a much larger home range (> 500 ha) for one or two individuals.

The moderate quality dry grass forest north of the study area could potentially be used by the species for foraging or as it traverses its large home range, however this area does not support key breeding habitat resources for this species (i.e. termite mounds and large hollow logs are largely absent).

The southern section of the study area (south of Queanbeyan River) is substantially compromised as habitat and is not considered unique or important for this species. The proximity of residential housing, roads, and quarry have resulted in the removal of key habitat resources for this species. Other disturbances including barriers such as fencing, recreational use of the area, and presence of domestic pets (i.e. dogs) and ongoing dog walking in this area would most likely prevent the species from utilising the area regularly.

Movement corridors

The area of potential habitat of the study area (dry grass/shrub forest) is contiguous with a large extent of similar habitat that stretches east into Cuumbuen Nature Reserve and further south and west of the study into Jerrabomberra. This area forms part of a regional biolink and is likely to be an important corridor for the Rosenberg's Goanna. The study area does not fragment this biolink, but will reduce the extent of available habitat on its western edge.



Condition of regional habitats

It is assumed the species is more widespread than known records indicate given that detection of the species is difficult. As many records of the Rosenberg's Goanna are known within protected areas the condition of these regional habitats is assumed to be good. The species relies on a complex habitat structure to persist and therefore, is generally linked to large areas of intact habitat where it occurs.

Conservation status

The Rosenberg's Goanna is listed as Vulnerable under the NSW TSC Act. The majority of known records for the species are associated with protected areas.

Key Threatening Processes

The following KTPs apply to the Rosenberg's Goanna:

- Clearing of native vegetation
- Invasion of native plant communities by exotic perennial grasses
- Removal of dead wood and dead trees
- Bushrock removal

The proposal has the potential to result in the exacerbation of some of these KTP's particularly clearing of native vegetation. The proposal would result in the direct clearance of 13 ha of dry grass forest habitat for this species. This would include 13 termite mounds; 35 termite mounds would remain within the study area.

Greater than 7,000 ha of largely contiguous dry forest habitat are available within the locality which also supports a similar density of termite mounds to the study area, as determined during locality surveys. ELA (2010a) recorded 81 termite mounds north of Wickerslack Lane in a 100 ha area and GHD (2009) recorded greater than 250 termite mounds over a 130 ha area within habitat that is contiguous with the southern section of the study area. In this context, the amount of known habitat to be removed is minor relative to the extent available to the local population.

The removal of dead wood and dead trees, as well as bushrock, are KTPs affecting the Rosenberg's Goanna. As mentioned, the good condition dry grass forest supports a reasonably high density of fallen timber, but limited bushrock. The removal of fallen timber will affect the availability of sheltering sites on a local level. However, these habitat features are also common within the locality in the habitat stretching to the east of the study area and the removal of such features is unlikely to substantially contribute to the KTPs affecting the species.

Recovery planning

There is no recovery plan for the Rosenberg's Goanna. However, OEH identify nine priority actions developed to help recover this species:

- Identify key habitats or areas for protection and enhanced management on private land through management agreements and incentives
- Identify suitable habitat across the range of the species with reference to satellite imagery and vegetation surveys
- Undertake surveys for the species within identified suitable habitat
- Develop habitat identification, management and enhancement guidelines
- Implement management strategies that reduce the prevalence of bush rock removal, including surveillance



- Develop and undertake community education strategy that reduces demand for bush rock as landscaping material and provides/promotes alternatives
- Provide map of known occurrences to Rural Fire Service and seek protection of rocky outcrops and riparian zones on Bush Fire Risk Management Plan(s), risk register and/or operation map(s).
- Undertake investigations into general biology and ecology of the species, particularly movement patterns and tree use, rock crevice use and termitaria use
- Undertake investigations into taxonomic distinctions/genetic (DNA) differences between the various forms of the 'species'

The nine priority actions were reviewed and the proposal is not considered to be at variance to these actions given that the extent of contiguous habitat remaining in the locality is extensive.

Ameliorative measures

Two fauna underpasses will be constructed under the road within the good condition dry grass forest habitat suitable to this species. Exclusion fencing will also be included in this habitat along the eastern edge of the road corridor. The exclusion fencing will assist in restricting movement of this species across the road and reducing possible vehicle collisions. The fauna underpasses will promote a safe passage under the road for the species. The vehicle speed limit through this corridor will be 80 km/h and advisory signs for motorists will also be erected.

This species is a subject of the offset strategy. Offsets will be targeted to directly contribute to habitat protection and enhancement for this species.

Assessment of significant impact

The proposal would result in the direct clearance of 13 ha, including 13 termite mounds, of potential habitat for this species. Greater than 7000 ha of largely contiguous dry forest habitat is available within the locality which also supports a similar density of termite mounds to the study area, as determined during locality surveys. In this context, the direct impact of the proposal is not considered to place the Goanna at risk, given the extent of surrounding habitat and large home range of this species. However, in the context of the local population for the study area as defined by the TSC Act, a local population consists of individuals known or likely to use habitats within the study area (DECC 2007). Given the large home range it is expected the study area would support one or two individuals only, therefore it is possible if the proposal resulted in mortality through vehicle collisions the local population would be placed at risk if it only consists of one or two individuals.

While it is agreed the direct impacts of habitat loss are relatively minor, the indirect impact of eventual increased traffic volume through an area of known habitat which could result in mortality is likely to have a significant effect on the local population of Rosenberg's Goanna, in the context of the local population within the study area, as defined by the TSC Act.

Therefore, in this context the indirect impacts of the proposal have the potential to place the species at risk over the long-term and the proposal is considered to result in a significant impact to this species.

5.2.5 Brown Treecreeper

Local and regional abundance

The Brown Treecreeper was not recorded during the targeted surveys of the study area, although is known from the locality and has been recorded approximately 6 km south of the subject site near old Cooma Road. The species was not recorded in other studies nearby the study area (ELA 2012a; ELA 2012b; BES 2007;



GHD 2009). However, Thompson and Mullins (2004) cited in ELA (2010a) suggested the species was a permanent resident near to the Googong Dam Road turnoff. From the lack of sightings of this species within the locality, despite targeted surveys, it is reasonable to assume that the species is not common throughout all areas of potential habitat in the locality.

The regional abundance of the species is not known and records generally appear scattered across the region south of Canberra to Nimmitabel and north of Canberra to Yass. The Brown Treecreeper is largely concentrated on the slopes of the Great Dividing Range and the heaviest concentrations are known west of Canberra through to Narrandera. Some scattered records exist in protected areas including Glen Fergus State Forest, Scabby Range Nature Reserve, Tinderry Nature Reserve, Wollondilly River Nature Reserve, and Ben Bullen State Forest.

Habitat

Habitat requirements

Brown Treecreepers are found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest, mainly inhabiting woodlands dominated by stringybarks or other rough-barked eucalypts with an open grassy understorey (OEH 2012). The Brown Treecreeper is dependent on hollows for breeding and dead timber for foraging (provides habitat for invertebrate prey) (Noske 1991). The species feeds on insects by foraging on tree trunks, amongst leaf litter and on fallen logs.

Study area habitat values

<u>Location of potential habitat within study area</u>: Woodland (Box Gum Woodland) south of study area (refer Appendix E.2).

Woodland habitat (Box Gum Woodland) south of the Queanbeyan River is considered the most suitable habitat in the study area for this species and comprises 5.4 ha. Elsewhere in the study area, dry forest dominated by rough-barked eucalypts was accompanied by a shrub layer rather than being open and grassy. Open grassy dry forest in the very northern section of the study area was generally dominated by smooth-barked trees and shows reasonably high levels of disturbance from land uses associated with residential development (exotic weeds, walking tracks, presence of domestic animals, rabbits). The more intact good quality areas in the middle of the study area featured an abundance of fallen timber and may provide habitat for the species, although this habitat constitutes closed forest and is considered atypical habitat for the species.

As the species is sedentary and considered to be resident in many locations throughout its range, as well as being a gregarious species that is usually active and conspicuous while foraging in pairs or small groups, it is likely the species would have been observed in the study area, if present. In this context, habitat for the Brown Treecreeper is available within the study area, but is not considered optimal or likely to support a resident population.

Movement corridors

The species has been located further south of the study area in the Googong area, but not in denser habitat closer to the study area despite targeted surveys for the species. The known records of the species (Googong area) fall within a local biolink which connects to the larger regional biolink that adjoins vegetation within the study area. It is therefore considered possible that the Brown Treecreeper may move through these biolinks to utilise habitats of the study area (Box Gum Woodland and the intact dry grass forest in the middle section of the study area), but is unlikely to be common to the area. The proposal will not affect movement of the species through these biolinks.



Condition of regional habitats

The condition of the habitat in other areas of known regional records is unknown. Given that the habitat requirements of the species can coincide largely with low lying agricultural or grazing lands, it is expected that much of the habitat in the region is degraded to some extent, or at risk of degradation. However, some of the scattered records for the species are within protected areas which are expected to support habitat of at least moderate condition.

Conservation status

The Brown Treecreeper is listed as Vulnerable under the NSW TSC Act. The known records for the species are associated with both freehold land and protected areas. The Brown Treecreeper was formerly common and widespread but numbers have declined in recent years within the Queanbeyan/ACT areas. The species' overall range does not appear to have been reduced, but declines in density have been reported in most parts of its range (Garnett & Crowley 2000).

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to the Brown Treecreeper and include:

- Clearing of native vegetation
- Loss of hollow-bearing trees
- Removal of dead wood and dead trees

The proposal will result in removal of up to 5.4 ha of potential habitat, including two hollow-bearing trees, within the southern section of the study area however, the species has not been recorded in this area during targeted surveys and is considered unlikely to rely on the habitat in the subject site. There is potential for the species to occur in other areas of the study area, although the habitat is not typical to the species and is not unique in the locality. The locality supports extensive areas of similar woodland habitat (> 3000 ha), including contiguous vegetation to the south of the study area. Therefore the KTPs on the Brown Treecreeper are considered to be minor.

Recovery planning

There is no recovery plan for the Brown Treecreeper. However, OEH identify 7 priority actions developed to help recover this species:

- Conduct ecological research to determine habitat and resource requirements, threats and conservation issues
- Undertake surveys for threatened woodland birds in new and existing conservation reserves containing suitable habitat to assess the species' conservation status and identify key breeding and foraging habitat
- Identify key habitats or areas for protection and enhanced management through incentives
- Develop habitat identification, management and enhancement guidelines for woodland birds
- Implement sympathetic habitat management in conservation reserves, council reserves and crown reserves where the species occurs
- Increase understanding of woodland birds through promotion of the DEC website and other educational material
- Develop an Expressions of Interest targeted towards private landowners to locate new sites and from this negotiate, develop and implement conservation management agreements for high priority sites

The proposal is not directly at variance with any of the above priority actions.



Ameliorative measures

In light of the detailed assessment, no specific ameliorative measures have been defined for the Brown Treecreeper as impacts to the habitat of this species are considered to be minor. However, while not a subject species of the offset strategy, proposed offsets may indirectly contribute to habitat protection and enhancement for this species at a broader scale.

Assessment of significant impact

The proposal would not remove any known habitat for this species but would result in the removal of 5.4 ha of potential habitat in the southern parts of the study area, although the habitat is not considered unique to this species. The locality supports extensive areas of similar woodland habitat, including contiguous vegetation to the south of the study area (> 3000 ha).

Given that no evidence of the species was detected during surveys, despite the fact the species is gregarious and conspicuous, and the potential habitat within the study area does not support habitat of particular importance, the proposal will not result in a significant impact to the Brown Treecreeper.

5.2.6 Scarlet Robin and Hooded Robin

Local and regional abundance

The Hooded Robin or Scarlet Robin were not recorded during the targeted surveys of the study area, although the species are known from the locality. The Scarlet Robin has been recorded west of the study area, with the nearest record occurring about 800 m away. This species was also regularly observed within Cuumbuen Nature Reserve during locality surveys in March 2013. The Hooded Robin has been recorded about 4 km south-west of the study area.

The Hooded Robin is known in the locality from scattered records and rarely recorded in the region, with records from north of Canberra to Nimmitabel. All known records for the species are south of the study area, with the majority along the Queanbeyan River corridor north and south of Googong Reservoir (Bionet). One record also occurs west of Old Cooma Road (ELA 2010a). Biosis (2003) also recorded the species near the Tralee area.

The Scarlet Robin is reasonably common through the region with several records known between Yass and Bredbo and west of Canberra through to Tarcutta. The species is well represented in protected areas including Cuumbuen Nature Reserve nearby the study area, as well as Bondo State Forest, Tinderry Nature Reserve, Yanununbeyan National Park, and Coornartha Nature Reserve.

Habitat

Habitat requirements

Hooded Robins are found in open eucalypt forest and woodland often in, or near clearings, or open areas (OEH 2012). The species requires structurally diverse habitats including ample fallen timber and logs for insect prey (Schodde and Tidemann 2007). The species favours open areas with a sparse shrub layer as it will forage in bare ground or open ground and through leaf litter for insects. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. Small cup-shaped nests are constructed in a tree fork or crevice, from less than 1 m to 5 m above the ground (OEH 2012).

Scarlet Robins occur in dry eucalypt forests and woodland with open grassy understorey with abundant logs and fallen timber (OEH 2012). The Scarlet Robin utilises open areas in their habitat and some studies have found higher abundance of Scarlet Robins along forest edges than the interior (Berry 2001). Birds

ngh environmental

forage from low perches, fence-posts or on the ground, from where they pounce on small insects and other invertebrates which are taken from the ground, or off tree trunks and logs; they sometimes forage in the shrub or canopy layer. This species' nest is an open cup built in the fork of a tree usually more than 2 m above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub (OEH 2012).

Study area habitat values

Location of habitat within study area: Dry grass forest, woodland and dry shrub forest south of the study area (refer Appendix E.2).

Potential habitat for these species is associated with the more intact forest habitats including the dry grass forest within the middle section of the study area and the woodland, the dry shrub forest habitat (Box Gum Woodland) in the southern section of the study area and the dry grass forest in the northern section of the study area; these areas comprise 19 ha. The dry grass forest supports some potential foraging habitat through fallen timber and logs in the ground stratum for both species, but is not considered optimal habitat as it contains a closed canopy and generally lacks open grassier areas to forage that are not structurally diverse.

These species are not expected to occur elsewhere in the study area due to the disturbed condition of the remaining habitat which lacks structural integrity; these areas are also in close proximity to adjacent residential land and subject to the effects of associated land uses (dogs, weed invasion, rabbits).

The detection of the Scarlet Robin in Cuumbuen Reserve, but not the study area during the March 2013 survey, would suggest the species is easily observed if it were to utilise the area on a permanent basis. The Scarlet Robin was observed in dry forest habitat in the reserve; however the forest was in better condition than that of the study area as it supported a structurally diverse ground stratum far superior than that in the study area in which fall timber and tussock grasses were dominant. This result would suggest the habitat within the study area is not optimal for the Scarlet Robin and the species does not readily inhabit the site.

Movement corridors

As the Hooded Robin has largely been located south of the study area nearby the Googong Reservoir, the regional biolink between the reservoir and the eastern side of the study area provides the most likely movement corridor for this species. It is expected the Box Gum Woodland areas of this biolink would provide the most suitable habitat due to the open nature of this community and its association with native grass species. Box Gum Woodland is most dominant south of the study area and also occurs adjacent the site, but is not common within the study area. The dry grass forest would promote movement of the species, but is considered less suitable for the species due to its closed canopy. The lack of species in this habitat type would suggest Box Gum Woodland is more typical habitat of this species in the locality.

The known records of the Scarlet Robin suggest this species is more likely to move through both Box Gum Woodland and dry forest habitat of the regional biolink, with a possible preference for dry forest habitat. The proposal will not affect movement of this species through these habitats as a strong connection corridor will remain to the east of the study area through to Cuumbuen Nature Reserve, where this species is readily recorded.

Condition of regional habitats

The condition of the habitat in other areas of known regional records is unknown. Given that the habitat requirements of the species can coincide largely with low lying agricultural or grazing lands, it is expected that much of the habitat in the region is possibly at risk of degradation. However, some of the scattered



records for the species are within protected areas, particularly for the Scarlet Robin which is commonly observed in Cuumbuen Nature Reserve.

Conservation status

The Scarlet Robin and Hooded Robin are listed as Vulnerable under the NSW TSC Act. Within the Murrumbidgee Catchment region, 341 and 342 Bionet records are listed for the Scarlet Robin and Hooded Robin respectively. The known records for the species are associated with both freehold land and protected areas.

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to the Scarlet and Hooded Robins and includes:

- Clearing of native vegetation
- Invasion of native plant communities by exotic perennial grass
- Removal of dead wood and dead trees

The proposal will result in removal of up to 19 ha of potential habitat however neither species has been recorded in these areas during targeted surveys and are considered unlikely to rely on the habitat in the subject site. These species are susceptible to threats associated with clearing and fragmentation which either isolate habitat or simplify the ground structure, however the locality supports extensive areas of similar habitat (at least 7000 ha), including contiguous vegetation to the west and south of the study area which will not be isolated by the proposal. The proposal could also increase the invasion of exotic perennial grasses which may degrade potential habitat of these species, but as both species are not considered permanent inhabitants of the study area this threat will not have an adverse effect on their persistence in the locality. Therefore, the extent of impact of these KTPs on the Scarlet and Hooded Robin, as a consequence of the proposal, are considered minor.

Recovery planning

There is no recovery plan for the Scarlet or Hooded Robin. However, OEH identify five priority actions developed to help recover the Hooded Robin:

- Conduct ecological research to determine habitat and resource requirements, threats and conservation issues
- Conduct annual monitoring of key populations that are managed under property agreements or are within DECCW estate, conservation reserves, council reserves and crown reserves
- Provide stewardship payments, develop property agreements and apply other land management incentives for the protection and enhanced management of priority woodland vegetation that is used by the Hooded Robin
- Increase community awareness about the Hooded Robin through promotion of the DECCW Threatened Species Website and the development of education and extension material for threatened woodland and mallee birds
- Implement sympathetic habitat management in conservation reserves, council reserves and crown reserves where the species occurs

The proposal is not considered to be at variance to the above priority actions.

No recovery plan or priority actions have been developed for the Scarlet Robin.


Ameliorative measures

In light of the detailed assessment, no specific ameliorative measures have been defined for the Scarlet and Hooded Robin as impacts to the habitat of these species are considered to be minor. However, while not a subject species of the offset strategy, proposed offsets may indirectly contribute to habitat protection and enhancement for these species at a broader scale.

Assessment of significant impact

The proposal would not remove any known habitat for this species but would result in the removal of 19 ha of potential habitat. However, the habitat to be removed is not considered unique to this species as it lacks the structural diversity usually required by these species (mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses, as well as abundant logs and fallen timber).

Given that no evidence of these species was detected during surveys, despite the fact both species are conspicuous, and the potential habitat within the study area does not support habitat of particular importance, the proposal will not result in a significant impact to the Hooded Robin or Scarlet Robin.

5.2.7 Diamond Firetail

Local and regional abundance

The Diamond Firetail was not recorded during the targeted surveys of the study area, although the species is known from the locality to the south and far east of the site.

The Diamond Firetail is widely distributed in NSW, with a concentration of records from the Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Records are common from Canberra through to Cooma, predominantly within woodland environments.

Habitat

Habitat requirements

The Diamond Firetail is found in grassy eucalypt woodlands, including Box Gum Woodland. It is also known to occur in secondary grassland or open forest, native grassland and riparian areas (OEH 2012). Diamond Firetails hunt for insect prey from low perches on dead stumps, fallen timber, fence posts and low hanging branches (Garnett & Crowley 2000). The habitat components considered important to this species are water and shelter near feeding areas during the day and dense shrubbery for roosting by night (Schodde and Tidemann 2007). Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests.

Study area habitat values

<u>Location of habitat within study area</u>: Shrubland, grassland, open woodland, and dry shrub forest south of study area (refer Appendix E.2).

Suitable habitat for the species is associated with grassy woodland and open areas, such as the Box Gum Woodland and more open grassland, shrubland and open dry forest areas in the southern section of the study area and comprises 13.4 ha (including 6.6 ha of exotic shrubland and disturbed areas). However, no particularly important habitat for this species was observed; native grass habitat is patchy and large areas of weed invasion is prevalent in these areas. The species is conspicuous, often observed in flocks of 5 to 40 birds and is likely to be observed in its open habitat if present in the study area. The lack of records this current survey and from other studies indicates the species does not permanently occupy the study area, but may forage or move through there on occasions.



Movement corridors

The Diamond Firetail has largely been located south of the study area and the local biolink south and east of Cooma road that stretches towards the Googong Reservoir provides the most likely movement corridor. This biolink supports more suitable grassy habitat than other corridors in the locality. It is expected the Box Gum Woodland areas of this biolink would provide the most suitable habitat due to the open nature of this community and its association with native grass species. Box Gum Woodland is most dominant south of the study area and also occurs adjacent the site, but is not common within the study area. For this reason, the Diamond Firetail appears unlikely to be reliant upon the habitat corridors near the study area for regular movements, due to the lack of records and habitat connectivity through this area.

Condition of regional habitats

The condition of the habitat in other areas of known regional records is unknown. Given that the habitat requirements of the species can coincide largely with agricultural or grazing lands, it is expected that much of the habitat is at risk of degradation. However, some of the scattered records for the species are within protected areas which are expected to support habitat of at least moderate condition.

Conservation status

The Diamond Firetail is listed as Vulnerable under the NSW TSC Act. The species is widespread throughout its range, with several records south of Queanbeyan extending to Cooma. Within the Murrumbidgee Catchment region, 408 Bionet records of the species are listed. While the species appears relatively common, as mentioned above its habitat is associated with grazing land and therefore subject to potential long-term degradation. Known records of this species are also associated with protected areas or larger remnants of native habitat.

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to the Diamond Firetail and includes:

- Clearing of native vegetation
- Invasion of native plant communities by exotic perennial grass
- Removal of dead wood and dead trees

The proposal would result in the removal of 13.4 ha of potential habitat in the southern parts of the study area (including open grassy woodland and exotic grassland); however only 6.6 ha of native vegetation would be cleared and none is considered unique to this species. The locality supports extensive areas of similar woodland habitat (at least 3000 ha), including contiguous vegetation to the south of the study area. Therefore, the impact of these KTPs upon the Diamond Firetail are considered minor, as a consequence of the works.

Recovery planning

There is no recovery plan for the Diamond Firetail however, OEH identify five priority actions developed to help recover this species.

- Conduct ecological research to determine habitat and resource requirements, threats and conservation issues
- Conduct annual monitoring of key populations that are managed under property agreements or are within DECCW estate, conservation reserves, council reserves and crown reserves



- Provide stewardship payments, develop property agreements and apply other land management incentives for the protection and enhanced management of priority woodland vegetation used by the Diamond Firetail
- Increase community awareness about the Diamond Firetail through the promotion of the DECCW Threatened Species Website and the development of education and extension material for threatened woodland birds
- Implement sympathetic habitat management in DECCW estate, conservation reserves, council reserves and crown reserves where the Diamond Firetail occurs

The proposal is not considered to be at variance to the above priority actions.

Ameliorative measures

In light of the detailed assessment, no specific ameliorative measures have been defined for the Diamond Firetail as impacts to the habitat of this species are considered to be minor. However, while not a subject species of the offset strategy, proposed offsets may indirectly contribute to habitat protection and enhancement for this species at a broader scale, specifically through protection of Box Gum Woodland and grassland habitats.

Assessment of significant impact

The proposal would not remove any known habitat for this species but would result in the removal of 13.4 ha of potential habitat including shrubland, grassland, open woodland and forest areas south of the study area. However, the habitat to be removed is not considered unique to this species and much of it is degraded with exotic species prevalent in the understorey. The locality supports extensive areas of similar habitat, including contiguous vegetation to the south of the study area.

Given that no evidence of the species was detected during surveys, despite the fact the species is conspicuous and occurs in flocks, and the potential habitat within the study area does not support habitat of particular importance, the proposal will not result in a significant impact to the Diamond Firetail.

5.2.8 Painted Honeyeater

Local and regional abundance

The Painted Honeyeater distribution does not extend into Canberra or Queanbeyan LGA. The greatest concentrations recorded of the species, and almost all breeding, occurs on the inland slopes of the Great Dividing Range in NSW. The species was not observed during the current survey and only one other record is known for the locality, which was observed by ELA (2010b) on one occasion within the Jumping Creek Estate assessment. The species is generally considered a rare nomadic or summer migratory species in the locality. Within the region, most records are west of Canberra and concentrated from Cootamundra through to Hay.

Habitat

Habitat requirements

The Painted Honeyeater is a highly specialised honeyeater that inhabits dry open woodlands and forests containing mistletoe, particularly choosing sites with an abundance of mistletoe (Barea 2008; Barea 2012). It inhabits dry open forests and woodland including Boree, Brigalow and Box Gum Woodlands and Box-Ironbark open forests, also paperbark and casuarinas. It is a specialist feeder on mistletoe, particularly of the genus *Amyema*, and generally requires five or more mistletoes per hectare (NSW Scientific Committee



2011). The extent of available vegetation is considered to be important for this species and it is considered less likely to be found in strips or fragmented patches of vegetation than it is in wider blocks (Robinson 1994).

Study area habitat values

Location of habitat within study area: Dry shrub forest and woodland (Box Gum Woodland) supporting mistletoe (refer Appendix E.2).

Some suitable foraging resources are present in the study area, particularly in mature trees of dry shrub forest and woodland (Box Gum Woodland) containing mistletoes. Mistletoe is present throughout the study area, but generally in low abundance apart from the regenerating dry grass forest at the far northern end of the study area and amongst the older trees in woodland patches north and south of the Queanbeyan River of the study area. Mistletoe diversity is limited in areas of potential habitat with only one species recorded. On this basis, the species may forage within the study area as part of a much larger home range during migration events although it does not provide important habitat unique to this species.

Movement corridors

The Painted Honeyeater appears unlikely to be reliant upon either of the habitat corridors or biolinks in the study area for regular movements given the lack of records through the study area for the species. However, corridors in the south of the study area support greater Box Gum Woodland habitat which appears to be most commonly associated with mistletoe in the locality, and therefore a more likely movement corridor for this species.

Condition of regional habitats

The condition of regional habitats is unknown and largely dependent on the quality and diversity of mistletoe species. However, as the locality is not a known stronghold for the species the proposal will not contribute to the decline of the species nor will it affect its conservation status.

Conservation status

The Painted Honeyeater is listed as Vulnerable under the NSW TSC Act. Within the Murrumbidgee Catchment region, 174 Bionet records of the species are listed. The distribution of the species is 'predicted' to occur within the Queanbeyan LGA while known records are concentrated west of Canberra (OEH 2012). The conservation of the species is not at risk from the proposal given the species is not known to breed within the area and is a rare visitor to the locality.

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to the Painted Honeyeater and includes:

• Clearing of native vegetation

The proposal would result in the removal of up to 4 ha of Box Gum Woodland that supports mistletoe which is considered potential, but marginal, foraging habitat. The locality supports extensive areas of similar woodland habitat, including contiguous vegetation to the south and east of the study area (at least 3000 ha). While some of the trees supporting mistletoe will be removed for the proposal, a large extent of eucalypts supporting mistletoe will be retained both within the study area and surrounding lands.

Given that no evidence of the Painted Honeyeater was detected during surveys, the species is a rare visitor to the Queanbeyan LGA and potential habitat within the study area does not support habitat of particular importance, it is unlikely the proposal would contribute to the above KTPs for this species.



Recovery Planning

There is no recovery plan for the Painted Honeyeater. However, OEH identify five priority actions developed to help recover this species.

- Encourage retention of natural densities of mistletoes, particularly Amyema spp.
- Promote sustainable grazing of habitat patches
- Restore habitat in agriculturally-productive areas
- Encourage and undertake studies to determine the species status, distribution, habitat and resource requirements
- Inform stakeholders of the importance of mistletoes to this species

Ameliorative measures

No specific ameliorative measures have been implemented for the Painted Honeyeater, as impacts to the habitat of this species are considered likely to be minor. The movement of the species is not expected to be substantially affected by the widening of the road corridor through areas of potential habitat. However, as for other bird species, proposed offsets may indirectly contribute to habitat protection and enhancement for this species at a broader scale. Proposed offsets may include good condition Box Gum Woodland which has the potential to support mistletoe species; mistletoe was regularly sighted in this habitat during locality surveys.

Assessment of significant impact

The proposal would result in the removal of up to 4 ha of potential, but marginal, foraging habitat in the study area, although none is considered important to this species. While some of the trees supporting mistletoe will be removed for the proposal, a large extent of eucalypts supporting mistletoe will be retained both within the study area and surrounding lands. The locality supports extensive areas of similar woodland habitat, including contiguous vegetation to the south and east of the study area.

Given that no evidence of the Painted Honeyeater was detected during surveys, the distribution of the species does not extend into Canberra or Queanbeyan LGA, only one record of the species is known for the Queanbeyan LGA the proposal is not considered to result in a significant impact to this species.

5.2.9 Gang-gang Cockatoo

Local and regional abundance

The Gang-gang Cockatoo was targeted during the November 2012 and 2013 surveys during their known breeding season. In November 2012 two adults and two juveniles were recorded in the south of the study area and in November 2012 two adults were observed in the north of the study area. These observations were of birds flying through the study area. The species was also recorded in the locality during the field surveys. No birds were observed nesting within the study area despite targeted stag watch surveys of hollow-bearing trees.

Several other records of the species are known to the east of the study area in what appears to be intact dry forest habitat. A female / male pair was also observed within Cuumbuen Nature Reserve during the March 2013 survey. Other records are known from Queanbeyan River corridor, the Googong area, and Jerrabomberra. The Gang-gang Cockatoo is a regular inhabitant of the Queanbeyan LGA and it is most commonly an inhabitant of larger intact forested areas.



Regionally, the species occurs widely and records are common within protected areas, including Tinderry Nature Reserve, Talaganda State Forest, Brindabella National Park, Bondo State Forest, Kosciuszko National Park, and Maragle State Forest.

Habitat

Habitat requirements

The Gang-gang Cockatoo is sedentary or seasonally nomadic (also part-migratory in Autumn-Spring) and occurs in single pairs to small flocks. It is found in tall mountain forest and woodlands, especially mature wet sclerophyll forests in summer. In winter, it moves to lower altitudes occupying drier more open eucalypt forests and woodlands (particularly box-ironbark assemblages or dry coastal forest) and urban areas (DECC 2005b). The Gang-gang Cockatoo favours vegetation with old growth elements for nesting and roosting. Birds nest in large hollows in the trunk or limbs of living or dead eucalypt trees. Hollows of sufficient size generally do not form in eucalypt trees less than 150 - 200 years old (Mackowski 1984). The species feeds mainly on the fruits of eucalypts and acacias but will feed on other seeds and fruit such as Callitris, garden fruits, Hawthorn (*Crataegus monogyna*) and Callistemon as well as some insects and their larvae. They have been observed foraging and nesting in dry forest on the tablelands (pers. ob. Bianca Heinze). The nest trees have been of moderate size (approximately 60 centimetres DBH) with a medium hollow entrance size. It is likely that the internal dimensions of the hollow were large. Breeding in the Canberra area has been observed over winter, with young fledging during October (pers. ob. Bianca Heinze).

Study area habitat values

Location of habitat within study area: Entire length of study area provides potential foraging habitat, however dry grass forest in the middle section of study area and woodland within southern section of study area are most suitable for breeding (refer Appendix E.2).

The entire length of the study area supports potential foraging resources, some of which are considered marginal, but it is possible the species could forage there as part of a much larger area and comprises 26 ha. However, of the habitat available the more intact dry grass forest and woodland areas within the middle section and southern end of the study area are considered most appropriate to this species for breeding and comprise a total of 7.5 ha; this area supports a greater abundance of feed trees (Acacias) and patches of forest that support increased structural diversity and old growth elements, including 12 hollow-bearing trees. The northern section of the study area supports limited breeding resources as the forest is reasonably disturbed and does not support old growth elements and has limited hollow-bearing trees.

The 12 hollow-bearing trees, including four that support larger hollows, considered suitable for nesting are present north of the Queanbeyan River; hollows suitable for this species are generally limited to this area. The species was not observed nesting in the study area despite stag watching at these trees during the known breeding season.

Movement corridors

The Gang-gang Cockatoo is a mobile and strong flying species that is capable of travelling reasonable distances and would therefore not be reliant on any particular habitat corridor nearby the study area. Large intact tracts of vegetation are present within the locality, primarily to the south and east of the study area and the species is likely to utilise any of these corridors.

Condition of regional habitats

The Gang-gang Cockatoo typically inhabits taller forests with old growth elements for nesting and roosting, which largely limits the species to areas of good quality vegetation. The condition of regional habitats is



expected to be good given the specific habitat requirements of the Gang-gang Cockatoo. Its occurrence in national parks coincides with large intact remnants supporting vegetation of higher value.

Conservation status

The Gang-gang Cockatoo is listed as Vulnerable under the NSW TSC Act. Within the Murrumbidgee Catchment region, 343 Bionet records of the species are listed. The species is widely represented within protected areas in large tracts of native vegetation, including national parks.

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to the Gang-gang Cockatoo and includes:

- Clearing of native vegetation
- Removal of dead wood and trees
- Loss of hollow-bearing trees

Overall, the proposal could remove up to 26 ha of potential habitat for this species however, of this, 7.5 ha of good quality dry grass forest, including 12 hollow-bearing trees, is considered to be most suitable as it supports both foraging and breeding resources for the Gang-gang Cockatoo.

No observations of nesting Gang-gang Cockatoos were observed in any of the hollow-bearing trees to be removed. The 12 hollow-bearing trees to be removed are considered 'potential' breeding habitat for this species. Sixty-seven hollow-bearing trees will remain within the study area, with 29 of these supporting a medium or large hollow. Greater than 7000 ha of largely contiguous dry forest habitat are available within the locality which also supports a similar density of hollow-bearing trees to the study area, as determined during locality surveys. Parts of the dry forest in the locality are known to support habitat of higher conservation value due to increased structural diversity and absence of disturbance, especially habitat within Cuumbuen Nature Reserve in which a pair of Gang-gang Cockatoos were observed during the survey.

Given that the removal of vegetation is restricted to a linear area already adjacent residential development and the habitat is not typical of old-growth forest used by the species, the study area is not considered any more important to these species than the vast amount of available habitat remaining in the locality (> 7000 ha). Additionally, the species is mobile and strong flying with a large home-range and the direct impact of the proposal is not considered to threaten the long-term survival of this species.

Recovery planning

There is no recovery plan for the Painted Honeyeater. However, OEH identify 11 priority actions developed to help recover this species:

- Provide input to National Park and local bushfire management plans to minimise impacts of fire on critical resources
- Increase landholder and public awareness of status, threats and priority actions
- Investigate movement patterns of selected populations
- Determine the status of representative local populations distributed across the species range
- Investigate the impacts of wildfire and hazard reduction burns on foraging and nesting resources
- Investigate the breeding biology of selected populations to improve understanding of threatening processes
- Model the impact of global warming and develop mitigation strategies
- Identify important nesting habitat on public lands



- Negotiate management agreements and covenants over important areas of habitat
- Prepare and distribute information to decision makers
- Determine the disease status of selected populations

The 11 priority actions were reviewed and the proposal is not considered to be at variance to these actions.

Ameliorative measures

While this proposal is not considered to have a significant impact on a local population of the species in the locality, it is considered there may be some impact to this species on a broader level and it has been included in the offset strategy as a precautionary approach. Offsets will be targeted to directly contribute to habitat protection and enhancement for this species. The ongoing management of Box Gum woodland and dry grass forest would mitigate the effects of the above KTPs on this species. Additionally, pre-clearing protocols are prescribed for felling of hollow-bearing trees to avoid the peak of the nesting season for bird species, as well as manage any species located within hollows during clearing works.

Assessment of significant impact

A total of 26 ha of foraging habitat are present throughout the study area and the species is likely to forage there as part of a much larger area. However, of the habitat available the more intact forest and woodland areas within the middle section and southern end of the study area are considered most appropriate to this species and comprise a total of 7.5 ha, including 12 hollow-bearing trees. These areas also join or comprise part of the regional biolink that extends east of the study area into contiguous forest habitat.

As the habitat to be removed is expected to be predominantly used for foraging and to a lesser extent breeding, no nesting Gang-gang Cockatoos were observed in any of the hollow bearing trees to be removed, numerous hollow-bearing trees of similar quality remain in the locality, and the species is mobile and occupies a large home range, the proposal is not considered to result in a significant impact to this species but has been included in the offset strategy as a precautionary principle.

5.2.10 Speckled Warbler

Local and regional abundance

One individual of the Speckled Warbler was recorded north of Queanbeyan River in November 2013 in low shrubs and grassland habitat. The assessment of Jumping Creek Flat Estate completed by ELA (2010b) recorded two Speckled Warblers in riparian habitats nearby the same location of the individual recorded this assessment. Jumping Creek Estate crosses the current study area and extends to the west indicating that the individual recorded this assessment is likely from the same population as those recorded by ELA (2010b).

Other studies in the locality have observed Speckled Warblers with most observations occurring in close proximity to watercourses (GHD 2009; ELA 2010a; ELA 2010b). GHD (2009) recorded two Speckled Warblers along Barracks Creek below the dam in their assessment of Edwin Land Parkway, but did not observe it in other areas of the study area. ELA (2010a) recorded two individuals along Old Cooma Road. The species has also been recorded from the Googong area and Tralee (Biosis 2003) and Jerrabomberra Creek in Fernleigh Estate (BES 2008).

The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and appears to be patchily distributed throughout much of its range. The Speckled Warbler doesn't appear to be well conserved within protected areas.



Habitat

Habitat requirements

The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Habitats typically are structurally diverse with a grassy understorey, a sparse shrub layer and an open canopy (Watson *et al.* 2001). Preferred foraging habitat is a combination of open grassy patches, leaf litter and shrub cover. Declines have been linked to habitat fragmentation as the species appears to be locally extinct in districts where no habitat fragments larger than 100 ha remain (Watson *et al.* 2001). Further, larger remnants (about 300 ha) may be required for populations to be viable (Gardner 2002a). This species nests and forages for seeds and insects on the ground utilising grass tussocks, dense litter and fallen branches. The home range of the species varies from approximately 6 to 12 ha.

Study area habitat values

Location of habitat within study area: All habitat types of the study area (refer Appendix E.2).

The species was detected north of the Queanbeyan River this study in an area that has been highly modified, but is located within an ecotonal area of different habitat types including shrubland, grassland, forest and riverine area; the proximity of different habitat types supports a mosaic of habitat features and provides structural diversity for this species. Habitat descriptions of this species suggests it is likely to inhabit various habitat types with a combination of habitat features with an open grassy understorey similar to the area the species was recorded this assessment. As the Speckled Warbler was also detected in the same general vicinity by ELA (2010b) the area immediately north and east of Queanbeyan River is considered the most important habitat for this species in the study area. It is possible given the species presence in the area it could move through the dry grass forest areas in the northern section of the study area also; however, it was not recorded in this area habitat types despite extensive bird surveys in this area.

The proposal would involve the removal of potential habitat comprising 26 ha across the entire study area, but the species is known to occur within a discrete area of the study area which comprises 8.1 ha. The proposal will also extend the current area of disturbance between known habitat for the species, which is between the Edwin Land Parkway and the proposed Jumping Creek Estate. The road corridor in this location will increase the amount of traffic on the road and may possibly lead to an eventual increase in indirect impacts of mortality from vehicle strikes to the species.

Movement corridors

As mentioned, the known records of the Speckled Warbler would indicate the species is a permanent resident of the locality and likely to move through suitable habitat in both the local and regional biolinks south of the study area. In particular, the more open woodland habitat of the local biolink appears important for movement of the species which links to the regional biolink that supports good quality dry forest habitat.

The proposal will not isolate any habitat but it will increase the width of fragmentation and traffic volume passing on the edge of one regional biolink where the species has been recorded nearby.

Condition of regional habitats

Regional habitat for the species is expected to be reasonably widespread, based on the distribution of Bionet records. However, records appear to be patchily distributed throughout much of its range, and the corresponding habitats do not appear to fall within protected areas. Condition and security of these habitats is therefore expected to be variable.



Conservation status

The Speckled Warbler is listed as Vulnerable under the NSW TSC Act. Within the Murrumbidgee Catchment region, 515 Bionet records of the species are listed. While the species appears widespread, there has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive (OEH 2012). Large tracts of remnant vegetation are important to the species longevity, such as those biolinks adjoining the study area.

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to Speckled Warbler and includes:

- Clearing of native vegetation
- Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
- Invasion of native plant communities by exotic perennial grass
- Removal of dead wood and dead trees

The species is susceptible to threats associated with clearing and fragmentation which either isolate habitat or simplify the ground structure. The proposal will result in the direct removal of up to 26 ha of potential habitat for the Speckled Warbler which includes 8.1 ha of known habitat that supports both breeding and foraging resources. However, the locality supports extensive areas of similar woodland and forest habitat, including contiguous vegetation to the south and east of the study area. At least 3,000 ha of Box Gum Woodland and 7,000 ha of dry forest are available within the locality. However, the condition of the Box Gum Woodland is expected to vary, while the dry forest directly east of the study area and within Cuumbuen Nature Reserve is known to be in good condition.

The proposal may also increase the invasion of exotic perennial grasses which could degrade potential foraging habitat of this species.

Recovery planning

There is no recovery plan for the Speckled Warbler. However, OEH identify 7 priority actions developed to help recover this species:

- Conduct ecological research to determine habitat and resource requirements, threats and conservation issues
- Undertake surveys for threatened woodland birds in new and existing conservation reserves containing suitable habitat to assess the species' conservation status and identify key breeding and foraging habitat
- Identify key habitats or areas for protection and enhanced management through incentives
- Develop habitat identification, management and enhancement guidelines for woodland birds
- Implement sympathetic habitat management in conservation reserves, council reserves and crown reserves where the species occurs
- Increase understanding of woodland birds through promotion of the DEC website and other educational material
- Develop an Expression of Interest targeted towards private landowners to locate new sites and from this negotiate, develop and implement conservation management agreements

The seven priority actions were reviewed and the proposal is not considered to be at variance to these actions.



Ameliorative measures

Ameliorative measures proposed for the Speckled Warbler largely relate to the appropriate management of remaining adjacent habitat in the southern section of the study area and in Box Gum Woodland immediately adjacent the study area. Short-term measures including barrier fencing, erosion controls, induction of construction workers and rehabilitation of disturbed edges will be implemented to protect adjoining habitat from unnecessary degradation.

This species is a subject of the offset strategy. Offsets will be targeted to directly contribute to habitat protection and enhancement for this species. Longer-term measures to appropriately monitor the population and manage edge effects, particularly in the southern section of the study area as detailed above, will be ongoing. Proposed offsets and their associated management, are likely to directly conserve habitat for this species over the long-term and mitigate the effects of the above KTPs on the species.

In terms of the indirect impact of increased traffic volume through areas of habitat, measures to facilitate the movement of woodland birds in general across the road involve minimising the width of vegetative clearing in areas of taller woodland or forest allowing birds to fly above the height of traffic.

Assessment of significant impact

The observation of the species this assessment north of the Queanbeyan River, and the known records of the species recorded to the south of the study area by GHD (2009) near the dam of Edwin Land Parkway (~ 500 m south), by ELA (2010b) near the Queanbeyan River corridor (~ 200 m west), and by ELA (2010a) near Old Cooma Road (~ 400 m south) indicate the species is a permanent resident of the locality given the species is sedentary and occupies a discrete home range (~ 10 ha). The location of records indicate the species is likely to move through suitable habitat in both the local and regional biolinks south of the study area. Based on the proximity of these records, the home range of these individuals includes habitat within the study area.

Birds are often less affected by the impacts associated with roads than other species because of their greater mobility. The Speckled Warbler is mobile, but as it has been recorded near the study area and the species tends to utilise habitats close to the ground, it may be more susceptible to vehicle impacts when moving across roads.

A total of 26 ha of habitat will be removed as part of the proposal, of this 8.1 ha of habitat nearby the Queanbeyan River is considered important habitat comprising part of a permanent home range for this species.

The loss of habitat from this proposal and an indirect increase in traffic volume through known habitat may have an adverse effect on the life cycle of the species such that a viable local population would be placed at risk. The proposal has the potential to result in a significant impact to this species.

5.2.11 Koala

Local and regional abundance

Koalas were not detected during the survey and the species is not common within the locality, with one record known north of the study area along a minor waterway, while another anecdotal record of a Koala occurs within a residential property to the west of the proposed road corridor (Allison Treweek (OEH) pers. comm.).

The Koala has a fragmented distribution throughout its range in NSW and the species occurs in sparse and possibly disjunct populations (OEH 2012). Within the region, the species mainly occurs west of the Great Dividing Range. Records around the Queanbeyan / ACT area are few and scattered; the only documented Bionet record for the Queanbeyan LGA post year 2000 is of the record listed above. There is a concentration



of records to the east and north-east of Cooma on the Monaro Tablelands (DECC 2008). There are scattered records throughout the Central and Southern Tablelands, including populations in Bathurst, in parts of the Goulburn LGA, in Bungonia State Recreation Area (Allen 2002) and in the Mundoonen Nature Reserve.

Habitat

Habitat requirements

The Koala inhabits eucalypt woodlands and forests including coastal forests, the woodlands of the tablelands and western slopes, and the riparian communities of the western plains. The species feeds on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. The home range of Koalas varies depending on the quality of the habitat and the number of available food trees and ranges from less than 2 ha to several hundred ha in size; if feed trees are sparse or primary feed trees absent, the home range of the Koala is expected to be on the larger side of the above range. The species is generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery.

The quality of forest and woodland communities as habitat for Koalas is influenced by a range of factors (Reed *et al.* 1990), such as: species and size of trees present, structural diversity of the vegetation, soil nutrients, climate and rainfall, and size and disturbance history of the habitat patch.

The most important factor influencing Koala occurrence is the suite of tree species available. In any one area, Koalas rely primarily on regionally specific primary and/or secondary food tree species. If primary food tree species are not present or occur in low density, Koalas will rely on secondary food tree species, but the carrying capacity of the habitat (i.e. number of animals per ha) is inevitably lower (DECC 2008).

Study area habitat values

Location of habitat within study area: All woodland and forest habitat types of the study area (refer Appendix E.2).

There is potential for Koalas to move through all woodland and forest habitats of the study area; however Koalas were not detected during the survey, nor detected by call during call playback surveys. It is generally recommended that searches are completed every 500m to ascertain the presence or absence of a Koala, or 30 trees are searched every 25 ha (Chris Allen pers. comm. 2013). X RapSAT surveys were undertaken this assessment, equating to a survey approximately every 3 ha within the subject site which is an adequate survey intensity for the size of impact of the proposed works. No Koala scats or scratching on trees attributed to the Koala were detected during RapSAT surveys.

The study area does not support preferred food trees for the Koala, but supports four secondary food trees, as listed in the Koala Recovery Plan for the Southern Tablelands (DECC 2008). The dry forest habitat of the study area supports potential but low quality habitat for the Koala due to the absence of preferred food trees and paucity of sheltering sites. The absence of primary food trees indicates the Koala would use the study area as part of a much larger home range as populations usually centre around primary food trees; secondary food trees become more important to the species if they occur amongst primary food trees (DECC 2008). The quality of the habitat in the study area would only support very low densities of Koalas, if they were to occur. The rarity of records (one documented and one anecdotal) in the Queanbeyan LGA implies a Koala population does not exist within the area, but records are more likely attributed to dispersing individuals moving through the locality as part of a larger home range.

Known threats that can affect the life cycle of the Koala include predation pressures from domestic dogs, loss of habitat, and vehicle collisions. These pressures are already clearly evident within the study area, particularly within the north and south of the site. Dogs are a known key threat to the persistence of Koala



populations (REF) and were regularly observed in the study area both by direct observation and scats; residents regularly walk dogs through the entire length of the study area on permanently formed walking tracks and dogs were observed roaming the area unaccompanied several times during field surveys. The ongoing presence of dogs, coupled with other existing disturbances (i.e. clearing and recreational use of the site), is considered an existing major threat preventing Koalas from occupying the study area. It is also expected that dogs easily detect a Koala and if there was a permanent population or an individual had a perminuta home range in the study area, they would have been noted by the abundant dog walkers over time (Chris Allen pers. comm. 2013).

Movement corridors

The potential, but unlikely, habitat for this species is bordered by residential housing to the west and generally contiguous vegetation to the east. The proposal will not fragment or isolate other areas of habitat and if the species were to occur, the proposal would not affect movement to the east of the study area into the larger tracts of remnant vegetation that may support more suitable habitat.

Condition of regional habitats

Koalas are concentrated on flat, fertile, low-elevation soils and are not widely found in public forests, particularly national parks (DECC 2008). While the condition of regional habitats on freehold land may be compromised in the long-term, the locality is not known to support a Koala population; therefore the proposal is not considered likely to contribute to the decline of the species.

Conservation status

The Koala is listed as Vulnerable under the TSC Act. There have been no studies to estimate the size of the NSW koala population. Decisions about its status and decline have been based on the changes in its distribution.

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to the Koala and includes:

- Clearing of native vegetation
- Removal of dead wood and dead trees

The proposal does not involve the removal of, or direct disturbance to, Koala habitat however, potential habitat, covering a total of 20 ha will be removed. As the species has not been recorded in this area during targeted surveys and the study area is considered very unlikely to support a viable population the KTPs listed above are therefore unlikely to affect the Koala. Additionally, the northern and southern areas are already largely disturbed from surrounding development and current land uses associated with residential areas which would affect the ability of the species to persist in the region (i.e. clearing, cars, predation and disturbance by domestic dogs).

Recovery planning

A state recovery plan has been drafted for the Koala (DECC 2008). The overall objectives of the plan are to reverse the decline of the koala in NSW, to ensure adequate protection, management and restoration of koala habitat, and to maintain healthy breeding populations of koalas throughout their current range.

The recovery lists seven specific objectives to which the recovery actions apply and includes:

- Conserve Koalas in their existing habitat
- Rehabilitate and restore Koala habitat and populations
- Develop a better understanding of the conservation biology of Koalas



- Ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local level
- Manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care
- Manage over-browsing to prevent both Koala starvation and ecosystem damage in discrete patches of habitat
- Coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW.

The study area is not known to support a Koala population and the locality has never supported a known viable population. Therefore the proposal is not considered to be at variance to the recovery of this species.

Ameliorative measures

No specific ameliorative measures have been implemented for the Koala, as impacts to the habitat of this species are unlikely and the movement of the species is not expected to be substantially affected by the widening of the road corridor through areas of potential habitat. However, two fauna underpasses have been recommended for the Rosenberg's Goanna and while not specifically designed for the Koala, it is considered they would be indirectly beneficial if a dispersing Koala were to pass through the area. The underpasses would be constructed under the road within the good condition dry grass forest habitat.

While the proposal is not expected to have a significant impact on the Koala and the species is therefore not a subject species of the offset strategy, the proposed offsets may however, indirectly contribute to habitat protection and enhancement for this species at a broader scale.

Assessment of significant impact

The proposal would result in the removal of 20 ha of potential habitat that is not known to support a Koala population, but is potentially used by young dispersing animals. Much of the area to be affected by the proposed works is subject to ongoing disturbances due to prior clearing and its proximity to residential housing with resulting predation by domestic animals, ingress of weeds, clearing, and other infrastructure construction. Greater than 10 000 ha of similar woodland and forest habitat is available in the locality. Given the targeted surveys did not detect the species, the study area is not known to support a Koala population, the habitat does not support primary feed trees and the large extent of available habitat that will remain in the locality, the proposal is not considered to result in a significant impact to this species.

5.2.12 Microbats (Eastern False Pipistrelle, Eastern Bent-wing Bat)

Local and regional abundance

Two Anabat files were attributed to the Eastern False Pipistrelle during field surveys for this proposal (recorded on one overnight survey only with 10 overnight surveys undertaken). One existing record occurs in the locality approximately 2 km east of the study area in Cuumbuen Nature Reserve. Other existing records of the species are known from Talpa and near the Queanbeyan River (Bionet).

Two Anabat files were recorded for the Eastern Bent-wing Bat (recorded on one overnight survey only). One existing record occurs approximately 3.5 km south of the study area along Queanbeyan River. Other existing records are known near Googong Dam and central Queanbeyan (Bionet).



Habitat

Habitat requirements

The Eastern False Pipistrelle is found in wet sclerophyll forest, preferring tall and wet forests where trees are more than 20 m high and the understorey is dense. They generally roost in hollow trunks of eucalypt trees, but can be occasionally found in caves and old wooden buildings. These bats have a home range up to 136 ha and are known to change roosts nightly. The species forages primarily on beetle, moths, some bugs and ants. The species forages within continuous forest where they primarily forage along tracks, creeks and rivers just below the canopy avoiding dense understorey (Churchill 2008).

The Eastern Bent-wing Bat is found in a range of habitat types from Rainforest to wet and dry sclerophyll forest, open woodland and open grasslands. Eastern Bent-wing Bats primarily roost in caves but also use derelict mines, storm-water tunnels, buildings and other man-made structures, with discrete populations centred on maternity caves that are used annually for birth and development of young. The species forages both above and below the canopy layer and are known to travel large distances during foraging bouts; one female was recorded to travel 65 km in one night (Churchill 2008).

Study area habitat values

Location of habitat within study area: All habitat types of the study area (refer Appendix E.2).

The study area provides potential habitat in the form of forest, woodland and open grassland foraging resources for both these species and it is possible both species could forage throughout the study area. However, the larger areas of intact forest and woodland are expected to provide the most substantial foraging resources, and if used, would form a small portion of a much larger home range. In particular, the good quality dry grass forest habitat within the middle section of the study area and the Queanbeyan River corridor is considered the most suitable habitat providing both foraging and roosting resources. This area supports a taller canopy layer and several hollow-bearing trees. The remainder of the study area provides foraging habitat, but limited and unlikely roosting habitat.

While multiple hollow-bearing trees will be removed as part of the proposal and are possible roosting sites, the Eastern Bent-wing Bat is primarily known to roost in caves and roosting is not expected apart from short-term opportunistic sheltering. The hollow-bearing trees offer potential, but not particularly high quality, roosting sites for the Eastern False Pipistrelle. Additionally, at least 68 hollow-bearing trees will remain within the study area, with more known in the locality. No microbats were observed leaving hollows during stag watching surveys for the Gang-gang Cockatoo.

Movement corridors

Neither the Eastern False Pipistrelle nor the Eastern Bent-wing Bat is reliant on habitat corridors for movement between areas of habitat. However, it is expected that both species would move through more intact forest or woodland areas especially the regional biolink to the noth and east of the study area. There is potential for both species to also move along the Queanbeyan River corridor during foraging bouts. The proposal will not affect movement of these species through the locality or wider region.

Conservation status and condition of regional habitats

The Eastern False Pipistrelle and Eastern Bent-wing Bat are listed as Vulnerable under the TSC Act. In the Murrumbidgee Catchment region, Bionet contains 63 and 158 records for the Eastern False Pipistrelle and Eastern Bent-wing Bat respectively, most of which are associated with the larger conservation reserves and state forests. As these species have large home ranges, the species rely on a mosaic of habitat resources which usually occurs across a multitude of land tenures. The condition of regional habitats is therefore



expected to vary, with some areas at risk of degradation. However, the number of records known within protected areas indicates some level of security for these species.

Key Threatening Processes

The action proposed will contribute to the following KTPs relevant to the Eastern False Pipistrelle and Eastern Bent-wing Bat and include:

- Clearing of native vegetation
- Loss of hollow-bearing trees

The proposal will result in approximately 26 ha of vegetation removal within the subject site which could conceivably be considered potential foraging habitat for both these species. Of this forest habitat, approximately 7.5 ha provides potential roosting habitat for the Eastern False Pipistrelle as it contains 31 hollow-bearing trees that may require removal. The majority of the hollow-bearing trees to be removed are not large enough to be considered maternity sites. Stags are often likely roosting or maternity sites for microbats. Four stags will be removed for the proposal but are generally considered marginal for this species; three of the stages were below 50 cm DBH, while one was recorded at 90 cm DBH. None of these stags supported large hollows suitable for a maternity roost site.

However, at least 72 hollow-bearing trees of varying sizes and quality will be retained within the study area, with many more known to be present within the locality in similar habitat (i.e. in vegetation directly east of the study area and within Cuumbuen Nature Reserve.

Given that the removal of vegetation (foraging habitat) is restricted to a linear area already adjacent residential development, the study area is not considered any more important to these species than the vast amount of available habitat remaining in the locality (> 7000 ha) and extensive areas of resources will remain within the locality, the impacts of the above KTPs on these bat species are considered minor.

Recovery planning

There is no recovery plan for the Eastern False Pipistrelle or Eastern Bent-wing Bat. However, OEH identify several priority actions developed to help recover these species:

Eastern False Pipistrelle

- Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments or other land assessment tools
- Develop and promote State-wide bat awareness programs for schools, CMAs, landholders and industry groups etc.
- Research the effectiveness of rehabilitation measures intended to increase bat populations in degraded landscapes, such as revegetating and installing bat boxes
- Quantify any benefits to local bat populations from reducing the impact of insect pests on commercial crops
- Ensure the Code of Practice for private native forestry includes adequate measures to protect large, hollow-bearing trees and viable numbers of recruit trees
- Research the roosting ecology of tree-roosting bats. For example identifying the attributes of key roosts
- Research the degree of long-term fidelity to roost trees and roosting areas in order to assess their importance and the effects of their removal
- Identify important foraging range and key habitat components for this species
- Research the effect of different burning regimes



- Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, and structural diversity. Give priority to largest hollow bearing trees
- Investigate the effectiveness of logging prescriptions
- Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes
- Identify the effects of fragmentation in a range of fragmented landscapes e.g. cleared Tableland landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes
- Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species
- Identify areas of private land that contain high densities of large hollow-bearing trees as areas of high conservation value (HCV) planning instruments and land management negotiations e.g. LEP, CAPs, PVPs
- Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and BioBanking, acquisition for reserve establishment or other means

Eastern Bent-wing Bat

- Promote bats throughout the rural community as ecologically interesting and important, but sensitive to disturbance at caves/disused mine tunnels
- Undertake non-chemical removal of weeds (e.g. lantana, blackberry) to prevent obstruction of cave entrances
- Restrict access where possible to known maternity sites. (e.g.: signs; bat-friendly, preferably external gates at caves)
- Restrict caving activity during critical times of year in important roosts used by species, particularly maternity and hibernation roosts
- Establish a gating design for disused mines across species range that will not adversely impact species. Consultation with cave bat specialist prior to any gating operations
- Determine the effectiveness of PVP assessment, offsets and actions for bats
- Monitor the breeding success of a representative sample of maternity colonies in cave roosts over a number of years to determine the viability of regional populations
- Regular censuses of maternity colonies (Wee Jasper, Bungonia, Willi-Willi, Riverton) and other key roosts in network, especially where there are population estimates from banding in the 1960s
- For roost caves Vulnerable to human disturbance, monitor their visitation by people, particularly during winter and spring/summer maternity season and in school holidays
- Measure genetic population structure among cave roosts of maternity colonies to estimate dispersal and genetic isolation, and vulnerability to regional population extinction
- Research the effect of different burning regimes on cave disturbance and surrounding foraging habitat
- Control foxes and feral cats around roosting sites, particularly maternity caves and hibernation sites
- Study the ecological requirements of maternity colonies and their environs and migratory patterns
- Research to identify important foraging range and key habitat components around significant roosts



- Confirm species taxonomy of NSW populations, relative to other Australian populations
- Search for significant roost sites and restrict access where possible. Significant includes maternity, hibernation and transient sites including in artificial structures
- Compile register of all known roost sites in natural and artificial structures including current and historical data and identify significance of roost, e.g. maternity, hibernation, transient roost
- Promote the conservation of these key roost areas using measures such as incentive funding to landholders, offsetting and BioBanking, acquisition for reserve establishment or other means
- Prepare fire management plans for significant roost caves, disused mines, culverts, especially maternity and winter roosts
- Exclude prescription burns from 100m from cave entrance, ensure smoke/flames of fires do not enter caves/roosts in artificial structures
- Ensure protection of known roosts and forest within 10 km of roosts in PVP assessments (offsets should include nearby remnants in high productivity) and other environmental planning instruments
- Prepare management plans for significant bat roosts especially all known maternity colonies and winter colonies
- Restrict caving activities at significant roosts during important stages of the annual bat life cycle (e.g. winter hibernation, summer maternity season)
- Identify and protect significant roost habitat in artificial structures (e.g. culverts, old buildings and derelict mines)
- Identify the susceptibility of the species to pesticides

The priority actions were reviewed and the proposal is not considered to be at variance to these actions.

Ameliorative measures

No specific ameliorative measures have been implemented for the Eastern False Pipistrelle and Eastern Bent-wing Bat, as impacts to the habitat of these species are likely to be minor. The movement of these species is not expected to be substantially affected by the widening of the road corridor through areas of potential habitat. However, as for other species, proposed offsets may indirectly contribute to habitat protection and enhancement for these species at a broader scale.

Assessment of significant impact

The proposal would result in the removal of up to 26 ha of foraging habitat in the study area (including 7.5 ha of better quality habitat supporting hollow-bearing trees for roosting), although none is considered unique or important to these species. Given the Eastern False Pipistrelle and Eastern Bent-wing Bat were recorded in low numbers, the large home range of these species, the quality of foraging and roosting resources remaining within the locality is high, and the proposal will affect habitat on the boundary of residential development it is considered the proposed works would not result in a significant impact to these species.

5.2.13 Golden Sun Moth

Local and regional abundance

No Golden Sun Moths were observed during the survey period, despite a targeted focus over four days of those areas containing potential habitat. Several records are known to the south and west of the study area nearby Lanyon Drive (east of the Monaro Highway) (Biosis 2003), Jerrabomberra Valley and Old



Cooma Road (ELA 2010a). The species has not been recorded in the locality during other studies (GHD 2009; ELA 2010a, ELA 2010b; BES 2007) indicating that the species is confined to discrete areas of suitable habitat where it is known.

The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Yass, Young and Tumut. The species is reported from 48 sites in NSW, with 32 sites occurring in the ACT (DSEWPaC 2013). Forty-eight Bionet records of the species are known for the Murrumbidgee Catchment region, with the heaviest concentrations north of Canberra towards Yass.

Habitat

Habitat requirements

The Golden Sun Moth has shown a preference for natural temperate grasslands or secondary grasslands (derived from Box Gum grassy woodland) that are dominated by a low and open cover of native wallaby grasses (*Rytidosperma* spp., formerly *Austrodanthonia* spp.) (OEH 2012). The Golden Sun Moth has also been recorded in degraded and weed infested patches of grasses dominated by Redleg Grass (*Bothriochloa macra*), Spear Grasses (*Austrostipa* spp.), Weeping Grass (*Microlaena stipoides*) and the introduced Chilean Needle Grass (*Nassella neesiana*) (OEH 2012).

Only the male moth regularly flies, but is thought not to travel beyond 100 m from suitable habitat (Clarke & O'Dwyer 2000). Male moths fly only in bright sunshine during the warmest part of the day (10:00 - 14:00; 24 h time), although moths have been recorded flying up to 16:00 under favourable conditions. Moths are observed flying generally in relatively calm conditions, although walking across habitat in slightly windy conditions may cause the moths to become airborne. Adults emerge continuously throughout the flying season. The local ACT region flying season is relatively short, being about six to eight weeks between November and December, depending on seasonal conditions (OEH 2012). The larvae of the Golden Sun Moth feed on the roots of grasses, however the adults have no functioning mouthparts and so do not feed.

Study area habitat values

Location of habitat within study area: Dry forest (Box Gum Woodland) and grassland in the southern section of the study area (refer AppendixE.2).

In general, the study area provides little potential habitat for the Golden Sun Moth, with the exception of the southern end of the study area which supports potential, but low quality, habitat for this species. This area is classified as open grassland and dry forest (Box Gum Woodland) that is primarily disturbed over some exotic and native grass species and comprises 4 ha. Most of this southern section is considered unsuitable for the species, as the potential habitat contains a substantial amount of fill and has been disturbed by the construction of the Edwin Land Parkway and subsequent rehabilitation works. Suitable open grassy woodland areas dominated by Wallaby Grass are largely absent from the area or only occur in patches. Elsewhere in the broader study area, habitat for this species is considered unsuitable.

Movement corridors

No areas of known or potential habitat for the species will become isolated or fragmented as a result of the proposal and movement of the species will not be affected. Suitable habitat does not occur between the study area and the known Golden Sun Moth records nearby Lanyon Drive. Approximately 3 km of unsuitable habitat (i.e. residential development or non-preferred habitat) exists between the study area and the known records and it is very unlikely the species would move through this area given that its dispersal ability through unfavourable habitat is limited to approximately 100 m (DEWHA 2009). Populations separated by distances greater than 200 m can be considered effectively isolated (Clarke & O'Dwyer 2000).



Condition of regional habitats

The species requires relatively intact native grasslands and therefore regional habitats are most likely of good quality. However, the distribution of the species is patchy and populations occur in isolated fragments putting them at risk of long-term degradation.

Conservation status

The Golden Sun Moth is listed as Endangered under the NSW TSC Act and Critically Endangered under the Commonwealth EPBC Act. Historically, across Australia, it is probable the moth occurred wherever there were high densities of wallaby grasses within suitable grassland habitat, however today less than 1% of these temperate native grasslands remain. As a result, the remaining Golden Sun Moth populations are highly reduced and fragmented (Clarke & O'Dwyer 2000). Within the Queanbeyan LGA, records of the Golden Sun Moth occur within both protected and freehold land.

Key Threatening Processes

The action proposed will include the following KTPs relevant to the Golden Sun Moth:

- Clearing of native vegetation
- Invasion of native plant communities by exotic perennial grass

Known threats to the species include fragmentation and degradation of preferred habitat, which may be caused by various types of development and agricultural practices. The proposal will result in the removal of 4 ha of potential habitat within the southern section of the study area; however, the species has not been recorded in this area during targeted surveys and is considered very unlikely to occur in the subject site. The potential habitat to be removed in the southern parts of the study area is already subject to ongoing disturbances due to its proximity to residential housing and prior clearing has already resulting in weed invasion in the area. As the species is not considered to occur within the study area, the proposal will not exacerbate the KTPs listed above for the Golden Sun Moth.

Recovery planning

There is no recovery plan for Golden Sun Moth. However, OEH identify 20 priority actions developed to help recover this species:

- Finalise recovery plan for the Golden Sun Moth by 2007
- Undertake distribution modelling
- Undertake targeted surveys in areas of suitable habitat within predicted range
- Survey newly discovered populations to determine their extent
- Produce and disseminate EIA guidelines for local government
- Local government to record sites on section 149 notices
- Develop habitat identification, management and enhancement guidelines
- Provide incentive payments for protection and enhanced management of identified sites on private land (see DEC for details)
- Develop and implement a conservation management plan for Gocup TSR
- Develop and implement conservation management plans for Davis, Eady's New, Lagoon, Wargeila, Warroo, Blackburn, Coolalie, Deringullen, Lambs, McInerneys, Merriville and Nanima TSR's
- Develop and implement conservation management plans for Tarengo, Pudman and Wolverhampton TSR's
- Develop and implement a roadside management plan for populations at Springvale and Valrosa



- Develop and implement a roadside management plan for populations at Bowning, Gounyan Rd, Grace's Flat Rd, Jeir Ck, Kia Ora and Tallagandra Lane
- Undertake regular monitoring of priority populations using survey and monitoring guidelines
- Increase understanding of the species through promotion of the DEC website and other educational material
- Encourage landowners to join the Grassy Box Woodlands and Southern Tablelands Grassy Ecosystems CMN's
- Undertake genetic analysis of newly discovered populations
- Undertake research into biology and ecology
- Prepare and implement plan of management for Queanbeyan NR
- Undertake biennial monitoring at Queanbeyan NR

The 20 priority actions were reviewed and the proposal is not considered to be at variance to these actions, given that the species is not likely to occur within the study area and the potential habitat to be removed is considered to be of low-quality.

Ameliorative measures

In light of the detailed assessment, no specific ameliorative measures have been defined for the Golden Sun Moth given the species is not expected to occur within the study area regularly. However, while not a subject species of the offset strategy, proposed offsets may indirectly contribute to habitat protection and enhancement for this species at a broader scale (particularly as Box-Gum woodland is likely to form a major component). Additionally, prescriptions for management of exotic weeds, especially perennial grasses, during construction will prevent the proposal exacerbating this key threatening process in the locality.

Assessment of significant impact

The proposal would result in the removal of 4 ha of marginal habitat in the southern parts of the study area. No Golden Sun Moths were observed, despite a targeted focus over four days of those areas containing potential habitat, including areas dominated by wallaby grasses in small or extensive patches, and areas containing spear grasses and Redleg grass. Given that no evidence of the species was detected during surveys despite surveys being undertaken within the known flying season of this species, and the potential habitat within the study area is considered unsuitable or low quality, it is assessed that the proposal would not result in a significant impact to this species.





Ś

Table 5-2 Summary of clearance impacts on threatened fauna species that could be affected by the proposal

Impact level	Moderate	Moderate	Low	High (known for the area and mortality of individuals from vehicle strike could affect a local population)
Ameliorative Measures	Yes – Avoidance, weed control, rehabilitation, offset strategy	Yes – Avoidance, weed control	No specific measures	Yes – fauna underpass and barrier fencing. Included in offset strategy.
Potential habitat remaining within locality	> 3000 ha	 > 3000 ha Box Gum Woodland > 7000 ha dry grass forest 	> 3000 ha Box Gum Woodland	 > 7000 ha dry grass forest
Potential habitat remaining in study area	4.5 ha(additional5.5 hacontiguousoutside ofstudy area)	24 ha (based on veg types, not all ideal)	~ 15 ha	~ 93 ha; at least 35 termite mounds
Potential habitat impacted in subject site	4 ha	19 ha (based on veg types, not all ideal)	4 ha	13 ha; 13 termite mounds in identified habitat for this species
Recorded in locality and wider region.	Yes. Widespread in locality and region	Yes. Widespread in locality	Yes. South of the study area nearby Tralee or the Poplars, west of Cooma Road nearby the Queanbeyan River.	Yes. North, east and south of the site within Cuumbuen Nature Reserve, nearby Kings Highway, nearby the Queanbeyan River Corridor, Old Cooma Road and Wickerslack Lane
Recorded during survey	Yes	Yes	ON	No, but several termite mounds present
Vegetation type species likely to occur in within study area	Box-Gum Woodland	Box-Gum Woodland and Dry Forest	Dry Shrub Forest (Box Gum Woodland) and grassland.	Dry grass / shrub forest in north of study area (i.e. north of Queanbeyan River).
Status	EEC TSC Act CEEC EPBC Act	E EPBC Act	V TSC Act V EPBC Act	V TSC Act
Species	Box-Gum Woodland	Hoary Sunray	Pink-tailed Worm-lizard	Rosenberg's Goanna



4733 Final v1.2

83

Impact level	Low	Low	LOW
Ameliorative Measures	No specific measures, but potential habitat indirectly conserved through management of habitat for other affected species.	No specific measures, but potential habitat indirectly conserved through management of habitat for other affected species.	No specific measures, but potential habitat indirectly conserved through management of habitat for other affected species.
Potential habitat remaining within locality	> 3000 ha Box Gum Woodland	 > 3000 ha Box Gum Woodland > 7000 ha dry grass forest 	
Potential habitat remaining in study area	~ 15ha	At least 115 ha	
Potential habitat impacted in subject site	5.4 ha	19 ha	
Recorded in locality and wider region.	Yes. 6 km south of the subject site near old Cooma Road. Near Googong Dam turnoff.	Yes. West of the study area, regularly observed within Cuumbuen Nature Reserve during locality surveys in March 2013.	Yes. 4 km south- west of the study area.
Recorded during survey	ON	ON	ON
Vegetation type species likely to occur in within study area	Woodland habitat (Box-Gum Woodland) south of the Queanbeyan River.	Dry grass forest, dry shrub forest and woodland.	
Status	V TSC Act	V TSC Act	V TSC Act
Species	Brown Treecreeper	Scarlet Robin	Hooded Robin

ngh environmental

84

4733 Final v1.2

Species Impact Statement Ellerton Drive Extension

Impact level	Low	Low	Moderate (known within site, but no known breeding resources will be affected)
Ameliorative Measures	No specific measures, but potential habitat indirectly conserved through management of habitat for other affected species.	No specific measures, but potential habitat indirectly conserved through management of other species.	No specific measures, but potential habitat indirectly conserved through management of habitat for other affected species.
Potential habitat remaining within locality	> 3000 ha Box Gum Woodland	> 3000 ha Box Gum Woodland	 > 3000 ha Box Gum Woodland > 7000 ha dry grass forest
Potential habitat remaining in study area	6.7 ha	15 ha	At least 93 ha
Potential habitat impacted in subject site	13.4 ha	4 ha (where mistletoe is present in Box Gum Woodland)	26 ha (7.5 good quality dry grass forest supporting breeding resources)
Recorded in locality and wider region.	Yes. South and far east of study area.	Yes. One record within the Jumping Creek Estate	Yes. East of study area. Observed within Cuumbuen Nature Reserve during the March 2013 survey. Known from Queanbeyan River corridor, Googong area, and Jerrabomberra
Recorded during survey	Q	õ	Yes
Vegetation type species likely to occur in within study area	Shrubland, grassland, open woodland, and dry shrub forest south of study area.	Dry shrub forest and woodland (Box Gum Woodland) supporting mistletoe.	Entire length of study area provides potential foraging habitat, however dry grass forest in the middle section of study area and woodland within southern section of study area are most suitable for breeding.
Status	V TSC Act	V TSC Act	V TSC Act
Species	Diamond Firetail	Painted Honeyeater	Gang-gang Cockatoo

Species Impact Statement Ellerton Drive Extension

ngh environmental

85

4733 Final v1.2

Impact level	High (the proposal may result in impact to a permanent population)	Low	Low
Ameliorative Measures	Yes – management of Box Gum Woodland immediately adjacent study area. Included in offset strategy.	No specific measures, but potential habitat indirectly conserved through management of other species.	No specific measures, but potential habitat indirectly conserved through management of other species.
Potential habitat remaining within locality	 > 3000 ha Box Gum Woodland > 7000 ha dry grass forest 	 > 3000 ha Box Gum Woodland > 7000 ha dry grass forest 	 > 7000 ha dry grass forest
Potential habitat remaining in study area	At least 115 ha	At least 115 ha	At least 165 ha
Potential habitat impacted in subject site	26 ha (8.1 ha important habitat where species detected)	20 ha	26 ha (7.5 good quality dry grass forest supporting roosting resources)
Recorded in locality and wider region.	Yes. 1.5 km west and 4 km south and south-east of the subject site. Observed near riparian habitats adjacent the western edge of the current study. Along Barracks Creek below the dam. Along Old Cooma Road. Also at Tralee and Jerrabomberra Creek.	Yes. One record north of the study area. Anecdotal record at a residential property nearby the proposed road corridor.	Yes. 2 km east of study area in Cuumbuen Nature Reserve. Known from Talpa and near Queanbeyan River
Recorded during survey	Yes	ON	Yes. 2 records on 1 night.
Vegetation type species likely to occur in within study area All habitat types of the study area, however recorded north of Queanbeyan River.		All woodland and forest habitat types of the study area.	All habitat types of the study area.
Status	V TSC Act	V TSC Act	V TSC Act
Species	Speckled Warbler	Koala	Eastern False Pipistrelle

Species Impact Statement Ellerton Drive Extension

4733 Final v1.2

ngh environmental

86

Species	Status	Vegetation type species likely to occur in within study area	Recorded during survey	Recorded in locality and wider region.	Potential habitat impacted in subject site	Potential habitat remaining in study area	Potential habitat remaining within locality	Ameliorative Measures	Impact level
Eastern Bent- wing Bat	V TSC Act		Yes. 2 records on 1 night.	Yes. 3.5 km south of the study area along Queanbeyan River. Known near Googong Dam and central Queanbeyan				No specific measures, but potential habitat indirectly conserved through management of other species.	Low
Golden Sun Moth	E TSC Act, CE EPBC Act	Dry forest (Box Gum Woodland) and grassland in the southern section of the study area.	°Z	Yes. South and west of the study area nearby Lanyon Drive (east of the Monaro Highway), Jerrabomberra Valley and Old Cooma Road	4 ha	15 ha	> 3000 ha Box Gum Woodland	No specific measures, but potential habitat indirectly conserved through management of habitat for other affected species.	Low

Species Impact Statement Ellerton Drive Extension

Table 5-3 Summary of clearance impacts

EEC TSC = Endangered Ecological Community listed under Schedule 1 of the NSW TSC Act 1995

CEEC EPBC = listed as Critically Endangered under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999.

CE EPBC = listed as Critically Endangered under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999.

E TSC = listed as Endangered under Schedule 1 of the NSW Threatened Species Conservation Act 1995

E EPBC = listed as Endangered under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999.

V TSC = listed as Vulnerable under Schedule 2 of the NSW Threatened Species Conservation Act 1995.

V EPBC = listed as Vulnerable under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999.



ngh environmental

87

6 IMPACT AMELIORATION

The detailed assessment in Section 5 allowed key impacts and impact amelioration strategies to be distilled for affected species, where required. Management strategies are outlined below in the following categories:

- Measures to avoid impacts, as a first preference
- Measures to mitigate construction impacts of the proposal that cannot be avoided
- Measures to mitigate operational impacts of the proposal that cannot be avoided
- Measures to compensate for residual impacts
- Ongoing monitoring requirements

6.1 AVOIDANCE OF IMPACTS

The proposal has avoided impacts by minimising the footprint of the development to the smallest extent possible whilst still achieving the objectives of the proposal. To further minimise impacts to affected species and communities it is recommended that:

- Where works impact upon the Box-Gum Woodland EEC, fauna habitat in good condition or groups of Hoary Sunray (or in close proximity to groups of plants outside of the subject site), all works would be confined within the final road formation unless it is absolutely necessary to utilise the 5 m buffer area.
- In general, vegetation clearing would be kept to the minimum required. Clearing would comply with QCC guidelines.
- Areas outside of the works area would be clearly demarcated with temporary fencing, flagging tape or similar. No works or movement of equipment or machinery would occur within these areas. Mitigation of Construction impacts

6.1.1 Timing of vegetation clearance

Consideration should be given to completing the vegetation clearing north of the Queanbeyan River in two distinct stages, so that the northern and middle sections of the site are not affected simultaneously. Clearing of the middle section of the proposal, supporting the good quality dry grass forest, would be considered first for clearing due to the abundance of hollow-bearing trees. Removing this section first will encourage fauna to move from this area to adjacent habitat and prevent ongoing disturbance.

Clearing of forest and woodland habitats containing hollow-bearing trees would not occur between the beginning of spring (September) and the end of summer (February) to avoid the breeding period of microbat species and the key nesting time of many bird species including the Gang-gang Cockatoo.

6.1.2 Pre-clearance fauna surveys

The NSW Transport Roads and Traffic Authority (RTA, now Roads and Maritime Services; RMS) has a set of Biodiversity Guidelines for protecting and managing biodiversity on RTA projects (RTA 2011), which document best practice for pre-clearing and fauna management. These guidelines are considered appropriate to manage the impacts of this proposal and include:

Prior to clearing of fauna habitats, searches for fauna are to be conducted by a suitably qualified ecologist:



- Searches would be undertaken within rock habitats and large fallen logs for threatened reptiles, or any other vertebrate fauna. Any animals found would be relocated to nearby suitable habitat.
- Hollow-bearing trees to be removed within the road corridor will undergo a nocturnal preclearing survey by an ecologist prior to being removed (stag watch, spotlight survey and bat detection methods) to determine if hollows are being utilised by arboreal fauna.
- If trees are occupied by fauna, the tree and adjacent trees will be marked and left overnight. Any non-hollow-bearing trees and other vegetation around hollow-bearing trees to be felled will be removed first. At least one day will be left between clearing of surrounding vegetation and the hollow-bearing trees to allow fauna time to vacate the trees.
- If fauna have not moved after being left overnight (as confirmed by an ecologist), the animals are to be captured and released into nearby suitable habitat; or the tree or hollow/s being occupied are to be lowered to the ground to allow animals to be captured and relocated as per below.
- Within any felled tree, all hollows sections are to be lowered to the ground and inspected for resident fauna. A search will be made of the branches around the tree for any fleeing fauna. Any animals within hollows will be removed by the Project Ecologist or NPWS licensed wildlife handler and relocated to nearby habitat. If any animals are injured during the process, they would be assessed by the wildlife handler and rehabilitated and later released if necessary.
- If considered appropriate during the time of capture, the source hollow would be placed appropriately in similar adjoining vegetation to be retained and the captured individuals will be released into the translocated hollow by an appropriately skilled licensed wildlife handler under the supervision of the Project Ecologist.

6.1.3 Relocation of habitat features

All hollow-bearing trees, large logs and rock habitats disturbed during the clearing process would be relocated to nearby habitat in public land, particularly within areas that would be utilised by fauna. The land immediate east and south-east of the subject site is most appropriate. Rocks and logs removed from the subject site may also be used to enhance the habitat value at the entrances of the fauna underpasses.

6.1.4 Soil and drainage

Erosion (including loss of topsoil) and the deposition of sediments, materials and chemicals washed from construction areas, has the potential to degrade flora and fauna habitats. A soil and water management plan would be prepared prior to construction and adaptively managed during construction to ensure that erosion and the movement of sediments outside of the works areas is minimised.

Spill response protocols would be in place to allow for timely and effective containment of hazardous materials and remediation, should a spill occur.

6.1.5 Weed introduction and spread

The movement of vehicles, plant, equipment and personnel on, off and around the subject site, has the potential to introduce new weed species and spread existing infestations. This includes the introduction and spread of exotic perennial grasses into native vegetation communities which is a listed KTP. A strict construction weed control plan would be developed and incorporated into a vegetation management plan for the site (VMP). The weed control plan would include provision for:



- The control of noxious weeds within the subject site prior to the commencement of construction works.
- The cleaning of dirt and vegetation from vehicles and equipment prior to accessing areas of native vegetation on the site and prior to leaving the site, when working in weedy areas particularly the area north of the Queanbeyan River and within the weedy gully within the dry forest community south of the end of the existing Ellerton Drive.
- Ongoing monitoring and control of existing weeds and new introductions throughout the construction phase.

6.1.6 Site rehabilitation

The works will involve the disturbance of areas that are outside of the final road footprint. The Stage 1 works will also include the earth works for the subsequent stage, resulting in large areas of bare ground that will not be developed until Stage 2. A rehabilitation plan would be included within the VMP for the site detailing:

- Methods for rapid and progressive stabilisation of bare soils
- Methods for long-term rehabilitation of disturbed areas not included within subsequent stages of the proposal. This would include details of proposed species to be planted (seed and stock of local provenance is recommended applicable to the relevant vegetation types), proposed planting densities and layout and proposed maintenance and monitoring regimes.
- The timing for all rehabilitation works. Rehabilitation works would commence in a staged approach as soon as construction works in any particular area are completed.

6.1.7 Induction program

Prior to the commencement of any construction activities at the subject site, all workers entering the area will be required to undertake an environmental induction. The induction will highlight the conservation significance of vegetation and habitats and the measures required to avoid unwanted impacts to these areas. In particular, the location of the Box Gum Woodland EEC and the potential for fauna species to occupy hollows during felling would be highlighted.

The induction will be conducted by a qualified ecologist, landscape contractor or Site Manager, familiar with the activities to be undertaken as well as the ecological constraints of the site.

6.2 MITIGATION OF OPERATIONAL IMPACTS

6.2.1 Vegetation/habitat management

Road corridors create a vector for the introduction of invasive species and pollutants to surrounding vegetation communities and fauna habitats. Having increased the edge to area ratio of surrounding habitat, vehicles and motorists may distribute weed seeds on soil, along the length of the road corridor. Weed invasion and pollution has the potential to degrade the Box-Gum Woodland EEC and fauna habitats and cause the decline of the Hoary Sunray within the study area. The following mitigation measures would minimise the potential for impacts from these processes:

- Weed management would be ongoing for the life of the road, included in QCC's routine weed control practices.
- Vegetation within the study area adjacent to the road corridor would be included in all on going management.



- Spill response protocols would be in place to allow for timely and effective containment of hazardous materials and remediation should a spill occur (e.g. herbicides used in weed control).
- Adequate drainage would be provided along the road edges to prevent hydrocarbons from the road surface being washed in to adjacent vegetation during rainfall events.

In addition, the maintenance of appropriate fire regimes is important for maintaining species diversity within the Box-Gum Woodland community, and creating the disturbance necessary for the ongoing survival of the local Hoary Sunray population. It is recommended that a fire management plan be developed in conjunction with the Rural Fire Service (RFS).

6.2.2 Barrier fencing and fauna underpasses

Mortality due to road kill during operation has the potential to affect local fauna species at the subpopulation level. In general, rates of road kill mortality are likely to be directly proportional to the distance of native vegetation/fauna habitat either adjacent to, or crossed by the road. However, other factors such as the design of the road (e.g. raised or not, presence of walls and fences, fauna underpasses) also influence road kill mortality. Crossing structures are generally combined with exclusion fencing or barrier walls (Dodd *et al.* 2004; Olsson and Widen 2008) that attempt to prevent animals from entering a road and funnel them towards the crossing structure.

Fauna exclusion fencing (at least 1.5 m high mesh) to prevent access to the road by fauna would be included as part of the design. The underpasses are primarily required to facilitate movement of the Rosenberg's Goanna, but will also promote movement of smaller fauna, particularly reptiles, possums, wallabies. In this particular case, the prevention of fauna movement across the road is considered the priority rather than facilitating movement through the locality. The proposed road corridor will not fragment any large tracts of vegetation due to the proximity of housing on its western side which supports patchy remnant vegetation in this urban setting. In this scenario, facilitating movement into areas of residential housing has little value, whereas restricting animals to the regional biolink containing large tracts of vegetation that extends east of the proposed road is most appropriate. At a minimum, exclusion fencing would be installed along the length of the good condition dry grass forest habitat.

Fauna underpasses will be incorporated into the design of the road, with the primary aim to prevent isolation to resident fauna on the western side of the road corridor. The fauna underpasses will be situated in areas of higher value habitat, where animal movement is expected to be more prevalent, and where the road adjoins some remnant vegetation on its eastern side.

Two fauna culvert underpasses will be included within the road corridor, but the feasibility of the engineering design will influence their specific placement and design. The locations of the culverts will target the good quality dry grass forest; one at the northern end just south of Taylor Place; and one north of the Queanbeyan River approximately east of Woodman Place. Fauna underpasses are not considered appropriate in other areas of the study area due to the proximity of the road to residential housing or disturbed areas.

The fauna underpasses will be designed in Stage 1 and will include the provisions of natural habitat features including logs, ground timber, and rock piles. The entrances to the underpasses will also include vegetation enhancement and/or rehabilitation with appropriate plantings to improve the connectivity to adjacent habitats and promote movement through the culverts.

The Road Maritime Service (RMS) have model drawings that show standard details of components and construction techniques to be used in road works for fencing, including fauna exclusion fencing.



Additionally, vegetation overhanging barriers that may encourage fauna crossing into the road reserve would be avoided and any plantings within close proximity to the road reserve would be carefully considered so that they do not attract fauna species. For example, Koala feed trees would not be used for plantings in the road reserve.

6.2.3 Advisory road signs

Road signs signifying the presence of goannas, kangaroos and wallabies would be considered, especially nearby the fauna underpasses with the aim of minimising collisions with fauna through increased motorist awareness. In particular, the dry forest habitat is most suitable for goannas and signs should be installed in this area also. Within the dry forest habitat speed limits, would be reduced to 80 km/h to further minimise collision risks.

6.3 COMPENSATORY STRATEGY

Residual impacts to the affected species and communities will be mitigated through an offset developed by QCC in consultation with OEH. A strategy to develop this plan is included with this SIS as Appendix H. The Offset Strategy sets out three pathways to identify, manage and secure an offset in perpetuity:

- 1. Proposing a predetermined set ratio of habitat area impacted to that to be offset for subject species and communities affected by the proposal. An offset site would then be selected meeting these requirements.
- 2. Employing the OEH endorsed BioBanking assessment methodology (BBAM) to calculate the credits required by the development with regard to subject species and communities affected by the proposal and retire these credits through the BioBanking scheme.
- 3. Using the BBAM to determine the suitability of a proposed offset site by comparing the credits required at the development site to those generated at a proposed offset.

A methodology has yet to be decided upon and an offset site yet to be identified, but it is considered likely that there are adequate credits available for purchase or land of a suitable type and size within the local area available for offsetting. The strategy requires input from OEH and landholders prior to any impacts occurring. It is anticipated that this strategy would be developed further into a final offset package, prior to commencement of construction works. Offsets would be finalised within 12 months of the start of construction.

6.4 ONGOING MONITORING

6.4.1 Fauna monitoring

A monitoring program should be implemented to determine the effectiveness of mitigation measures for fauna including:

- The utilisation of fauna underpasses by fauna and maintenance of their condition
- The effectiveness and maintenance of exclusion fencing
- The number of native fauna killed or injured by vehicle collisions, in particular the Rosenberg's Goanna
- The condition of the Box Gum woodland immediately adjacent the southern section of the study area, to ensure weed ingress and edge effects were not affecting the habitat quality of this area for threatened woodland birds, particularly the Speckled Warbler



7 FEASIBLE ALTERNATIVES AND JUSTIFICATION FOR THE PROPOSAL

The proposed construction of a 4.6 kilometre extension of Ellerton Drive in Queanbeyan has been identified as having potential to generate an impact for a number of species and a community listed under threatened species legislation (NSW and Commonwealth). Section 5 characterised the impacts for each entity, specific to local ecology. Section 6 outlined feasible management strategies to avoid impacts where possible, mitigate and offset residual impacts, as part of the design and implementation of the proposal. This section considers the justification for the residual mitigated impacts, in light of feasible alternatives to the proposal and the overall need for the proposal.

7.1 DO NOTHING APPROACH

The 'do nothing' approach (not developing the Ellerton Drive extension) would avoid impacts to affected species and communities however, would not provide the necessary transport infrastructure to accommodate the future transport demands of the Queanbeyan area. Pressures on existing roads would continue to increase, eventually exceeding the capacity of the current road network. This would cause substantial traffic congestion and delays and ultimately restrict the growth potential of the Queanbeyan area.

7.2 ALTERNATIVES

Feasible alternative routes for the Ellerton Drive Extension have been previously assessed as part of traffic studies completed for the Queanbeyan LGA. A main feature of the road network in Queanbeyan is that the lack of river crossings forces most traffic through the central business district (CBD). This has long been recognised and a series of studies were undertaken to identify the best means of addressing this problem:

- PG Pak-Poy and Associates Pty Ltd (1973) Report "Queanbeyan Traffic Report" identified the general route of Edwin Land Parkway/Ellerton Drive
- PJ Nairn and Partners (1985) Report "The Queanbeyan Road System Review"
- Highlighted the need for Edwin Land Parkway Bypass / Ellerton Drive
- Ove Arup and Partners and RTA Investigation (1993 to 1996)
- Queanbeyan Origin Destination Surveys, (NSW RTA 1993)
- Queanbeyan Traffic Management Study (Ove Arup and Partners, April 1995)
- Queanbeyan Ring Road Study (Ove Arup and Partners, September 1995) including an addendum report "Queanbeyan ring road study addendum report, tunnel option: transport assessment, March 1996"
- ERM Mitchell McCotter Report "Queanbeyan Ring Road Route Selection Study Draft report, February 1997
- RTA Studies (1991 & 2001)
- Report "Queanbeyan Heavy Vehicle Usage of Monaro Street, November 1999". This study identified strategies for future augmentation of a ring road network and identified Edwin Land Parkway as a key transport link. The recommendations made in this report was presented to Council in a business paper and adopted.
- Report "Queanbeyan Heavy Vehicle Usage of Monaro Street. Addendum Benefit Cost Analysis, March 2001"



 Gabities Porter Pty Ltd (June 2009) – Report "Queanbeyan 2031 Transport Report Overview"

The option of a Northern Bypass (proposed by QCC) to divert traffic around the existing busy Queanbeyan CBD and reduce congestion on Monaro Street and the Queens Bridge was rejected by the Roads and Traffic Authority (RTA) now RMS advised that the Northern Bypass Alignment was too expensive at this time. The report states *"The benefits gained by the northern traffic diversion were currently insufficient to warrant any project including the northern bypass"*.

7.3 JUSTIFICATION FOR THE PREFERRED APPROACH

The report by Gabities Porter Pty Ltd (2009) identified, "*Clearly, the parts of Queanbeyan under most stress are Old Cooma Road, Cooma Street, Queens Bridge and parts of Yass Road*". The report shows that Ellerton Drive construction (in a 2 lane configuration) is required to join Existing Ellerton Drive in east Queanbeyan and the recently constructed Edwin Land Parkway Stage 2 at the intersection with Old Cooma Road by 2021. This will reduce traffic on the Queens Bridge and Cooma Street back to acceptable levels of Service in the future.

The road extension will provide a bridge across Queanbeyan River at a level greater than a 1:100 year flood event, as currently both existing bridges in Queanbeyan are cut off in a 1:100yr storm event separating East Queanbeyan from the rest of Queanbeyan. The latest storm event that closed the Main road in Queanbeyan (Monaro Highway) and Queens Bridge was December 2010.

The road extension is located on the existing residential zoned boundaries with this road forming the boundary between residential areas and bush land with the exemption of the proposed Jumping Creek Subdivision and parts of Barracks Creek where the proposed road (and existing road corridor) already cuts the exiting subdivision layout.

The road will also act as an Asset Protection Zone for rural fire fighting, providing an additional line of defence prior to fire reaching the existing dwellings of Greenleigh and provide residences with an optional evacuation route.

In addition, the road corridor provides the necessary alignment for planned infrastructure as follows:

- Nine Inch High Pressure Gas Main (Jemena). It is possible that the recently installed Gas Main will be extended to provide adequate supply to the existing residences of Barracks Flat and then onto the proposed Jumping Creek Development located off the future Ellerton Drive extension just east of the Queanbeyan River.
- Additional Telstra cable for the new NBN Network which will soon roll out through Queanbeyan as well as to the proposed Jumping Creek Development. This is required to supplement existing communication systems and meet future demands.
- The road is located partially within the cleared easement for the existing high voltage power line crossings
- The road adjoins the cleared easement for the ACTEW Googong water main (supplying Canberra) and the cleared easement for Queanbeyan City Council Water supply from the Greenleigh Water reservoir through to Old Cooma Road including an existing crossing of the Queanbeyan River.





In response to the growing population and increased suburbanisation within the Queanbeyan LGA, the Council is conscious of their role in providing appropriate traffic and transport infrastructure within the region. The proposal would enable council to fulfil this role and is considered justified on this basis.



8 ASSESSMENT OF SIGNIFICANCE

Assessments of significance (seven-part tests) of the mitigated impacts of the proposal on affected species and communities have been completed and are included as Appendix I. Where applicable, significant impact assessments have also been undertaken with regard to communities and species listed under the EPBC Act. A summary of these assessments is given in Table 8-1.

The assessments concluded that the proposal will have a significant impact on the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland EEC/CEEC and Rosenberg's Goanna and Speckled Warbler. No significant impacts are considered likely for other species affected by the proposal.

Species/community affected	Status	Significant impact?
Flora		
Hoary Sunray (Leucochrysum albicans var. tricolor)	E EPBC	No
Community		
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	EEC TSC / CEEC EPBC	Yes
Fauna		
Pink-tailed Worm Lizard (Aprasia parapulchella)	V TSC / V EPBC	No
Rosenberg's Goanna (Varanus rosenbergi)	V TSC	Yes
Brown Treecreeper (eastern subspecies) (<i>Climacteris picumnus victoriae</i>)	V TSC	No
Scarlet Robin (Petroica boodang)	V TSC	No
Hooded Robin (South eastern form) (<i>Melanodryas cucullata cucullata</i>)	V TSC	No
Diamond Firetail (Stagonopleura guttata)	V TSC	No
Painted Honeyeater (Grantiella picta)	V TSC	No
Gang-gang Cockatoo (Callocephalon fimbriatum)	V TSC	No
Speckled Warbler (Pyrrholaemus saggitatus)	V TSC	Yes
Koala (Phascolarctos cinereus)	V TSC	No
Eastern False Pipistrelle (Falsistrellus tasmaniensis)	V TSC	No
Eastern Bent-wing Bat (Miniopterus schreibersii oceanensis)	V TSC	No
Golden Sun Moth (Synemon plana)	E TSC / CE EPBC	No

Table 8-1 Summary of the conclusions of assessments of significance

EEC TSC = Endangered Ecological Community listed under Schedule 1 of the NSW TSC Act 1995

CEEC EPBC = listed as Critically Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.*

CE EPBC = listed as Critically Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act* 1999.



E TSC = listed as Endangered under Schedule 1 of the NSW Threatened Species Conservation Act 1995

- E EPBC = listed as Endangered under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999.
- V TSC = listed as Vulnerable under Schedule 2 of the NSW Threatened Species Conservation Act 1995.

V EPBC = listed as Vulnerable under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999.


9 ADDITIONAL INFORMATION

9.1 QUALIFICATIONS AND EXPERIENCE

Name and role	Specialist skills and abilities
Dave Maynard BSc Biological Ecology (Hons1) Botanist	Dave is part of nghenvironmental's biodiversity team and specialises in flora assessment. Dave has been involved in a range of projects including constraint and biodiversity impact assessment for major solar and wind farm projects. Dave has also conducted biodiversity and environmental impact assessments for sewerage, power line, communications and road infrastructure and commercial and residential developments. Dave also has extensive experience in GIS mapping and analysis.
Report preparation, Field work	Dave has conducted numerous botanical surveys within several biogeographic areas of NSW including the south-east coast, southern and northern tablelands and western slopes, alpine areas and the north-western plains. He has extensive experience in floristic survey planning and design incorporating methodologies such as rapid site assessment, transects, random meanders, standardised quadrats, Biometric plots and OEH's Grassy Ecosystem Assessment methodology. He has worked on a number of offset packages and is experienced in the application of the BioBanking methodology. Dave has also conducted numerous targeted surveys for threatened flora species listed under state and federal legislation in a wide range of habitats.
	Throughout his professional career, Dave has gained experience working for public and private organisations in project management, environmental management planning, community engagement and working with local Indigenous communities. Dave is also a qualified Aircraft Engineer and has a sound understanding of engineering principles and design.
Deb Frazer BAppSc Biodiversity Management (Hons) Senior Ecologist Report preparation, Field work	Deb has over 8 years experience as an ecologist and within biodiversity assessment, including several major project assessments. Deb's positions have included management and senior roles, as well as educational and wildlife research assistant positions. Deb has experience in impact assessment and fauna survey projects throughout southern NSW and South Australia. Deb has broad knowledge and demonstrated skills in environmental management; coordinating and delivering environmental programs / plans; assessment of development proposals; preparation of biodiversity and management plans and monitoring programs. In particular Deb is skilled in interpretation and application of legislation and statutory controls; stakeholder, contractor, and client consultation; design and execution of field work; data collection and analysis; and reporting (verbal and written).
Bianca Heinze BSc (ERM, coastal management) Ecologist Field work	Bianca specialises in fauna assessment. Bianca has been involved in complex infrastructure projects in a range of biogeographic areas, including wind farms, highway realignments and power transmission alignments in New South Wales, South Australia and Western Australia. She has prepared constraint and biodiversity assessments for projects approved Part 3A of the NSW <i>Environmental Planning and Assessment Act 1979</i> and referrals under the Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> . Bianca also undertakes general environmental impacts assessment including Review of Environmental Factors and Environmental Assessments and has been involved in a variety of projects such as municipal water treatment plants, power line upgrades, residential and commercial developments. Bianca has been involved with surveys for marine and terrestrial mammals, birds, reptiles and microbats.



Name and role	Specialist skills and abilities
Jackie Miles BSc (Hons) Senior Botanist Field work	Jackie is an experienced senior botanist and has worked on a number of large assignments including botanical surveys for the Comprehensive Regional Assessment which included full CRA floristic field validation for the Department of Environment and Climate Change (formerly NPWS). She also assisted in the preparation of the Vegetation Map for South East Forests National Park, botanical surveys for mapping of all NSW ski resort areas (for Planning NSW), surveys of significant remnant grassy vegetation for Bega Valley Shire Council, and a large number of botanical and fauna assessments for minor and major development proposals. She has provided training for Council planning and works staff and local extension staff in interpretation and conservation significance of remnant vegetation. Jackie has also worked in the Hunter area, and has carried out surveys on Hawkesbury sandstone.
	Jackie has also written a number of publications and reports including State of the Vegetation Report for the Bega Valley Shire, Remnant Grassy Vegetation on Public Land in Bega Valley Shire and Weeds of the NSW South Coast, A Guide to Identification and Control. She produced the text and photos for the website www.esc.nsw.gov.au/weeds/ and co-authored the Guide to Revegetation in the Bega Valley Shire and the paper Vascular Flora of the South East Forests Region, NSW (published in the journal of plant ecology Cunninghamia).
Freya Gordon BSc (Hons) Senior Ecologist Fieldwork	Freya Gordon is a senior ecologist with nghenvironmental. Projects she has managed and implemented include a microbat monitoring program for the Holbrook Bypass (RTA); a Squirrel Glider monitoring program for the Albury Bypass (Conneq); and multiple ecological assessments and constraints analyses for Stockland, RMS, Lake Coal, Epuron, and local councils. Freya has recently completed an Environmental Assessment for a Solar Farm in western NSW including a detailed investigation of the status of the Grey-crowned Babbler on the site and surrounding study area. Freya has designed and coordinated a Striped Legless Lizard (Delma impar) monitoring program for Infigen Energy, completed a Pest Bird Management Plan for Bathurst Regional Council, and an EIS for a dam upgrade at Tamworth, including liaison with OEH and DSEWPaC and preparation of an EPBC referral. Her work requires experience in Commonwealth and State environmental legislation, policies and standards. Prior to joining nghenvironmental she worked for the Institute of Wildlife Research, The University of Sydney, designing, managing and implementing survey programs for a range of species. She has conducted shorebird monitoring for Birds Australia, wildlife monitoring for Sydney Airport Corporation Limited, and managed large scale field programs in the Simpson Desert for the University of Sydney Desert Ecology Research Group. Freya has excellent report writing and communication skills and works efficiently as part of a team or independently.
Brooke Marshall Bachelor of Natural and Resource Management (Hons) Project Manager Senior review	Brooke is Certified Environmental Practitioner (CEnvP) and manages the project work undertaken by the Bega office of ngh environmental. Brooke also undertakes project work and has increasingly focused on large-scale infrastructure environmental assessment and management and strategic biodiversity assessment. She has prepared large infrastructure project environmental assessments, co- coordinating the timely preparation and incorporation of specialist reports to the Department of Planning, under Part 3A of the NSW <i>Environmental Planning and</i> <i>Assessment Act 1979</i> . She has prepared and coordinated construction and operational environmental management plans for energy and linear infrastructure development. She has prepared referrals under the Commonwealth Environment Protection Biodiversity Conservation Act 1999. Brooke is also an accredited BioBanking assessor and has undertaken BioBanking assessments and prepared offset plans under this scheme in NSW.



9.2 OTHER APPROVALS REQUIRED FOR THE DEVELOPMENT

Approvals and legislation that apply to the proposal are described in Table 9-1 below.

Table 9-1 Approvals, legislation and policy applicable to the proposal

Law, Policy or Regulation	Objective	Requirement for the Proposal
Commonwealth Law		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act protects the environment, particularly matters of National Environmental Significance (MNES). It streamlines the national environmental assessment and approvals process, protects Australian biodiversity (including threatened flora, fauna and communities) and integrates management of important natural and cultural places. Approval by the Environment Minister is required if an action is likely to have a significant impact on a matter of national environmental significance.	This SIS assesses the potential for the proposal to impact on MNES. Matters of National Environmental Significance relative to the proposal include the Box-Gum Woodland CEEC and the Hoary Sunray. EPBC Act significant impact assessments are included as Appendix I.2 and have concluded the proposal is likely to have a significant impact on the Box-Gum Woodland CEEC and as such a referral to the minister is considered to be required.
State Law		
Environmental Planning and Assessment Act 1979 (EP&A Act)	Provides for a co-ordinated approach to development ensuring the proper management, development and conservation of natural and cultural resources and promoting social and economic welfare and a better environment. Central themes are to ensure protection of the environment, ecologically sustainable development, promotion of shared responsibility for environmental planning between the different levels of State government and increased opportunities for public participation. All development in NSW must consider this Act.	The proposal requires approval under Part 5 of the EP&A Act. Council and OEH are the joint approval authorities. A review of Environmental factors (REF) will be required for the proposal.



Law, Policy or Regulation	Objective	Requirement for the Proposal		
Threatened Species Conservation Act 1995 (TSC Act)	Under the EP&A Act, the impact of the proposal on threatened species must be considered. The Act specifies seven factors which must be considered by decision makers regarding the effect of a proposed development or activity on threatened species, populations or ecological communities, or their habitats. These factors form part of the threatened species assessment process under the EP&A Act and are collectively referred to as an Assessment of Significance. If the seven- part test determines that there is likely to be a significant effect, then the proposal must be modified to remove the potential for this impact, or a Species Impact Statement (SIS) must be prepared and the concurrence of the Director-General of the Department of Premier and Cabinet (which includes the OEH) obtained by the consent authority prior to determination.	Following the preparation of the SIS, concurrence of the Director-General of the Department of Premier and Cabinet (which includes the OEH) needs to be sought by the council prior to determination.		
Fisheries Management Act 1994 (FM Act)	The objects of this Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. In particular, to conserve fish stocks and key habitats, to conserve threatened species, populations and ecological communities (including marine vegetation), and to promote ecologically sustainable development. The FM Act works in conjunction with the EP&A Act. If the following activities form part of a proposal, a permit from DPI under the FMA Act is required: • Aquaculture • Dredging or reclamation • Harm marine vegetation (mangrove, seagrass, seaweed) • Obstruct free passage of fish	A permit from the Minister for Primary Industries would be required under section 200 of the FM Act for a local government authority to undertake any excavation within 'water land' as defined in the FM Act. The development of a bridge across the Queanbeyan River would be likely to trigger the requirement of such a permit. A permit may be required to temporarily block fish passage under section 219 of the Fisheries Management Act 1994. Such works may include the bunding of waterways during bridge or culvert construction, use of silt fences across waterways and other similar works.		
Water Management Act 2000 (WM Act)	Under the WM Act a controlled activity approval is required from the NSW Office of Water for certain types of developments and activities that are carried out on 'waterfront land' (i.e. in or within 40 metres of a river, lake or estuary). Public authorities and Councils are, however, exempt from requiring a controlled activity approval under Clause 38 of the Water Management (General) Regulation 2011.	While public authorities such as QCC are exempt from the requirement for approval under this Act for works in and near waterways, guidelines issued by the (then) Department of Water and Energy are useful for applying Government objectives for watercourse protection. Relevant guidelines relate to the riparian zone, instream works, outlet structures and vegetation management.		



9.3 LICENSING MATTERS RELATING TO FLORA AND FAUNA SURVEYS

During the survey period, **ngh**environmental held a current Section 132C Scientific Licence (Number SL100682) under the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys, as issued by the NSW OEH. **ngh**environmental also hold current Animal Care and Ethics Committee Certificates of Approval to conduct animal research under the general working operations of an environmental consultancy under the *Animal Research Act 1985*.



10 REFERENCES

- Allen, C. (2002). Distribution Surveys, Habitat Assessment and Management Recommendations for the Koala (Phascolarctos cinereus) in the Shoalhaven Gorge Region. NSW National Parks & Wildlife Service, Queanbeyan.
- Barea, L.P. (2008) 'Nest-site selection by the Painted Honeyeater (*Grantiella picta*), a mistletoe specialist' *Emu*, 108: 213-220
- Barea, L. P. (2012) 'Habitat influences on nest-site selection by the Painted Honeyeater (*Grantiella picta*): do food resources matter?' *Emu* 112: 39-45
- Berry, L. (2001) 'Edge effects on the distribution and abundance of birds in a southern Victorian forest', *Wildlife Research*, 28: 239 245
- Bionet (2012) *Bionet Atlas of NSW Wildlife records for Murrumbidgee CMA, Monaro subregion 2012*, Office of Environment and Heritage
- Bushfire and Environmental Service (BES) (2007). Flora and Fauna Assessment Proposed Deviation of Old Cooma Road, Googong. A report for Canberra Investment Corporation Ltd on behalf of Queanbeyan City Council.
- Bushfire and Environmental Services (BES) (2008) Biodiversity Study Findings Report Queanbeyan Local Government Area. A report for Queanbeyan City Council.
- Biosis (2003a) Final Draft: Flora and fauna habitat assessment at 300 Lanyon Drive (Poplars). Biosis.
- Biosis (2003b) Natural Heritage Assessment of 'Tralee' Queanbeyan, NSW. Biosis.
- Churchill, S (2008). Australian Bats. Allen and Unwin, Crows Nest, NSW.
- Clarke, G.M. & C. O'Dwyer (2000). Genetic variability and population structure of the endangered golden sun moth, *Synemon plana*. *Biological Conservation*. 92:371-381.Cropper, S.C. (1993). *Management of Endangered Plants*. East Melbourne, Victoria: CSIRO.
- Cogger, H. (2000). Reptiles and Amphibians of Australia 6th edn. Reed New Holland Australia.
- Cropper, S.C. (1993). Management of Endangered Plants. East Melbourne, Victoria: CSIRO.
- DEC (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities.
- DECC (2007). Threatened Species Assessment Guidelines: The assessment of significance. Department of Environment and Climate Change, Sydney NSW.
- DECC (2008) BioMetric 2.0 A Terrestrial Biodiversity Assessment Tool for the NSW Native Vegetation Assessment Tool Operational Manual. Department of Environment and Climate Change, July 2008.
- DECC (2008) *Recovery Plan for the koala* Phascolarctos cinereus, Department of Environment and Climate Change, Sydney NSW
- DEWHA (2009). Background paper to EPBC Act Policy Statement 3.12 Nationally Threatened Species and Ecological Communities. Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*). Department of the Environment, Water, Heritage, and the Arts.
- Dodd, D., Barichivich, W., Smith, L. (2004). Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily travelled highway in Florida. *Biological Conservation*, 118, 619-631
- DSEWPaC (2012) EPBC Act Environmental Offsets Policy. Department of Sustainability, Environment, Water, Populations and Communities. Available from

http://www.environment.gov.au/epbc/publications/environmental-offsets-policy.html [accessed March 2013]

- DSEWPaC (2013) Species Profile and Threats Database. Department of Sustainability, Environment, Water, Populations and Communities. Available from: http://www.environment.gov.au/cgibin/sprat/public/sprat.pl [accessed March 2013]
- Ecological Australia (ELA) (2010a) Draft Species Impact Statement Old Cooma Road Realignment and Duplication Queanbeyan. Report prepared for Brown Consulting and Queanbeyan City Council.
- Ecological Australia (ELA) (2010b) Draft Flora and Fauna Assessment Rezoning Investigations, Jumping Creek Estate, Queanbeyan. A report for Canberra Investment Corporation Ltd on behalf of Queanbeyan City Council.
- Fallding, M. 2002. A Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands. Natural Heritage Trust, NSW National Parks and Wildlife Service and Land & Environment Planning.
- Gabites Porter (2010) Googong and Tralee Traffic Study (2031). Report prepared for Queanbeyan City Council.
- Gardner, J. L. (2004). Winter flocking behaviour of speckled warblers and the Allee effect. *Biological Conservation*, 118, 195-204.
- Garnett, S. and Crowley, G.M. (2000) The Action Plan for Australian Birds, Environment Australia. Canberra, ACT
- Gellie, N.J.H. 2005. Native vegetation of the southern forests: South-east Highlands, Australian Alps, South-west Slopes and South-east Corner bioregions. Cunninghamia 9, 219-254.
- GHD. (2009). Species Impact Statement, Report for Edwin Land Parkway Extension, Queanbeyan. Report prepared for Queanbeyan City Council.
- Giffney, R.A., Russell, T., and Kohen, J.L. (2010) 'Age of road-killed common brushtail possums (*Trichosurus vulpecula*) and common ringtail possums (*Pseudocheirus peregrinus*) in an urban environment' Australian Mammalogy, 31: 137-142
- Harden, G.J. (ed) (1990-2002) Flora of New South Wales, Vols 1-4. New South Wales University Press.
- Hayes, I.F. and Goldingay, R.L. (2009) 'Use of fauna road-crossing structures in north-eastern New South Wales' Australian Mammalogy, 31: 89-95
- Hills Environmental (2012) Review of Environmental Factors Addendum [online], report prepared for Roads and

 Maritime
 Services,
 Wollongong.
 Available
 at

 <a href_addendum_kinghorne_wwrd.pdf [accessed 4 December 2012]
- Hobday, A.J. (2010) 'Nighttime driver detection distances for Tasmanian fauna: informing speed limits to reduce roadkill' *Wildlife Research*, 37: 265-272
- Hogg, D. (2008). Scoping Assessment Old Cooma Road Realignment Review of Environmental Factors. Report for Queanbeyan City Council.
- Joint ANZECC-MCFFA National Forest Policy Statement Implementation Sub-committee (JANIS) (1997) Nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia, prepared by the Technical Working Group on Reserve Criteria, Australian Government
- Koch, A.J. (2008) 'Errors associated with two methods of assessing tree hollow occurrence and abundance in Eucalyptus obliqua forest, Tasmania', *Forest Ecology and Management* vol. 255; 674–685

- Mackowski, C. (1984). The ontogeny of hollows in Blackbutt, Eucalyptus pilularis and its relevance to the management of forests for possums, gliders and timber. In 'Possums and Gliders'. (Eds AP Smith and ID Hume) pp. 517-525. (Surrey Beatty and Sons: Sydney).
- Nash, K. and Hogg, D. (2010) Review of Environmental Factors Old Cooma Road Realignment. Report to Queanbeyan City Council in association with Brown Consulting.
- **ngh**environmental (2010) Offset Plan Old Cooma Road Duplication. Report prepared for Brown Consulting and Queanbeyan City Council.
- Noske, R.A. (1991) 'A demographic comparison of cooperatively breeding and non-cooperative treecreepers (Climacteridae)' *Emu* 91, 73-86
- Natural Resource Atlas (NRAtlas) (2013) Groundwater bore layer available from: http://www.nratlas.nsw.gov.au/wmc/custom/homepage/home.html [accessed March 2013]
- NSW Scientific Committee (SC) (2002) *White box yellow box Blakely's red gum woodland Endangered ecological community listing*, available from: http://www.environment.nsw.gov.au/determinations/BoxgumWoodlandEndComListing.htm [accessed March 2013]
- Office of Environment and Heritage (2011) Plant Communities of the South Eastern Highlands and Australian Alps within the Murrumbidgee Catchment of New South Wales. Version 1.1. Technical Report. A Report to Catchment Action NSW. NSW Office of Environment and Heritage; Department of Premier and Cabinet, Queanbeyan.
- OEH (2012) Biometric vegetation types database. NSW Office of Environment and Heritage, May 2012.
- OEH (2012) NSW Threatened Species [online], NSW Office of Environment and Heritage. Available from: http://www.environment.nsw.gov.au/threatenedspecies/ [accessed November – December 2012]
- Oliver, D., Chambers, M.A. and Parker, D.G. (2003) 'Habitat and resource selection of the Painted Honeyeater *(Grantiella picta)* on the northern floodplains region of New South Wales' *Emu*, 103: 171-176
- Olsen, J. and Fuentes, E. (2005) 'Collapse in numbers of breeding Little Eagles in the Australian Capital Territory' *Canberra Bird Notes*, 30: 4: 141-145
- Olsen, J., Osgood, M., Maconachie M., Dabb, G. (2008) 'Numbers of breeding Little Eagles *Hieraaetus morphnoides* in the Australian Capital Territory in 2007' *Canberra Bird Notes*, 33: 2: 77-80
- Olsson, M.P.O & Widen, P. 2008: Effects of highway fencing and wildlife crossings on moose *Alces alces* movements and space use in southwestern Sweden. Wildlife Biology, 14, 111-117.
- Phillips, S. and Callaghan, J. (2011) 'The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus' Australian Zoologist*, 35: 3: 774-780
- Pizzey, G. & Knight, F. (2003) A Field Guide to the Birds of Australia. Harper Collins Publishers, Sydney.
- Reed, P.C., Lunney, D. and Walker, P. 1990. 'A 1986–1987 survey of the koala Phascolarctos cinereus (Goldfuss) in New South Wales and an ecological interpretation of its distribution'. Pp. 55–74 in Biology of the Koala. Lee, A.K., Handasyde, K.A. and Sanson, G.D. (eds). Surrey Beatty & Sons, Sydney.
- Rehwinkel, R. (2007) A Method to Assess Grassy Ecosystem Sites: Using floristic information to assess a sites quality. NSW Department of Environment and Climate Change, Southern Branch.
- Robinson, D. 1994. Research plan for threatened woodland birds of south-eastern Australia. Arthur Rylah Institute for Environmental Research Technical Report 133.
- Roger, E., Laffan, S.W., Ramp, D. (2010) 'Road impacts a tipping point for wildlife populations in threatened landscapes' *Population ecology*, DOI 10.1007/s10144-010-0209-6



- RTA (2011). Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects Revision 0/September 2011. RTA Environment Branch.
- Russel, T.C., Herbert, C.A., Kohen, J.L. (2009) 'High possum mortality on urban roads: implications for the population viability of the common brushtail and the common ringtail possum' *Australian Journal of Zoology*, 57: 391-397
- Schodde, R. and Tidemann, S. C., Eds. (2007) *Readers Digest Complete Book of Australian Birds*, 2nd edition, Readers' Digest (Australia) Pty Ltd, NSW.
- Sinclair, S.J. (2011) National Recovery Plan for the Hoary Sunray Leucochrysum albicans var. tricolor. Victorian Department of Sustainability and Environment (DSE), Melbourne.
- Simpson, K., and Day, N. (1999). Field Guide to the Birds of Australia. Viking Publishing, Australia.
- SWIFFT (2011) Rosenbergs Goanna, [online] South West Integrated Flora & Fauna Team, Department of

 Sustainability
 & Environment,
 Victoria.
 Available
 from:

 http://bird.net.au/bird/index.php?title=Rosenbergs Goanna [accessed 4 December 2012]
- Strahan, R. (ed). (1995) The Mammals of Australia. Reed Books, Australia.
- Taylor, B.D. and Goldingay, R.L. (2010) 'Roads and wildlife: impacts, mitigation and implications for wildlife management in Australia' *Wildlife Research* 37: 320-331
- Taylor, B.G. and Goldingay, R.L. (2004) 'Wildlife road-kills on three major roads in north-eastern New South Wales' *Wildlife Research* 31: 83-91
- Thomas V, Gellie N, Harrison T (2000) Forest Ecosystem Classification and Mapping for the Southern CRA Region, report for the NSW CRA/RFA Steering Committee, Project No. NS 08EH. NSW National Parks and Wildlife Service, Queanbeyan
- Triggs, B. (1996) *Scats, tracks and other traces: a field guide to Australian mammals,* Oxford University Press, South Melbourne
- Weavers, B.W. (1993) 'Home Range of Male Lace Monitors, *Varanus varius* (Reptilia: Varanidae), in Southeastern Australia' *Wildlife Research*, 20: 303-11
- Watson, J., Freudenberger, D., Paull, D., (2001). An assessment of the focal-species approach for conserving birds in variegated land-scapes in southeastern Australia. *Conservation Biology* 15, 1364–1373.





APPENDIX A DGRS FOR THE PROPOSAL



Your reference: SF120328/06Our reference: FIL12/6177 DOC12/25378Contact: Allison Treweek 62297082

Applicant(s):

QUEANBEYAN CITY COUNCIL, Trading as QUEANBEYAN CITY COUNCIL, ABN 12 842 195 133, PO BOX 90, QUEANBEYAN NSW 2620 STANDARD POST

Dear Sir/Madam

DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR THE PROPOSED ELLERTON DRIVE EXTENSION

Issued pursuant to s. 111 Threatened Species Conservation Act 1995

Thank you for your letter dated 30TH May 2012 and received by the Department of Premier and Cabinet, Office of Environment and Heritage (OEH) on 30-May-2012 requesting Director-General's (DGRs) requirements for a species impact statement (SIS) for the proposal cited above. Please find enclosed a copy of the DGRs (Attachment A) issued on behalf of the Director General.

The purpose of a SIS is to:

- allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration for adverse impacts resulting from the proposal;
- assist consent and determining authorities in the assessment of a development application under Part 4 or request for Part 5 approval under the Environment Planning and Assessment Act 1979 (EP&A Act);
- assist the Director-General of the Department of Premier and Cabinet, OEH in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- assist the Director-General of the Department of Premier and Cabinet, OEH or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act;
- assist the Director-General of the Department of Premier and Cabinet, OEH in the assessment of Section 91 Licence applications lodged under the TSC Act.

OEH understands that Council is, or will in the future be, considering a development application for this site. To assist Council with the development assessment process, OEH provides the following information.

Referrals

Whilst OEH is unable to provide comment on draft SISs in their entirety, OEH will provide comment to proponents and their consultants on key issues arising in the drafting process. The ability of OEH to provide such advice is dependent on the availability of OEH resources and on other statutory priorities.

Please note that it is the determining or consent authority's responsibility to ensure that a draft or final SIS complies with the requirements issued by the Director-General. OEH is not available to perform this function on Council's behalf.

<u>Concurrence</u>

If Council decides to determine the development application by way of approval following a review of the final SIS lodged by the applicant, then the concurrence of the Director-General of OEH is required before consent can be granted. A concurrence application is not required should Council decide to refuse the development application.

Concurrence applications to OEH should be accompanied by:

- 1. Two copies of the SIS;
- 2. A copy of any preliminary flora and fauna assessment undertaken (i.e. the report addressing the assessment of significance that triggered the requirement for the SIS);
- 3. A copy of the development application;
- 4. A copy of Council's determination report recommending that consent be granted for the development application and the conditions of that proposed consent;
- 5. A copy of any submissions or objections received by Council concerning the development application;
- 6. A copy of any other supporting information lodged in support of the development application including social and economic impact assessments; and
- 7. in accordance with s.252A of the *Environmental Planning and Assessment Regulation* 2000 (EP&A Regulation) (as amended).

<u>Advertising</u>

Council is reminded that in accordance with clauses 86 – 91 of the EP&A Regulation, development that is considered to be "*threatened species development*" is classified as a form of "*advertised development*" requiring the consent authority to give written and published notice of the development application.

Other Information

If OEH grants concurrence to Council's determination report, then OEH would appreciate a copy of the development consent issued by Council to the applicant. OEH would use this information to monitor the type and number of consents being issued which affect threatened species, populations or ecological communities.

OEH would also like to mention the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act requires the approval of the Federal Minister for the Environment (in addition to any State or Local Government approval or determination) for an action that will have, or is likely to have, a significant impact on a matter of national environmental significance. Threatened species and communities listed by the EPBC Act are considered to be a matter of national environmental significance.

Many of the species and ecological communities listed in the *Threatened Species Conservation Act 1995* (NSW) are also listed in the Commonwealth EPBC Act. Further information regarding the operation of the EPBC Act (including Federally listed threatened species and communities) may be obtained from the website of the Commonwealth Department of Environment and Water Resources www.dewr.gov.au or by contacting the department on 1800 803 772.

Should you require any additional information please contact Allison Treweek, Regional Biodiversity Conservation Officer, on (02) 62297082.

Yours sincerely

Ms Sandie Jones A/Manager Landscape & Aboriginal Heritage Protection South (by Delegation) Dated: 22-Jun-2012

ATTACHMENT A

DIRECTOR GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT ELLERTON DRIVE EXTENSION QUEANBEYAN

INTRODUCTION

The purpose of a Species Impact Statement (SIS) in the development assessment process as it relates to your application is:

- to allow you, as applicant, to identify the issues pertaining to threatened species, populations, ecological communities or their habitats, and provide appropriate amelioration for adverse impacts resulting from the action; and
- to assist the consent or approval authorities in the assessment of your proposal pursuant to the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

Section 111(1) of the *Threatened Species Conservation Act 1995* (TSC Act) requires that it must be either the applicant for the development consent or the proponent of the activity who makes the request for Director-General's Requirements (DGRs). The Office of Environment and Heritage (OEH) notes that in this instance, Eli Ramsland, Contracts engineer, made the request for the DGRs. Please advise the OEH contact officer, Allison Treweek, Regional Biodiversity Conservation Officer, on (02) 62297082, if it is not intended that Eli Ramsland will be the applicant or proponent whatever the case may be.

It is also essential to note that Section 111(1) requires that the applicant must, in preparing the SIS, comply with the requirements of the Director-General. As any consent or approval granted where the Director-General's requirements are not met may be invalid, it is strongly recommended that Council ensure that all of the requirements detailed below are complied with.

The following requirements are based on the standards developed for other SISs prepared elsewhere in NSW. As per normal practice, specific requirements have been identified for threatened species, populations and ecological communities that are known to occur on the subject site.

DEFINITIONS

The definitions given below are relevant to these requirements:

- **Development** has the same meaning as in the EP&A Act.
- Activity has the same meaning as in the EP&A Act
- Proposal is the development, activity or action proposed
- Subject Site means the area directly affected by the proposal.
- Study Area means the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account.
- Subject Species, Populations or Ecological Communities means those threatened species, populations or ecological communities that are known or considered likely to occur in the study area. The SIS is to explicitly consider the impacts of the proposal on each of these entities.
- Direct Impacts are those that directly affect habitat and individuals, usually within the footprint of the proposal. They include, but are not limited to, clearing and habitat

removal. Consideration must be given to all of the likely direct impacts of the proposed activity or development.

- Indirect Impacts occur when project-related actions affect species, populations or ecological communities in a manner other than direct loss, usually beyond the footprint of the proposal. Indirect impacts can include loss of individuals through predation by domestic and/or feral animals, deleterious hydrological changes (including increased runoff and raising or lowering of the water table), erosion, weed invasion, pollution, trampling or other impacts due to increased human activity within or directly adjacent to sensitive habitat areas, altered fire regimes, habitat fragmentation and disruption of wildlife movement corridors. As with direct impacts, consideration must be given to all of the likely indirect impacts of the proposed activity or development.
- Life Cycle is the series or stages of reproduction, growth, development, aging and death of an organism.
- Viable means the capacity to successfully complete each stage of the life cycle under normal conditions.
- **Risk of Extinction** is the likelihood that the local population of the species or local occurrence of the endangered population or ecological community will become extinct either in the short, medium or long-term as a result of direct or indirect impacts on the viability of that population and includes changes to the ecological function of communities.
- Local Population is the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.
 - The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
 - The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.
 - The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time.

In cases where multiple populations occur in the study area, each population should be assessed separately.

- Local Occurrence means the ecological community that occurs within the study area. However the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
- **Composition** means both the plant and animal species present, and the physical structure of the ecological community. Note that while many ecological communities are identified primarily by their vascular plant composition, an ecological community consists of all plants and animals as defined under the TSC Act that occur in that ecological community.

All other definitions are the same as those contained in the TSC Act.

MATTERS WHICH HAVE BEEN LIMITED OR MODIFIED

The SIS need not address Section 110(2)(g) and 110(3)(d) of the TSC Act. The matters raised in these sections of the TSC Act have been clarified by these DGRs.

The following matters from Section 110 of the TSC Act need only be addressed where relevant:

- All reference to threat abatement plans. There are no threat abatement plans relevant to the key threatening processes associated with the *proposal*.
- All reference to recovery plans. There are draft recovery plans relevant to the *subject species* listed in Tables 1 and 2 and the *subject ecological community* listed in Section 3.2 of these DGRs. However, if other entities should be deemed as *subject species, populations or ecological communities* by analysis in accordance with these DGRs, then any relevant recovery plans pertaining to these entities will need to be addressed in the SIS.
- All reference to key threatening processes. Only the following key threatening processes are relevant to this proposal:
 - > Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
 - Bushrock removal
 - Clearing of native vegetation;
 - > Invasion of native plant communities by exotic perennial grasses
 - Removal of dead wood and dead trees;
 - Loss of hollow-bearing trees

For each *subject species, population or ecological community* likely to be affected by any of these key threatening processes, the SIS shall address whether the action will increase this threat, and shall describe proposed measures to ameliorate such threats.

Please note that recovery plans may be approved, critical habitat may be declared and key threatening processes may be listed between the issue of these DGRs and the determination of the *proposal*. If this occurs, these additional matters will need to be addressed in the SIS and considered by the consent, determining or concurrence authority.

MATTERS TO BE ADDRESSED

The TSC Act provides that the SIS must meet all the matters specified in Sections 109 and 110 of the Act with the exception of those matters limited above. Some of the requirements outlined in Sections 109 and 110 (excluding the matters limited above) have been repeated below (italics) along with the specific Director-General's Requirements for your *proposal*.

Previous surveys and assessments may be used to assist in addressing these requirements. All references used throughout the SIS must be cited and detailed in a reference list.

1 FORM OF THE SPECIES IMPACT STATEMENT

A species impact statement must be in writing [Section 109 (1)]

A species impact statement must be signed by the principal author of the statement and by:

- (a) the applicant for the licence, or
- (b) if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) [Section 109(2)].

The SIS must include the following declaration signed by the applicant or proponent:

"I...[insert name], of ..[address], being the applicant for the [choose one of the following development consent for/proponent of] the action proposed...[insert DA number, Lot & DP numbers, street, suburb and LGA names] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be imposed as conditions of consent or concurrence for the action proposed."

2 CONTEXTUAL INFORMATION

2.1 Description of proposal, subject site and study area

A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout [Section 110 (1)]

A full description of the action proposed includes a description of all associated actions. These actions may occur on or off the *subject site*. In describing the action proposed, the proportion of the *subject site* and the *study area* that will be affected is to be provided, including details of the location of any auxiliary infrastructure and all component parts of the *proposal* including, but not restricted to, (i) roadworks and temporary access and egress routes, (ii) cycleways, walkways, drainage and settling ponds, stockpile areas, diversion banks, vehicle parking areas and temporary buildings, (iii) changes in surface water flows.

The type of action proposed shall be detailed, including the timetable for the construction of the *proposal*. If a staged construction approach is adopted then the timetable shall clearly indicate this.

If subsequent development of adjacent land is proposed by the proponent in the future, including any additional road construction then this shall be identified to the extent that it is known at the time of preparing the SIS. If existing structures such as the pipeline and transmission line are to be relocated, this should also be described and assessed.

Where the proposed road passes through the White Box, Yellow Box, Blakely's Red Gum Woodland endangered ecological community, the construction methods used shall be described in detail and the feasibility of construction of the road without adversely impacting on this ecological community shall be demonstrated.

The vegetation within the study that is to be retained is to be fully documented, and shown on the relevant plans and maps. The proposed management regimes for such areas are also to be documented.

2.2 Provision of relevant plans and maps

A detailed plan of the *study area* shall be provided at a preferred scale of 1:4,000 or finer. This plan shall show the *proposal*, the location and type of vegetation communities present within the *study area*, the full extent of vegetation clearing anticipated, and the scale of the plan. This plan shall also show the location of any key habitat resources for threatened species (eg. hollow-bearing trees, identified feed trees, potential breeding sites, rock outcrops). Where the general habitat of each *subject species, population or ecological community* within the *study area* can be clearly delineated, this habitat shall be represented on the plan.

Colour aerial photography of the locality (or a reproduction of such a photograph) shall be provided. This aerial photograph shall clearly show the subject site and the scale of the photograph.

The locations of the *subject species populations or ecological communities* recorded in any survey conducted for the purposes of the SIS shall be represented on a map of the *study area* that shows the *proposal* (preferred scale 1:4,000 or finer).

A topographic map of the general *locality* at a scale of 1:25,000 is to be provided. This map is to detail the location of the action proposed, landscape features including rivers, swamps, wetlands, any locally significant sites of *subject species, populations or ecological communities*, and areas of high human activity such as townships and major roads. This map shall incorporate the area within a radius of 10km from the subject site. All available historical records are to be included of *subject species, populations of ecological communities* sourced from various databases and other sources are to be included on this map.

2.3 Land tenure information

The land tenure across the *study area* is to be described and any limitations to sampling across the *study area* resulting from this tenure (e.g. denied access to private land) shall be noted.

3 INITIAL ASSESSMENT

A general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action [Section 110 (2)(a)].

3.1 Identifying subject species and populations

For the purposes of this SIS, the species listed in Table 1 are to be addressed as subject species:

Table 1.List of subject species.

SPECIES	SCIENTIFIC NAME	STATUS
FAUNA		
Little Whip Snake	Suta flagellum	Vulnerable
Golden Sun Moth	Synemon plana	Endangered
Pink-tailed Worm-lizard	Aprasia parapulchella	Vulnerable
Rosenberg's Goanna	Varanus rosenbergi	Vulnerable
Brown Treecreeper	Climacteris picumnus victoriae	Endangered

SPECIES .		STATUS
Diamond Firetail	Stagonopleura guttata	Vulnerable
Gang- Gang Cockatoo	Callocephalon fimbriatum	Vulnerable
Hooded Robin	Melanodryas cucullata cucullata	Vulnerable
Speckled Warbler	Pyrrholaemus sagittatus	Vulnerable
Scarlet Robin	Petroica boodang	Vulnerable
Little Eagle	Hieraaetus morphnoides	Vulnerable
Painted Honeyeater	Grantiella picta	Vulnerable
Eastern False Pipistrelle	Falsistrellus tasmaniensis	Endangered
Striped Legless Lizard	Delma impar	Vulnerable
Koala	Phascolarctos cinereus	Vulnerable
Threatened Microchiropteran bats(including the Greater Long eared bat)		
FLORA	·	
Pale pomaderris	Pomaderris pallida	Vulnerable
Button Wrinklewort	Rutidosis leptorrhynchoides	Endangered
Buttercup Doubletail	Diuris aequalis	Endangered
Small purple pea	Swainsona recta	Endangered
Silky Swainson Pea	Swainsona sericea	Vulnerable
	· · ·	
Endangered Ecological Comr	nunities	

White Box, Yellow Box, Blakely's Red Gum Woodland

One of the roles of a SIS is to determine which species, populations or ecological communities may be utilising, or present, on a development site. This list is not exhaustive and other entities may also need to be included for assessment in this SIS on the basis of desktop and habitat analyses and the outcomes of fieldwork.

In determining whether other entities, should also be addressed as *subject species, populations and ecological communities*, consideration shall be given to the habitat types present within the *study area*, recent records of threatened species, populations or ecological communities in the

locality and the known distributions of threatened species, populations and ecological communities. This analysis and its conclusion are to be documented in the SIS.

Databases such as the OEH Atlas of NSW Wildlife and BioNet, as well as databases held by the Australian Museum and Royal Botanic Gardens, should be consulted to assist in compiling the list of possible entities to be analysed. It should be noted that if the OEH Atlas is the only database that is referred to, due to data exchange agreements, the data provided by OEH will only include that for which OEH is a custodian. In many cases, this may only be a small subset of the data available. Other databases must also be consulted to create a comprehensive list of entities for consideration as *subject species, populations or ecological communities*.

3.2 Identifying habitats

In describing the *study area*, consideration shall be given to the previous land uses and the effect of these land uses on the *study area*. Relevant historical events may include fire, clearing, logging, slashing, recreational use and agricultural activities.

A description of habitats including such components as the frequency of tree hollows, the presence of wetlands, the density of understorey vegetation, the composition of the ground cover, the soil type and the presence of heath and permanent or ephemeral swamps shall be given. The condition of these habitats within the *study area* shall be discussed, including the prevalence of introduced species. A description of the habitat requirements of threatened species, populations or ecological communities likely to occur in the *study area* shall be provided.

Any areas which may provide habitat connectivity between the *study area* and adjacent areas of likely habitat for *subject species, populations or ecological communities* shall be identified and described.

In defining the *study area*, consideration shall be given to possible *indirect impacts* of the proposed action on species/habitats in and surrounding the *subject site*. These could include impacts arising from altered fire and hydrology regimes, soil erosion or pollution, fencing, habitat fragmentation and disruption of wildlife movement corridors, edge effects, altered light and noise regimes, disturbance of roosting areas or other impacts due to increased use of the area by humans, and the impacts of increased levels of domestic and feral predators.

4 SURVEY

4.1 Requirement to survey

A flora and fauna survey is to be conducted in the *study area*. Targeted surveys shall be conducted for all *subject species, populations and ecological communities* determined in accordance with Section 3. Previous surveys and assessments may be used to assist in addressing this requirement. However, the efficacy of such previous surveys and assessments in meeting this requirement must be described in full. These previous surveys do not negate the need for the additional targeted survey work set out in Appendix 1 of these DGRs.

Particular attention shall be paid to the timing and climatic conditions for conducting fauna surveys including invertebrates, as many of the subject species will only be present or detectable for a few months each year or during certain climatic conditions. Additional advice on these matters should be sought from the OEH contact officer.

Identification of all species is essential. Identification to genus only is not acceptable. Species of taxonomic uncertainty shall be confirmed by a recognised authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.

4.2 Documentation of survey effort and technique

Survey technique(s) shall be described and a reference given, where available, outlining the survey technique employed.

Survey site(s) shall be identified on a map with a clear legend. The size, orientation and dimensions of quadrat or length of transect shall be clearly noted for each type of survey technique undertaken. Full AMG grid references for the survey site(s) shall be provided.

OEH survey proformas are to be used by field staff when applying a range of standard fauna survey techniques. Copies of standard proformas are included in Appendix 2 to these DGRs. Digital copies of these proformas can be requested from the nominated OEH contact officer. These proformas shall be used by field staff when undertaking fauna surveys and completed data sheets are to be included as an appendix to the SIS.

The time invested in each survey technique shall be summarised in the SIS, based on completed proformas, e.g. number of person hours / transect, duration of call playback, number of nights that traps are set.

It is not sufficient to aggregate all time spent on all survey techniques. Effort must be expressed separately for each survey technique that is applied.

Personnel details including name of surveyor(s), contact phone number, qualifications and experience must be included. The person who identified records (e.g. Anabat, hair tubes, scat analysis) shall also be identified in this manner.

Environmental conditions during the survey shall be noted from the commencement of each survey technique until its completion. These conditions must be documented in the SIS.

An assessment of the efficacy of each survey regime in detecting each species under the intensity utilised by the study is to be provided. The effect of the season and weather at the time of the field survey shall be considered with respect to the adequacy of survey results. An assessment will also be made of the adequacy of the survey and background information used to assess the likely area of use (home range) for each *subject species, population or ecological community*, and the areas providing habitat connectivity.

A full list of all flora and fauna species recorded during the course of surveys shall be included (such information is indicative of the habitat quality of the site). Completed Atlas of NSW Wildlife cards are to be provided for each threatened species record in any survey conducted for the purposes of the SIS. For confidentiality, these cards are not to be included in the SIS but rather shall accompany the SIS when supplied to the OEH.

4.3 Specific survey requirements

Appendix 1 details the specific survey requirements for the *subject species, populations or ecological communities* identified in Table 1 of these DGRs. These survey requirements can determine the presence of *subject species, populations or ecological communities* known or likely to be in the *study area* and/or can provide contextual information on habitats to allow appropriate assessment of impacts at a broader scale. The flora and fauna survey of the *study area* must include the use of these survey methods.

You are advised that discussions between the consultant(s) engaged to prepare the SIS and OEH may be necessary in order to derive an appropriate survey regime for some of these requirements, and to confirm the survey regimes proposed for any additional *subject species, populations and ecological communities* derived by analysis as part of this SIS.

5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES, POPULATIONS AND ECOLOGICAL COMMUNITIES

For all *subject species, populations and ecological communities*, the SIS shall describe the following:

- a. the location, nature and extent of habitat removal or modification which will result from the action proposed;
- b. the likely and potential impact of the removal of habitat. Particular attention shall be given to the loss of:
 - i. White Box, Yellow Box, Blakely's Red Gum Woodland,
 - ii. habitat for Pink-tailed Worm Lizard, Little Whip Snake and,
 - iii. the likelihood of and extent of loss of hollow-bearing trees and termite mounds utilised for breeding, roosting or denning by threatened fauna such as microchiropteran bats, small woodland birds and Rosenberg's Goanna respectively.

Similarly, attention is to be given to the likelihood of and extent of loss of food resources and the impact this may have on the *subject species, populations or ecological communities*.

- c. any indirect impacts of the proposal including:
 - i. the fragmentation or isolation of *local populations* and/or *local occurrences*, and the increased distance required for the movement of individuals/genetic material between habitat patches,
 - ii. change in vegetation floristics and structure resulting from edge effects,
 - iii. altered hydrology regimes (including increased runoff and raising or lowering of the water table),
 - iv. soil erosion and pollution,
 - v. disturbance to feeding or nesting/breeding of species,
 - vi. trampling or other impacts due to increased use of the area by humans, particularly on White Box, Yellow Box, Blakely's Red Gum Woodland,
 - vii. increased mortality rates due to road deaths,
 - viii. habitat fragmentation and disruption of wildlife movement corridors and pollination mechanisms,
 - ix. altered light and noise regimes,
 - x. the likely contribution of the action proposed to the threatening processes already acting on populations of those *subject species or populations* and occurrences of *subject ecological communities* in the *locality*.

All of the above contextual information (which can be incorporated into Sections 5.1 - 5.5 below) will assist with the assessment of cumulative impacts on the *subject species, populations and ecological communities*.

5.1 Assessment of species likely to be affected

An assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action [Section 110(2)(b)].

This requirement allows refinement of the list of *subject species or populations* (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or populations may be affected, and the nature of the impact.

The remaining requirements in this section (5.2 - 5.5) need only be addressed for those threatened species or populations that are likely to be affected by the proposal.

5.2 Discussion of local and regional abundance

An estimate for the local and regional abundance of those species or populations [Section 110 (2)(d)]

5.2.1 Discussion of other known local populations

A discussion of other known *local populations* in the *locality* shall be provided. The long-term security of other habitats shall be examined as part of this discussion. The relative significance of the *subject site* for the *subject species, populations and ecological communities* in the *locality* shall be discussed. It is essential that the SIS includes some surveys conducted beyond the *study area* to clarify the conservation significance of the *subject site* to the *subject species and populations*.

The need for off-site surveys to provide context to the anticipated impacts of the *proposal* may also be required for other threatened species recorded during the surveys of the *study area.*

5.2.2 Discussion of habitat utilisation

An estimate of the number of individuals of each *subject species* utilising the *study area* shall be provided as well as a description of how these individuals use the *study area* (e.g. residents, transients, adults, juveniles, nesting, foraging). A discussion of the significance of these individuals to the viability of the *subject species* in the *locality* shall be provided.

5.2.3 Description of vegetation

The vegetation present within the *study area* and the surface area covered by each vegetation community shall be mapped and described. Reference to the vegetation classification system used (e.g. Specht, Benson, Keith) and to the ecological communities determined as endangered by the NSW Scientific Committee shall be provided. Classification must have regard to both structural and floristic elements.

5.2.4 Discussion of corridors

Particular attention shall be given to identifying movement corridors for *subject species* within the *study area*. The impact of the proposal on these corridors and the resulting impact on the resident *subject species* shall be discussed.

5.3 Assessment of habitat

A full description of the type, location, size and condition of the habitat (including critical habitat) of those species, populations and ecological communities and details of the distribution and condition of similar habitats in the region [Section 110 (2)(f) and Section 110 (3)(c)]

5.3.1 Description of habitat values

Specific habitat features in the *study area* shall be described and quantified (e.g. frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks, area of ecological communities etc.), as well as the density of understorey vegetation and groundcover.

The condition of the habitat within the *study area* shall be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of

erosion, prevalence of rubbish dumping, history of resource extraction or logging and proximity to roads. Details of the *study area's* fire history (e.g. frequency, time since last fire, intensity) and the source of fire history (e.g. observation, local records), shall be provided.

5.3.2 Distribution and condition of regional habitats

For the habitats of *subject species and populations* found in the study area, the SIS shall discuss the distribution and condition of similar habitats in the region. For the *subject ecological communities* found in the study area, the SIS shall discuss the distribution and condition of these ecological communities in the region. Regional information may be obtained from existing datasets and from other sources.

5.4 Discussion of conservation status

For each species or population likely to be affected, and for each ecological community present, details of its local, regional and State-wide conservation status,...[and]... its habitat requirements ... [Section 110(2)(c) and Section 110(3)(b)]

Assessment shall include reference to the threatening processes that are generally accepted by the scientific community as affecting the *subject species, population or ecological community* and which are likely to be caused or exacerbated by the *proposal*. Assessment shall also include reference to any approved or draft recovery plans which may be relevant to the *proposal*. Up-to-date lists and copies of approved and draft recovery plans are available on the OEH website <u>www.environment.nsw.gov.au</u> by following the links to threatened species.

5.5 Description of feasible alternatives

A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development [Section 110(2)(h) and Section 110(3)(e)].

In this instance, any planning documents relating to urban expansion in Queanbeyan (e.g. Googong), as well as any traffic analyses, shall be provided to support this description.

6 IMPACT AMELIORATION

6.1 Description of ameliorative measures

A full description and justification of the measures proposed to mitigate any adverse effect of the action on the species, populations and ecological communities including a compilation (in a single section of the statement) of those measures [Section 110 (2)(i) and Section 110 (3)(f)].

6.1.1 Long term management strategies

Consideration shall be given to the information contained in approved and draft recovery plans or threat abatement plans for existing taxa, known or likely to occur in the *study area*, and whether any recommendation is applicable to the *proposal*.

The development of long-term management strategies shall be considered to protect areas within the study area which are of particular importance for the *subject species, populations or ecological communities* likely to be affected by the *proposal*. This may include proposals to restore or improve habitat on site where possible. If mitigation is to include rehabilitation of the site, then the rehabilitation strategy shall be detailed.

Any measures proposed to mitigate the effect of the proposal on *local populations* of threatened species and populations and/or *local occurrences* of ecological communities shall be described. The potential effectiveness of any such amelioration in maintaining a viable *local population*

and/or *local occurrence* in the short, medium and long term shall be discussed (e.g. fauna underpasses, vegetation management).

6.1.2 Compensatory strategies

If significant modification of the *proposal* to minimise impacts on *subject species, populations or ecological communities* is not possible, then compensatory strategies shall be considered. These may include other off-site or local area proposals that contribute to long term conservation of the *subject species, populations or ecological communities*. These areas should be assessed in accordance with the Principles for the use of biodiversity offsets in NSW, which can be found on the following link on the OEH website

http://www.environment.nsw.gov.au/biocertification/offsets.htm.

The areas proposed to be used for compensatory strategies must be described in full including a detailed description of their biodiversity. A complete description of how the area will be managed for conservation in perpetuity must also be provided.

Where such proposals involve other lands, or where involvement of community groups is envisaged in such proposals, landholders, land managers and/or community groups are to be consulted and *proposals* shall contain evidence of support from these stakeholders and relevant land managers.

Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of the mechanisms through which they might best occur.

6.1.3 Ongoing monitoring

Any proposed pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation measures shall be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies that have not been proved effective should be undertaken under experimental design conditions and appropriately monitored.

6.1.4 Translocation

OEH does not consider that translocation of threatened species, populations and ecological communities is an appropriate ameliorative strategy for the purposes of considering impacts of a particular development/activity. It strongly supports the view that development proposals which may impact on significant local populations of *subject species and populations* or significant local occurrences of *subject ecological communities* as determined by the SIS should aim to:

- i. minimise the impacts by considering all possible alternatives to the *proposal*, such that a significant impact is not likely; and
- ii. manage the remaining habitat (if any) to ensure that the *local population* and/or *local occurrence* continues to exist in the long term.

The translocation of *subject species, populations and ecological communities* is only supported by OEH in specific conservation programs (e.g. recovery planning).

7. ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION

An assessment of significance (s5A EP&A Act) is to be provided for each *subject species, population or ecological community* identified in the SIS, incorporating relevant information from sections 5.1 to 7 of the SIS. On the basis of these assessments, a conclusion is to be provided concerning whether, based on more detailed assessment through the SIS process and consideration of alternatives and/or ameliorative measures proposed in the SIS, the proposal is

still considered likely to have a significant effect on threatened species, populations or ecological communities or their habitats.

8 ADDITIONAL INFORMATION

8.1 Qualifications and experience

A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement [Section 110(4)]

8.2 Other approvals required for the development or activity

A list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community [Sections 110(2)(j) and 110(3)(g)]

In providing a list of other approvals the following shall be included:

- Where consent is required under Part 4 of the *Environmental Planning and Assessment Act 1979*, the name of the consent authority and the timing of the development application shall be included; or
- Where approval is required under Part 5 of the *Environmental Planning and Assessment Act 1979*, the name of the determining authority, the basis for the approval and when the approval is proposed to be obtained shall be included.
- Where consent or approval is required under any other Act, the name of the consent or determining authority and the timing of the development application, basis for the approval and when the approval is proposed to be obtained shall be included

8.3 Licensing matters relating to flora and fauna surveys

Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:

National Parks and Wildlife Act 1974:

- General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna).
- Licence to pick protected native plants (Section 131).
- Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes.

Threatened Species Conservation Act 1995:

• Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91).

Animal Research Act 1985:

• Animal Research Authority to undertake fauna surveys.

8.4 Reports of State-wide conservation status

Section 110(5) of the *Threatened Species Conservation Act 1995* has the effect of requiring OEH to provide available information regarding the State-wide conservation status of the subject species, populations or ecological communities, in order to satisfy ss.110(2)&(3) of the Act.

OEH has also produced a set of profiles for a number of threatened species, populations and ecological communities that are available on the OEH threatened species website (www.threatenedspecies.environment.nsw.gov.au). Some of these are relevant to the list of *subject species, populations and ecological communities* for this *proposal*.

Proponents and consultants should note that OEH has no further published information available to satisfy s.110(5) of the Act and that receipt and use of the above profiles can be taken to have satisfied the requirements of ss.110(2)&(3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.

SPECIES	SURVEY REQUIREMENTS
Pink-tailed Worm-	Surveys of the subject site and study area shall be undertaken for this
lizard Little Whip	species. These shall involve rock rolling and searching under logs and
Snake, Striped	debris at a suitable intensity to provide appropriate survey coverage.
legless lizard.	Surveys shall be undertaken between mid-August and the end of October
	preferably after rain. Daily temperatures shall not exceed 25°C during the
	survey period. Rocks, logs and debris shall be replaced carefully to sustain
	habitat integrity. Surveys of the <i>locality</i> for habitat of the species shall be
	undertaken. These shall involve determining the extent of potentially
	suitable habitat from aerial photographs or other means, and ground-
	truthing selected sites to validate habitat suitability, condition and extent.
	The sites sampled shall be used to provide context to the habitat affected
	by the action proposed. Habitat surveys can be undertaken at any time of
	the year under varied seasonal conditions.
Rosenberg's Goanna	Surveys of the <i>subject site</i> , <i>study area</i> and <i>locality</i> shall be undertaken for
	termite mounds. This shall involve intensive searches for termite mounds in
	the subject site and study area. Representative sampling of the locality for
	termite mounds shall involve the use of transects in selected locations and
	the gathering of data in conjunction with ground-truthing for endangered
	ecological communities. The number of termite mounds recorded shall be
	used to provide context to the potential breeding habitat affected by the
	action proposed. Surveys can be undertaken at any time of the year under
	varied seasonal conditions.
Brown Treecreeper,	Diurnal bird census shall be undertaken in the early morning and/or late
Diamond Firetail,	afternoon within the subject site on three occasions each separated by a
Hooded Robin,	period of one week. Each census shall comprise observations for birds,
Speckled Warbler,	including call recognition, for a period of 45 minutes at a minimum of three
little eagle, Scarlet	locations spread across the subject site. Additional opportunistic bird
Robin	census shall be employed across the study area and locality during the
	course of other surveys for the SIS. Surveys can be undertaken at any time
	of the year, but shall avoid high-wind and/or rainy days.
Gang Gang-	Diurnal bird surveys across the study area.
Cockatoo	Identify and map all hollow-bearing trees (potential nest trees) on the subject site and estimate the availability of hollow-bearing trees in the
	Torget the europy to potential nexts during linear breading according
	raiget the survey to potential nests during known preeding season of
	development is post troop and appropriate variated buffers of buffers
	development le nest trees and appropriate vegetated putters of hollow

.

SPECIES	SURVEY REQUIREMENTS
Painted Honey eater	Diurnal bird census shall be undertaken in the early morning and/or late afternoon within the <i>subject site</i> . Surveys for the painted honeyeater are to be undertaken from late October through to early January. All areas of
	Mistletoe within the study area are to be mapped. Further detailed survey requirements, can be supplied on request.
Koala	OEH recommend the use of the RapSAT technique for the detection of koalas
Microchiropteran bats	Surveys using anabat recorders and stag watching should aim to identify the number and location of roost sites for the subject bats and identify important foraging habitat in the study area and the locality. If required, the OEH can provide further advice on bat survey techniques to acquire this information.
	Surveys of the subject site, study area and locality shall be undertaken for
	hollow-bearing trees. This shall involve intensive searches for hollow-
	bearing trees in the subject site and study area. Representative sampling
	of the <i>locality</i> for hollow-bearing trees shall involve the use of transects in
	selected locations and the gathering of data in conjunction with ground-
	truthing for endangered ecological communities. The number of hollow-
	breeding habitat affected by the action proposed. Surveys can be
	undertaken at any time of the year under varied seasonal conditions.
Golden Sun Moth	Surveys of the subject site and study area shall be undertaken for this
	species. These surveys should target areas with higher than 40%
,	Austrodanthonia in the groundcover. Areas of habitat should be hand-
	netted during known flight periods. The flight period for this species is short
	therefore surveys should be undertaken when other known populations in
	the area are flying. The consultant should discuss these periods with the
	OEH prior to the survey being conducted. Surveys of the <i>locality</i> for habitat
	of the species shall be undertaken. These shall involve determining the
	extent of potentially suitable habitat from aerial photographs or other
	means, and ground-truthing selected sites to validate habitat suitability,
	condition and extent. The sites sampled shall be used to provide context to
	the habitat affected by the action proposed. Habitat surveys can be
	undertaken at any time of the year under varied seasonal conditions.

SPECIES	SURVEY REQUIREMENTS
White Box, Yellow	Surveys shall identify the extent and condition of this ecological community
Box, Blakely's Red	in the subject site, study area and locality. This shall involve the use of
Gum Woodland	vegetation surveys in the <i>subject site</i> and the <i>study area</i> . The use of
	existing datasets held by OEH in combination with ground-truthing of
	selected sites within areas mapped by OEH as the ecological community is
	recommended for surveys of the <i>locality</i> . The sites sampled shall be used
	to provide context to the ecological community affected by the action
	proposed. Surveys can be undertaken at any time of the year under varied
	seasonal conditions.
Button Wrinklewort.	Systematic surveys using evenly spaced transects located about 10 m
	apart through all areas of woodland and grassland.
Pale pomaderris	Systematic surveys using evenly spaced transects located about 10 m apart through all areas of suitable habitat , concentrating on riparian areas
Silky Swainson Pea, Swainsona recta, Diuris aequalis	Systematic surveys using evenly spaced transects located about 5 m apart through all areas of woodland/grassland must be undertaken. OEH should be consulted by the Ecological consultant to confirm flowering times and seasons, and appropriate survey methods.

DIURNAL HERPETOFAUNA CENSUS SURVEY PROFORMA

Survey Details	-		
Date of survey	·	• •	
Name of surveyor		Contact number	
Number of surveyors			
Total effort expressed in person-hours		Total effort expressed in number of rocks/logs rolled	
Location Details			
Location (including basic habitat) description			
			· · · ·
Map number		Map name	
Map number Type of survey, e.g. transect or quadrat		Map name AMG Zone	
Map number Type of survey, e.g. transect or quadrat Active or passive search		Map name AMG Zone Size of survey area (ha)	
Map number Type of survey, e.g. transect or quadrat Active or passive search Survey area		Map name AMG Zone Size of survey area (ha)	
Map number Type of survey, e.g. transect or quadrat Active or passive search Survey area Eastings (6 digits)		Map name AMG Zone Size of survey area (ha) Northings (7 digits)	
Map number Type of survey, e.g. transect or quadrat Active or passive search Survey area Eastings (6 digits) Eastings (6 digits)		Map name AMG Zone Size of survey area (ha) Northings (7 digits) Northings (7 digit)	

Weather Details

At start of survey, record:	Cloud cover*			· ,	
Wind direction and speed*	Rain*				
Temperature (°C)	 Moon*				
At end of survey, record:					
Temperature (°C)					
Comments		·			

Species name (Scientific/Common)	Ob. type [*]	MH type [*]	Grid reference (full AMGs i.e. Eastings and Northings)	Accuracy
		· .		
		с. 		
· · · · · · · · · · · · · · · · · · ·				
		•		
			· · · ·	
				÷
		·		
· · · · · · · · · · · · · · · · · · ·				

* See Appendix 3: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

<u>Surve</u>	<u>/ Details</u>

Name of surveyor	·	Contact number	
Number of surveyors		Date of survey	
Total effort expressed in person hours		Number of hectares covered or transect or point dimensions	
Location Details			
Location description			
Map number		Map name	
Full AMG reference(s) for survey site or transect		AMG Zone	
Start details		Finish details	
Easting (6 digits)		Easting (6 digits)	· · · · · · · · · · · · · · · · · · ·
Northing (7 digits)		Northing (7 digits)	
Start time (24hr)		End time (24 hr)	· · ·
Weather Details			
At start of survey, record:		Cloud cover*	
Wind direction and speed*		Rain [*] -	·
Temperature (°C)		Moon*	
At end of survey record:			
Temperature (°C)			
Comments			

Species name	Ob. type	MH type [*]	Grid reference (full AMGs)	Accuracy
		-		

* See Appendix 3: Standard reporting codes
| Species name | Ob. | МН | Grid reference (full AMGs) | Accuracy | | |
|---------------------------------------|----------|-------------------|---------------------------------------|---------------------------------------|--|--|
| | type | type [*] | | | | |
| · · · · · · · · · · · · · · · · · · · | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | - | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | · · · · · · · · · · · · · · · · · · · | | |
| | | | | | | |
| | | | | · · · | | |
| | · · · | | | | | |
| | | | · · · · · · · · · · · · · · · · · · · | | | |
| | | | | | | |
| · · · · · · · · · · · · · · · · · · · | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | - | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | <u> </u> | · · | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | <u> </u> | | | | | |
| | | | | | | |
| | | | | | | |

		-

* See Appendix 3: Standard reporting codes

DIURNAL HOLLOW-BEARING TREE CENSUS SURVEY PROFORMA

Survey Details			
Date of survey		· .	
Name of surveyor		Contact number	
Number of surveyors			
Total effort expressed in person-hours	· · · ·		
Location Details			·
Location (including basic habitat) description			
· · · ·			
Map number		Map name	
Map number Type of survey, e.g. transect or quadrat		Map name AMG Zone	
Map number Type of survey, e.g. transect or quadrat		Map name AMG Zone Size of survey area (ha)	
Map number Type of survey, e.g. transect or quadrat Survey area Eastings (6 digits)		Map name AMG Zone Size of survey area (ha) Northings (7 digits)	
Map number Type of survey, e.g. transect or quadrat Survey area Eastings (6 digits) Eastings (6 digits)		Map name AMG Zone Size of survey area (ha) Northings (7 digits) Northings (7 digit)	

Tree No.	Species (Scientific Name)	Number, sizes and types of hollows *	Grid reference (full AMGs i.e. Eastings and Northings)	Accurac
			•	
	· · · · · · · · · · · · · · · · · · ·			
· .				
		· · · · · · · · · · · · · · · · · · ·		
			· · · · · · · · · · · · · · · · · · ·	
	· · ·			
			· · · ·	
<u> </u>	· · · · · · · · · · · · · · · · · · ·	,		
			-	
	· · ·			
	· · · · · · · · · · · · · · · · · · ·			
	· · · · · · · · · · · · · · · · · · ·		· ·	
<u> </u>				
	[···			
_ <u></u>			·	
			· · · · · · · · · · · · · · · · · · ·	
1				
		1	· · · · · · · · · · · ·	
	•			
·			· · · · · · · · · · · · · · · · · · ·	
			· · · · · · · · · · · · · · · · · · ·	
			1	

	-	· · ·	

* See Appendix 3: Standard reporting codes

DIURNAL TERMITE MOUND CENSUS SURVEY PROFORMA

Survey Details			
Date of survey			
Date of our cy			·
Name of surveyor		Contact number	
Number of surveyors			
Total effort expressed in person-hours			
	<u> </u>		
Location Details			
Location (including basic habitat) description	· ·		
Map number		Map name	
Type of survey, e.g.			
transect or quadrat		AMG Zone	
		Size of survey area (ha)	
Survey area			
Eastings (6 digits)		Northings (7 digits)	
Eastings (6 digits)		Northings (7 digit)	
Start time (24hr)		End time (24 hr)	
Termite mound no	Grid reference (full A	MGs)	Accuracy

			•
		· · · · · · · ·	
-			
		·	· · · · · · · · · · · · · · · · · · ·
		1	
			·
			· · · · · · · · · · · · · · · · · · ·
	; ;		

	·
	- ,

VERTEBRATE FAUNA SURVEY OPPORTUNISTIC RECORDS

 Survey name
 Fauna surveyors

 Surveyor's contact details
 Call analysis

AGM Zone

Date	Time	Site	Easting	Northing	Species Name	No	Ob.	MH*	Notes/Field No**
		#	(full 6 digits)	(full 7 digits)		ln d	type*	type*	
· .									
									· · · · · ·
				·					
					· · ·				· · · · · · · · · · · · · · · · · · ·
			,						

,				

* See over

** Include initials of observer and any other information that will help relocation of site.

Director-General's Requirements for a Species Impact Statement



Cloud cover. Record cloud cover in eights of sky.

Moon. Record using the following codes. 0=None, 1=1/4 moon, 2=1/2 moon, 3=3/4 moon, 4=full moon.

Wind direction and speed. Record wind direction to nearest cardinal point. Record wind speed using the following codes. 0=calm 1= Light, leaves rustle 2= Moderate, branches move 3=Strong, tops of trees move

Rain. Record using the following codes. 0=none, 1=drizzle - light, 2=drizzle - heavy 3=heavy rain

Sizes of hollows. Record using the following codes. S=Small (1-5cm diameter), M=Medium (5-15cm diameter), L=Large (greater than 15cm diameter).

Types of hollows. Record using the following codes. T=Trunk hollow, B=Branch hollow

Observation type

Use the following codes:

0	Observed (sighted)	R	Road kill	F	Tracks, scratching
W	Heard call	D	Dog kill	z	In raptor/owl pellet
x	In scat	с	Cat kill	М	Miscellaneous
Ρ	Scat	V	Fox kill	Е	Nest or roost
Г	Trapped or netted	к	Dead	в	Burnt
-	Hair or feathers	S	Shot	Y	Bones or teeth
4	Stranded/beached	I	Fossil/subfossil	Ν	Not located

MH (microhabitat	type
------------------	------

Use	e the following codes:			
AC	Flying above canopy	IB	In burrow	OB On (beach) sand
BR	In/on bridge	IC	In cave	OL On log
ΒU	In building	IG	In grass	OR On rock
ск	Crevice in rock	IH	In tree hollow	OW Over water
CL	Crevice in log	IL	In litter	RD On road
DA	Farm/fire dam	IR	In reeds	TK On trunk
DT	In dead tree (stag)	IS	In soil	UB Under bark

Decision Report No. 1131817 38

Printed: 2:09:30 PM 22/06/2012

Director-General's Requirements for a Species Impact Statement



ΕW	Edge	of wa	ater
----	------	-------	------

FC In/on post or stump

FL Flying within canopy

GR On ground

HS High shrub

IT In (live) tree	UC Upper canopy
IW In water	UG Undergrowth
LC Lower canopy	UL Under log
LS Low shrub	UR Under rock
MC Mid canopy	UT Under iron
	WH Waterhole

Decision Report No. 1131817 38 Printed: 2:09:30 PM 22/06/2012

APPENDIX B THREATENED SPECIES EVALUATION



The tables in this appendix present the habitat evaluation for threatened species, ecological communities and Endangered populations listed for the Murrumbidgee CMA, Monaro sub-catchment and Queanbeyan City LGA in the *Atlas of NSW Wildlife*⁵ and those identified as occurring or potentially occurring in the area (10km buffer) according to the Commonwealth EPBP *Protected Matters Search Tool*⁶.

The table is a preliminary assessment to identify which species need further consideration and detailed assessment to determine the severity of impact of the proposal on these species.

The likelihood of occurrence is evaluated based on presence of suitable habitat, proximity of nearest records and mobility of the species (where relevant). The assessment of potential impact is based on the nature of the proposal, the ecology of the species and its likelihood of occurrence. The following classifications are used:

Presence of habitat

Present:	Potential or known habitat is present within the study area.
Marginal:	Habitat present is not typical but may be suitable, or habitat type is suitable but condition and microhabitat requirements of species are not present.
Absent:	No potential or known habitat is present within the project area.

Likelihood of occurrence

- None: Species known or predicted within the locality but no suitable habitat present within the study area.
- Unlikely: Species known or predicted within the locality. Suitable habitat may be present in the study area but the proximity of nearest records suggest it is unlikely to occur.
- Possible: Suitable habitat present and the species could occur in the study area based on the proximity of nearest records.
- Present: Species was recorded during the field investigations.

Potential for impact

- No: The proposal would not result in an impact to this species. No Assessment of Significance (AoS) is necessary for this species.
- Low: The proposal is unlikely to result in an impact to this species. No AoS is necessary for this species.
- Moderate: The proposal could impact this species or its habitats. This species is considered further in this assessment. The risk to this species is considered manageable and an AoS is not considered necessary.
- High: The proposal is likely to impact this species or its habitats. An AOS has been applied to these entities.



⁵ The *Atlas of NSW Wildlife* is administered by the NSW Department of Environment, Climate Change and Water (OEH) and is an online database of fauna and flora records that contains over four million recorded sightings.

⁶ This online tool is designed for the public to search for matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is managed by the Commonwealth Department of the Environment, Water, Heritage and the Arts.

B.1 FLORA AND ECOLOGICAL COMMUNITIES

Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Trees				
<i>Eucalyptus parvula</i> Small-leaved Gum TSC-E, EPBC-V	The Small-leaved Gum is a readily recognisable small tree, often of woodland form with a dense rounded crown. Has a very small distribution in the eastern edge of the Monaro, in a narrow 100km strip from Big Badja Mountain (north-east of Cooma) to Nunnock Swamp in South-East Forests National Park, north-east of Bombala. Grows on tablelands above an elevation of 1100 m in acidic soil on cold wet grassy flats. It is often restricted to swampy areas in shallow valleys. These valleys, which are near the scarp of the tableland, are frost hollows and fogs are common. Sometimes occurs in small pure stands but is often mixed with Black Sally (<i>Eucalyptus stellulata</i>) and Snow Gum/White Sally (<i>E. pauciflora</i>) and with a wet tussock grass layer of <i>Poa caespitosa</i> or healthy undergrowth.	Absent	None	Q





⁷ Information sourced from species profiles on NSW OEH's threatened species database or the Australian Government's Species Profiles and Threats database (SPRAT) unless otherwise stated.

OEH threatened species database: <u>http://www.threatenedspecies.environment.nsw.gov.au/index.aspx</u> SPRAT: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Species Eucalyptus pulverulenta Silver-leafed Gum TSC-V, EPBC-V	Description of habitat ⁷ A distinctive, straggly mallee or small tree that grows to about 10 m tall. Found in two quite separate areas, the Lithgow to Bathurst area and the Monaro (Bredbo and Bombala areas). Occurs on the crests or upper slopes of moderately steep hillsides or mountains, at altitudes of 800–1000 m, usually on well-drained skeletal soils with frequent rock outcrops. The southern populations occur in sandy or gravelly loams over shales and sedimentary rock. Grows as an understorey plant in open forest, typically dominated by Brittle Gum (<i>Eucalyptus</i> moniford) Bed Strinkovhark (<i>Euncrohuncha</i>) bed sched	Presence of habitat Marginal	Likelihood of occurrence Unlikely.	Species Impact Statement Ellerton Drive Extension Possible impact? Low
Eucalyptus aggregata Black Gum TSC-V	Peppermint (<i>E. dives</i>), Silvertop Ash (<i>E. sieberi</i>) and Apple Box (<i>E. bridgesiana</i>). Black Gum is a small to medium-sized woodland tree growing to 18 m tall. Black Gum is found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT. In NSW it occurs in the South Eastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion. Black Gum has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands, for example in the Blayney, Crookwell, Goulburn, Braidwood and Bungendore districts. Grows in the lowest parts of the landscape on alluvial soils, on cold, poorlydrained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (<i>Eucalyptus pauciflora</i>), Manna or Ribbon Gum or White Sallee (<i>Eucalyptus pauciflora</i>), Black Sallee (<i>E. viminalis</i>), Candlebark (<i>E. rubida</i>), Black Sallee (<i>E. viminalis</i>) and Swamp Gum (<i>E. ovata</i>).	Absent	None	Q
4733 Final v1.2	B-IV			mgh environmental

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Shrubs				
<i>Monotoca rotundifolia</i> Trailing Monotoca TSC-E	A low shrub, less than 30 cm tall. In NSW Trailing Monotoca is known only from Big Badja Hill and Wadbilliga Trig. There is an unconfirmed record from west of Kybean State Conservation Area. In Victoria it is only known from Brumby Point on the Nunniong Plateau. The New South Wales populations occur in shrubland or Snow Gum woodland from 1250 to 1360m asl. Flowers in March.	Absent	None	Q
Dillwynia glaucula Michelago Parrot-pea TSC-E	Michelago Parrot-pea is an erect shrub to 2.5 m tall. It is recorded from four areas on the NSW Southern Tablelands: near Windellama, where the species is locally abundant, near Mongarlowe, north-east of Michelago and at Numeralla. There is potential habitat between the known sites. Occurs on exposed patches of clay or on rocky outcrops in eucalypt woodland often dominated by Scribbly Gum (<i>Eucalyptus rossil</i>), Snow Gum (<i>E. pauciflora</i>), Broad-leafed Peppermint (<i>E. dives</i>) and Red Stringybark (<i>E. macrorhyncha</i>). The understorey may be either grassy or shrubby.	Present	Unlikely	LOW
Dillwynia tenuifolia TSC-V	A low spreading pea-flower shrub to a metre high.The core distribution is the Cumberland Plain from Windsor to Penrith east to Deans Park. Other populations in western Sydney are recorded from Voyger Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Disjunct localities include: the Bulga Mountains at Yengo in the north, Kurrajong Heights and Woodford in the Lower Blue Mountains. In western Sydney, this species may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Absent	None	Q
4733 Final v1.2	B-V			ngh environmental

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
<i>Westringia kydrensis</i> Kydra Westringia TSC-E, EPBC-E	An erect shrub that grows up to 40 cm tall. Endemic to NSW and is found at Kydra Reefs, south-east of Cooma, and in Coolumbooka Nature Reserve. This species has also been recorded in the Queanbeyan area and near Tuross Falls. Known from heath communities on rocky areas with shallow rocky granite or quartzite soils. Associated species include <i>Allocasuarina nana</i> and <i>Banksia canei</i> . Flowers occur from August to November.	Absent	None	Q
<i>Pomaderris pallida</i> Pale Pomaderris TSC-V, EPBC-V	DGR Subject species A compact, rounded shrub to 1.5 m tall. Has been recorded from near Kydra Trig, north-west of Nimmitabel, Tinderry Nature Reserve, the Queanbeyan River and the Murrumbidgee River west of the ACT. A record from Byadbo in Kosciuszko National Park has not been relocated. It is also found along the Murrumbidgee River in the ACT and has been recently recorded in eastern Victoria. This species usually grows in dry open forests and shrub communities surrounded by Brittle Gum (<i>Eucalyptus mannifera</i>) and Red Stringybark (<i>E. macrorhynca</i>) or <i>Callitris spp.</i> woodland. The mid-stratum often has <i>Grevillea juniperina</i> , Bursaria spinosa, Acacia rubida, and <i>Kunzea ericoides</i> .	Present	Unlikely. Targett searches did not dete this species.	d Low, however, this ct species is a subject species of this SIS and is assessed further within this document.
Zieria adenophora Araluen Zieria TSC-CE, EPBC-E	A small erect, open sub-shrub 0.5-1 m high and 1.5 m wide. Two populations are known from the Bells Creek area north of Araluen, on the eastern boundary of the Southern Tablelands of NSW. Occurs on the steep, rocky upper slope of a hillside that faces north-north-west and overlooks a deep valley. The species grows in shallow sandy to gravelly loam, amongst granite boulders. The shrub community at this site also includes Acacia mearnsii, Dodonaea viscosa, Correa reflexa, <i>Ficus rubiginosa, Notelaea venosa, Plectranthus parviflorus</i> and <i>Poa sieberiana</i> .	Absent	None	Q
4733 Final v1.2	B-VI			ngh environmental

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Zieria citriodora Lemon Zieria TSC-E, EPBC-V	A lemon-scented, spreading, prostrate shrub up to 15 cm high. Restricted to two populations in the Countegany district of the Southern Tablelands of NSW and four populations in East Gippsland, Victoria. In NSW, the two populations are in the Kybean Range, east of Cooma. The NSW populations are on moderately steep, generally north to south-west facing slopes near small ephemeral creeks. The soils are shallow gravelly or sandy loams overlying decomposed granite or metamorphosed sediments. The vegetation is low eucalypt woodland with a shrub understorey. Associated vegetation in NSW includes <i>Eucalyptus mannifera</i> , <i>E. macrorhyncha</i> , <i>E. dives, Allocasuarina nana, Banksia canei, Brachyloma daphnoides, Monotoca scoparia, Leucopogon attenuatus, L. fraseri, L. fletcheri, L. pilibundus, Platysace lanceolata, <i>Pultenaea procumbens, Hibbertia obtusifolia, Bossiaea foliosa,</i> <i>Lomandra longifolia, Olearia iodochroa, Poa</i> sp. and Acacia spp.</i>	Absent	None	Q
Dodonaea procumbens Creeping Hop-bush TSC-V, EPBC-V	A low spreading shrub that forms a ground-hugging mat up to 1 m across and 10 cm tall. Found in the dry areas of the Monaro, between Michelago and Dalgety. Here it occurs mostly in Natural Temperate Grassland or Snow Gum <i>Eucalyptus pauciflora</i> Woodland. There is one population at Lake Bathurst (the northern-most occurrence of the species). Here it occurs in adjacent to the lake bed in grassland dominated by Corkscrew Grass <i>Austrostipa scabra</i> and Curly Sedge <i>Carex bichenoviana</i> . Grows in open bare patches where there is little competition from other species. Found on sandy- clay soils, usually on or near vertically-tilted shale outcrops. Often occurs on roadside batters. Does not persist in heavily grazed pastures of the Monaro.	Absent	None	Q
4733 Final v1.2	B-VI			ngh environmental

				Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Rulingia prostrata Dwarf Kerrawang TSC-E, EPBC-E	A prostrate, mat-forming shrub with trailing branches. Widely but patchily distributed between Rosedale (central Gippsland, Vic.) to Newcastle (central coast NSW). Currently known from seven sites in NSW: near Tallong, Penrose and Goulburn on the Southern Tablelands. The largest population occurs in the Tomago sandbeds area near Newcastle. Mainly occurs in gullies along the escarpment. On the Southern Tablelands, Dwarf Kerrawang occurs in <i>Eucalyptus agglomerata</i> open forest at Tallong and in <i>Eucalyptus mannifera</i> low open woodland at Penrose. Associated native species may include <i>Imperata cylindrica, Empodisma minus and Leptospermum</i> <i>continentale</i> . Appears to respond positively to some forms of disturbance however, there are conflicting reports about the response of the species to fire. Flowering is mainly between October and November.	Absent	None	Q
Herbs & Forbs				
Calotis glandulosa Mauve Burr-daisy TSC-V, EPBC-V	An erect or ascending, branching herb growing to 35 cm high. Mauve Burr-daisy's main distribution is in the Monaro and Kosciuszko regions. There are three known sites in the upper Shoalhaven catchment There are old and possibly dubious records from near Oberon, the Dubbo area and Mt Imlay. In Kosciuszko NP this species is locally abundant near Tantangara Dam, Nungar Plain, and surrounding areas in grassland and along roadsides. Found in montane and sub-alpine grassland (dominated by <i>Poa</i> spp.), and montane or natural temperate grassland (dominated by <i>Themeda australis</i>) and Snow Gum (<i>Eucalyptus pauciflora</i>) Woodlands on the Monaro and Shoalhaven area. Apparently common on roadsides in parts of the Monaro, though it does not persist for long in such sites. Does not persist in heavily-grazed pastures of the Monaro or the Shoalhaven area.	Marginal	Unlikely	LOW
4733 Final v1.2	B-VIII			ngh environmental

Species Impact Statement

Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
<i>Leucochrysum albicans tricolor</i> Hoary Sunray E EPBC	Var. Endemic to south-eastern Australia, where it is currently known from three geographically separate areas in Tasmania, Victoria and NSW/ACT. In NSW it currently occurs on the Southern Tablelands adjacent areas in an area roughly bounded by Albury, Bega and Goulburn. Occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. Can occur in modified habitats such as semi-urban areas and roadsides. Highly dependent on the presence of bare ground for germination. In some areas, disturbance is required for successful establishment.	Present	Present	High. This species is considered as a subject species within this SIS and is assessed further within this document
<i>Rutidosis leiolepis</i> Monaro Golden Daisy TSC-V, EPBC-V	A low, tufted perennial with a woody root-stock with flowers that occur on erect woolly stems to about 25 cm tall. Known from 21 locations in Kosciuszko National Park (NP) on high treeless plains, mainly above an altitude of 1200 m and over an area totalling about 17 hectares. These populations occur mainly in the Kiandra, Long Plain and Happy Jacks Plain areas. A few other populations occur outside the park, further east on the Monaro Tableland, near Cooma, at Adaminaby and at Dry Plain. Within Kosciuszko NP, Monaro Golden Daisy is usually found above 1200 m in or on the margins of subalpine treeless plains supporting alpine heath and grassland communities of the Alpine Complex. Populations outside the park are found at lower altitudes of 860–1010 m, on the temperate montane grasslands of the Monaro Tablelands, typically dominated by grasses of the genera <i>Austrodanthonia</i> , <i>Austrostipa, Poa</i> and/or <i>Themeda triandra</i> .	Absent	None	Q



ngh environmental

Species Impact Statement Ellerton Drive Extension

B-IX

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Rutidosis leptorrhynchoides Button Wrinklewort TSC-E, EPBC-E	DGR Subject species A slender perennial wildflower that grows to about 30 cm in height. Flowers from December to April. Known from 17 populations in the ACT region (ten within the ACT, six near Queanbeyan and one near Goulburn (NSW)) and nine in Victoria. In NSW, large known populations include The Poplars and Gundaring Travelling Stock Reserve. Occurs in box-gum woodland, secondary grassland derived from box-gum woodland or in natural temperate grassland; and often in the ecotone between the two communities. Associated eucalypts at NSW and ACT sites include Blakely's Red Gum (<i>Eucalyptus blakelyi</i>), Long-leaved Box (<i>E. goniocalyx</i>), Yellow Box (<i>E. melliodora</i>). Red Box (<i>E. polyanthemos</i>) and Apple Box (<i>E. bridgesiana</i>). Many sites are associated with Kangaroo Grass (<i>Themeda triandra</i>).	Present	Unlikely. Target searches did not dete this species.	ed Low, however, this ct species is a subject species of this SIS and is assessed further within this document.
Lepidium hyssopifolium Aromatic Pepper-cress TSC-E, EPBC-E	An erect perennial herb growing 30 to 50 cm tall. In NSW, there is a population consisting of 6 plants near Bathurst, a population near Bungendore and Crookwell both on the Southern Tablelands. The species was also recorded near Armidale in 1945 and 1958 however it is not known whether it remains in this area. A specimen collected in the Cooma area about 100 years ago may also be Aromatic Peppercress. The species occurs in a variety of habitats including woodland with a grassy understorey and grassland. Appears to respond to disturbance, having appeared after soil disturbance at one site.	Present	Unlikely. Target searches did not dete this species.	ed Low ct
4733 Final v1.2	B.X			mgh environmental

ngh environment:

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
<i>Wilsonia rotundifolia</i> Round-leafed Wilsonia TSC-E	A prostrate, perennial plant with succulent leaves. It is salt tolerant and occurs in coastal saltmarshes and inland saline sites. Known from several sites in the Jervis Bay area, Royal National Park, near Deniliquin and on the lakebeds of Lake George and Lake Bathurst. The Lake George and Lake Bathurst populations appear to be locally extensive. The coastal populations occur at Lake Wollumboola, Swan Lake, Meringo Lagoon and Lake Coila. The total number of plants in coastal sites is only a few hundred. It occurs in mid marsh, mixed with <i>Sporobolus virginicus</i> and <i>Sarcocornia quinqueflora</i> .	Absent	None	Q
<i>Swainsona recta</i> Small Purple-pea TSC-E, EPBC-E	DGR Subject species A slender, erect perennial plant with few stems 20 - 30 cm high. The range of <i>S. recta</i> has contracted to two disjunct clusters in NSW, one between Wellington and Mudgee, and the other from Canberra and Queanbeyan south to Williamsdale. The largest known population has about 3,400 plants, scattered along 22 km of narrow railway easement in NSW from Tralee (south of Queanbeyan) to south of Williamsdale. Occurs in grassland and open woodland, often on stony hillsides, dominated by one or more of the following: <i>Callitris endichleri, C. glaucophylla, Eucalyptus blakelyi, E. bridgesiana, E. dives, E. melliodora, E. microcarpa, E. nortonii and E. polyanthemos.</i> Requires a forb-rich grassy groundlayer dominated by <i>Themeda triandra, Poa sieberiana</i> var. <i>sieberiana or Austrostipa</i> spp. Resprouts in autumn and winter from a woody root. It flowers in spring, peaking over two to three weeks in October.	Present	Unlikely. Targeted searches did not detect this species.	Low, however, this species is a subject species of this SIS and is assessed further within this document.

4733 Final v1.2

B-XI



Species	Description of habitat ⁷	Presence of habitat	Likelihood of occu	urrence	Possible ii	mpact?
<i>Swainsona sericea</i> Silky Swainson-pea TSC-V	DGR Subject species A prostrate or erect perennial, growing to 10 cm tall. Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. Found in Natural Temperate Grassland and Snow Gum <i>Eucalyptus</i> <i>pauciflora</i> Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with cypress-pines <i>Callitris</i> spp. Habitat on plains is unknown. Regenerates from seed after fire. Flowers spring to summer.	Present	Unlikely. searches did no this species.	Targeted t detect	Low, h species is a of this SIS further document	nowever, th a subject speci s and is assesse within th t.
<i>Thesium australe</i> Austral Toadflax TSC-V, EPBC-V	An erect perennial herb to 40 cm high. Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland, often found in damp sites in association with Kangaroo Grass (<i>Themeda australis</i>). A root parasite that takes water and some nutrients from other plants, especially Kangaroo Grass. Flowering is predominantly in spring and summer.	Absent	None		°Z	

Species Impact Statement Ellerton Drive Extension





				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
<i>Lepidium ginninderrense</i> Ginninderra Peppercress V EPBC	The Ginninderra Peppercress is a perennial herb that grows to a maximum height of approximately 20cm, with one to six branched stems arising from a rootstock. Its leaves are thick and shiny on the upper side. The flowers are small, 2mm wide and 1.5mm long and have no petals. The plant flowers in late Spring. The Ginninderra Peppercress grows in a natural temperate grassland on the flood plain of Ginninderra Creek, especially in locations where grass tussocks and other plant growth are short and open, thus there is little competition for space and light. The soil type over most of the site is a shallow red earth, with patches of colluvium on the footslopes and the population occurs at an altitude of c.580 metres.	Absent	None	Q
<i>Pelargonium</i> sp. Striatellum Omeo Stork's-bill E EPBC	Pelargonium sp. Striatellum (G.W.Carr 10345) is known to occur in New South Wales and Victoria. Four populations are known to occur in the Southern Tablelands of NSW at altitudes of 680–1030 metres above sea level. The population at Maffra Lake is in a travelling stock reserve, while the Lake Bathurst population is on grazing leasehold land. The two other populations (one possibly extinct) are on private grazing properties, south-west of Cooma. Pelargonium sp. Striatellum (G.W.Carr 10345) is known to occur in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. It is not known if the species' rhizomes and soil seedbank persist through prolonged inundation or drought.	Absent	None	Q
4733 Final v1.2	B-XIII			ngh environmental



				Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Orchids				
Prasophyllum petilum Tarengo Leek Orchid TSC-E, EPBC-E	Natural populations are known from a total of four sites in NSW: Boorowa, Captains Flat, Ilford and Delegate. Also occurs at Hall in the Australian Capital Territory. This species has also been recorded at Bowning Cemetery where it was experimentally introduced, though it is not known whether this population has persisted. Grows in patchy woodland in fertile soils. Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites. Also grows in grassy woodland in association with River Tussock <i>Poa</i> <i>labillardieri</i> Black Gum <i>Eucalyptus aggregata</i> and tea-trees <i>Leptospermum</i> spp. at Captains Flat and within the grassy groundlayer dominated by Kanagroo Grass under Box-Gum Woodland at Ilford (and Hall, ACT). Co-occurring species include <i>Pentapogon quadrifidus, Schoenus apogon, Drosera</i> <i>peltato, Sebaea ovata</i> and <i>Haloragis heterophylla</i> .	Absent	None	Q
Caladenia tessellata Tessellated Spider Orchid, Thick-lipped Spider Orchid TSC-E, EPBC-V	The Tessellated Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. In NSW current populations occur in Morton NP, Munmorah State Recreation Area, Braidwood (private property), South Pacific Heathland Reserve, Wyrrabalong NP, and Porter Creek Wetland Reserve. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Present	Unlikely	POW
4733 Final v1.2	B-XIV			ngh environmental

Species Impact Statement

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
<i>Diuris aequalis</i> Buttercup Doubletail TSC-E, EPBC-V	DGR Subject species A terrestrial 'donkey' orchid with golden-yellow to orange flowers. The Buttercup Doubletail has been recorded in Kanangra-Boyd National Park, Gurnang State Forest, towards Wombeyan Caves, the Taralga - Goulburn area, and the ranges between Braidwood, Tarago and Bungendore. Favours montane eucalypt forest and low open woodland with a grassy heathy understory, and secondary grassland, growing in gravelly clay-loam, often on gentle slopes (especially on the Great Dividing Range).	Present	Unlikely. Targeted searches did not detect this species.	Low, however, this species is a subject species of this SIS and is assessed further within this document.
Diuris pedunculata Small Snake Orchid TSC-E, EPBC-E	Confined to NSW. It was originally found scattered from Tenterfield south to the Hawkesbury River, but is now mainly found on the New England Tablelands, around Armidale, Uralla, Guyra and Ebor. The Small Snake Orchid grows on grassy slopes or flats. It prefers moist areas, and has been found growing in open areas of dry sclerophyll forests with grassy understoreys, in riparian forests (including gallery rainforests), swamp forests, in sub-alpine grasslands and herbfields. The species is not often found in dense forests or heavily shrubby areas.	Marginal	Unlikely	POM
4733 Final v1.2	B-XV			nah environmental



				Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
EECs				
White Box Yellow Box Blakely's Red Gum Woodland TSC-EEC, EPBC-CEEC	DGR Subject species An open woodland community (sometimes occurring as a forest formation). Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles. This ecological community occurs in areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 metres to 1200 metres.	Present	Present	High. This community is a subject species of this SIS and is assessed further within this document.
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions TSC-EEC, EPBC-E (slightly different to NSW)	Comprises a dense, open or sparse layer of shrubs (including species of <i>Baeckea</i> , <i>Callistemon</i> and <i>Leptospermum</i>) with soft-leaved sedges, grasses and forbs. It is the only type of wetland that may contain more than trace amounts of <i>Sphagnum</i> spp., the hummock peat-forming mosses. Small trees may be present as scattered emergents or absent. currently known from parts of the Local Government Areas of Armidale Dumaresq, Bega Valley, Bellingen, Blue Mountains, Bombala, Cooma-Monaro, Eurobodalla, Gloucester, Greater Argyle, Guyra, Hawkesbury, Lithgow, Oberon, Palerang, Severn, Shoalhaven, Snowy River, Tenterfield, Tumbarumba, Tumut, Upper Lachlan and Wingecarribee but may occur elsewhere in these bioregions. nlt occurs on undulating tablelands and plateaux, above 400-500 m elevation, generally in catchments with basic volcanic or fine-grained sedimentary substrates or, occasionally, granite.	Absent	None	ğ
4733 Final v1.2	B-XVI			ngh environmental

Species Impact Statement

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions TSC-EEC TSC-EEC	Dominated by an open eucalypt canopy of variable composition. <i>Eucalyptus viminalis, E. radiata, E. dalrympleana</i> subsp. <i>dalrympleana</i> and <i>E. pauciflora</i> may occur in the community in pure stands or in varying combinations. The community typically has an open canopy of eucalypts with sparse mid-story shrubs (e.g. <i>Acacia melanoxylon</i> and <i>A.</i> <i>dealbata</i>) and understory shrubs (e.g. <i>Rubus parvifolius</i>) and a dense groundcover of herbs and grasses, although disturbed stands may lack either or both of the woody strata. Tableland Basalt Forest is currently found in the Eastern Highlands and Southern and Central Tablelands, covering the local government areas of Bathurst Regional, Goulburn Mulwaree, Oberon, Palerang, Shoalhaven, Upper Lachlan and Wingecarribee.	Absent	None	Ø
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions TSC-EEC	An open woodland community (sometimes occurring as an open-forest formation), in which the most obvious species are one or more of the following: Snow Gum (<i>Eucalyptus pauciflora</i>), Black Sallee (<i>E. stellulata</i>), Candlebark (<i>E. rubida</i>) and Ribbon Gum (<i>E. viminalis</i>). Occurs in the following bioregions: South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes. Mainly occurs on valley floors, margins of frost hollows, footslopes and undulating hills. Mainly occurs between approximately 600 and 1400 m in altitude. Occurs on a variety of substrates including granite, basalt, metasediments and Quaternary alluvium.	Absent	None	8
4733 Final v1.2	B-XVII			ngh environmental

				Species Impact Statement Ellerton Drive Extension
Species	Description of habitat ⁷	Presence of habitat	Likelihood of occurrence	Possible impact?
Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory E EPBC	Natural temperate grassland is grassy vegetation dominated by moderately tall (25–50 cm) to tall (50–100 cm), dense to open tussock grasses in the genera <i>Austrodanthonia</i> , <i>Austrostipa</i> , <i>Bothriochloa</i> , <i>Poa</i> and <i>Themeda</i> . Up to 70% of all plant species may be forbs (i.e. herbaceous, non-grassy/non- grass-like plants). The community may be treeless or contain up to 10% cover of trees, shrubs or sedges. It occurs within the geographical region of the Southern Tablelands of NSW and the ACT at altitudes between 560 metres in central and northern parts of its distribution and 1200 metres in the south, in valleys influenced by cold air drainage and in broad plains.	Absent	None	Ŋ
E TSC = listed as Endangered under S E EPBC = listed as Endangered under <i>Conservation Act 1999</i> . V TSC = listed as Vulnerable under S V EPBC = listed as Vulnerable under 1 <i>Conservation Act 1999</i> .	schedule 1 of the NSW <i>Threatened Species Conservation Act 1995</i> • the Commonwealth <i>Environment Protection & Biodiversity</i> chedule 2 of the NSW <i>Threatened Species Conservation Act 1995</i> . the Commonwealth <i>Environment Protection & Biodiversity</i>	EEC TSC = Endangered Ec 1995 CE EPBC = listed as Critics Protection & Biodiversity	ological Community listed under a ally Endangered under the Commo <i>Conservation Act 1999</i> .	Schedule 1 of the NSW TSC Act onwealth <i>Environment</i>



4733 Final v1.2

B-XVIII

B.2 FAUNA AND ENDANGERED POPULATIONS

Note: Marine and pelagic species have not been included in this assessment

Species and Status	Description of habitat ⁸	Presence of habitat	Records in the Locality (10 km)	Possible Impact
Invertebrates				
Golden Sun Moth <i>Synemon plana</i> E TSC CE EPBC	Ideal habitat is Natural Temperate and grassy Box-Gum Woodland in which ground cover is dominated by wallaby grasses (<i>Austrodanthonia</i> sp.). In the ACT, the grasses include Silvertop Wallaby Grass and in NSW, A. <i>auriculata</i> , A. <i>carphoides</i> , A. <i>pilosa</i> , A <i>eriantha</i> , and A <i>setacea</i> . At least a 40 % cover of Wallaby Grass is optimal for the species. However, is known to occur in small, fragmented and disturbed grassland remnants where native species may not be dominant.	Marginal	Yes. Five records west and south west of study area.	Low, however, this species is a subject species of this SIS and is assessed further within this document.
Amphibians				
Giant Burrowing Frog Heleioporus australiacus V TSC V EPBC	Breeding habitat is soaks or pools within first or second order streams, 'hanging swamp' seepage lines and where small pools form from the collected water. Non-breeding habitat is heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	Absent	Q	ΝΟ



⁸ Information sourced from species profiles on NSW DECCW's threatened species database or the Australian Government's Species Profiles and Threats database (SPRAT) unless otherwise stated.

DECCW threatened species database: <u>http://www.threatenedspecies.environment.nsw.gov.au/index.aspx</u> SPRAT: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Species Impact Statement Ellerton Drive Extension

4733 Final v1.2



B-XX

ngh environmental

4733 Final v1.2

B-XXI

Species Impact Statement Ellerton Drive Extension

Species and Status	Description of habitat ⁸	Presence of habitat	Records in the Locality (10 km)	Possible Impact
Little Whip Snake Suta flagellum V TSC	The Little Whip Snake is found within an area bounded by Crookwell in the north, Bombala in the south, Tumbarumba to the west and Braidwood to the east. Occurs in natural Temperate Grasslands and grassy woodlands, secondary grasslands. Found on well drained grassy slopes associated with loose scattered rock. Primarily nocturnal.	Marginal	Q	No. Surveys did not detect the species and habitat not suitable.
Grassland Earless Dragon <i>Tympanocryptis</i> <i>Singuicolla</i> E TSC	The only populations now known are in the ACT and adjacent NSW at Queanbeyan, and on the Monaro Basalt Plains between Cooma and south-west of Nimmitabel. Inhabits naturally treeless native tussock grassland on black clay, brown clay loams and podzolic soils. Where rocks are not present, the lizards shelter in spider burrows.	Absent	Q	NO
Diurnal Birds				
Spotted Harrier Circus assimilis V TSC	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Present	Q	NO
Little Eagle <i>Hieraaetus morphnoides</i> V TSC	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Present	Yes. One record ~ 10 km south-east of study area	No. No raptor nests were found during the survey and the study area does not support typical habitat for this species. Very little suitable open foraging habitat present.

Species Impact Statement Ellerton Drive Extension

B-XXII

ecies and Status ing-gang Cockatoo <i>llocephalon</i> <i>ibriatum</i> SSC	Description of habitat ⁸ Occupies a range of forest and woodland habitats and may be an altitudinal migrant, moving to lower altitudes and drier open forest over winter, including box-ironbox assemblages. May also occur in sub-alpine woodland and occasionally in temperate rainforests.	Presence of habitat Present	Records in the Locality (10 km) Yes. Two records nearby study area. Species recorded north and south of study area	Possible Impact Moderate, however, this species is a subject species of this SIS and is assessed further within
sy Black- katoo <i>ptorhynchus</i> ami C	hollow-bearing trees. Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (<i>Allocasuarina littoralis</i>), Forest She-oak (<i>A. torulosa</i>) or Drooping She-oak (<i>A. verticillata</i>) occur. Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species). Dependent on large hollow-	Absent	watch surveys. Wo	No
e Lorikeet sopsitta pusilla C	Dearing eucarypts for nest stres. Nomadic or locally nomadic species. Forages in the canopy of open Eucalyptus forest and woodland, Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	Present	Q	N
t Parrot a <i>mus discolour</i> C BC	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap- sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. microcarpa</i> , Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> .	Marginal	P	Q

B-XXIII



Species Impact Statement Ellerton Drive Extension

4733 Final v1.2

Species and Status	Description of habitat ⁸	Presence of habitat	Records in the Locality (10 km)	Possible Impact
Turquoise Parrot <i>Neophema pulchella</i> V TSC	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December.	Present	N	N
Superb Parrot <i>Polytelis swainsonii</i> V TSC V EPBC	Boree, River Red Gum and Box-Gum Woodland including isolated paddock trees. Nest in Blakely's Red Gum, Yellow Box, Red Box, Apple Box. Feed in trees and understorey shrubs and on the ground eating grass seeds and herbaceous plants. May forage up to 10 km from nesting sites.	Present	Q	No – core breeding area near Yass
Brown Treecreeper Climacteris picumnus V TSC	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. Usually not found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging. It is sedentary and nests in tree hollows within permanent territories.	Marginal – southern Box-Gum Woodland patch	Yes. One record south of study area.	Low, however, this species is a subject species of this SIS and is assessed further within this document.
Speckled Warbler <i>Pyrrholaemus</i> saggitatus V TSC	Occupies a wide range of <i>Eucalyptus</i> dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. Pairs are sedentary and occupy a breeding territory of about 10 ha, with a slightly larger home-range when not breeding.	Present	Yes. Known for study area and six records south of study area.	High. This species is a subject species of this SIS and is assessed further within this document.

ngh environmental

4733 Final v1.2

B-XXIV
			Specie Elle	s Impact Statement rton Drive Extension
Species and Status	Description of habitat ⁸	Presence of habitat	Records in the Locality (10 km)	Possible Impact
Regent Honeyeater Anthochaera Phrygia E TSC E EPBC M EPBC	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The Regent Honeyeater mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum and White Box. It is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar.	Present in Box-Gum Woodland	Q	Q
Painted Honeyeater Grantiella picta V TSC	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW. Known from Boree, Brigalow, Box-Ironbark and Box-Gum Woodlands. Specialist forager upon mistletoes preferring the genus <i>Amyena</i> . Nests from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, sheoak, paperbark or mistletoe branches.	Present in Box-Gum Woodland	No, but has been recently recorded in a nearby patch of woodland (pers.comm A.Treweek 06.11.12).	Low, however, this species is a subject species of this SIS and is assessed further within this document.
White-fronted Chat Epthianura albifrons V TSC	Found mostly in temperate to arid climates and very rarely sub- tropical areas, occupies foothills and lowlands up to 1000 m above sea level. Occurs in damp open habitats along the coast, and near waterways in the western part of the state.	Absent	Q	No
Varied Sittella <i>Daphoenositta</i> <i>chrysoptera</i> V TSC	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Survival and population viability are sensitive to habitat isolation, reduced patch size and habitat simplification, including reductions in tree species diversity, tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter. The Varied Sittella is also adversely affected by the dominance of Noisy Miners in woodland patches.	Present	Yes. One record to the west of study area in Jerrabomberra Reserve.	Q

4733 Final v1.2

B-XXV

Species and Status	Description of habitat ⁸	Presence of habitat	Records in the Locality (10 km)	Possible Impact
Olive Whistler Pachycephala olivacea V TSC	Inhabits the wet forests on the ranges of the east coast. In the south it is found inland to the Snowy Mountains and the Brindabella Range. Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes. Forage in trees and shrubs and on the ground, feeding on berries and insects. Make nests of twigs and grass in low forks of shrubs.	Marginal	No.	No
Hooded Robin Melanodryas cucullata V TSC	Inhabits lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey.	Present	Yes. Three records south of study area.	Low, however, this species is a subject species of this SIS and is assessed further within this document.
Scarlet Robin Petroica boodang V TSC	Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Present	Yes. Several records east of study area. Known from Cuumbuen N.R.	Low, however, this species is a subject species of this SIS and is assessed further within this document.
Flame Robin Petroica phoenicea V TSC	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes.	Present	Yes. Two records south of study area.	No
Pink Robin Petroica rodinogaster V TSC	Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. Catches prey by the perch-and-pounce method, foraging more on the ground than the more flycatcher-like Rose Robin. Insects and spiders are the main dietary items.	Absent	No	No



B-XXVI

Possible Impact	Low, however, this species is a subject species of this SIS and is assessed further within this document.		2	2
Records in the Locality (10 km)	Yes, predominantly south of study area		0	Q
Presence of habitat	Present – southern Box- Gum Woodland		Present	Present - Foraging habitat only
Description of habitat ⁸	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum <i>Eucalyptus pauciflora</i> Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.		Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Is flexible in its habitat use and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as <i>Acacia</i> and <i>Casuarina</i> species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Argyle Apple <i>Euclayptus cinerea</i> , Lilli Pilli, Turpentine <i>Syncarpia glomulifera</i> , Black She-oak <i>Allocasuarina littoralis</i> , Blackwood <i>Acacia melanoxylon</i> , Rough-barked Apple <i>Angorphora floribunda</i> , Cherry Ballart <i>Exocarpus cupresiformis</i> and a number of eucalypt species.
Species and Status	Diamond Firetail Stagonopleura guttata V TSC	Nocturnal Birds	Barking Owl <i>Ninox connivens</i> V TSC	Powerful Owl <i>Ninox strenua</i> V TSC

ngh environmental

B-XXVII

S

t Records in the Locality Possible Impact (10 km)		N	 Y es - only one north or Low, however, this study area. However, species is a subject anecdotal evidence of species of this SIS and recent sighting in assessed further within neighbouring backyard this document. Comm. A. Treweek) 	N
Presence of habitat		Absent	Present - secondary	Marginal
Description of habitat ⁸		Occurs in a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub- alpine zone to the coastline. Use 'latrine sites', often on flat rocks among boulder fields and rocky cliff-faces. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Usually traverse their ranges along densely vegetated creeklines.	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees.	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; soft fruits are eaten when flowers are unavailable. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (Pseudocheirus peregrinus) dreys or thickets of vegetation, (e.g grass-tree skirts).
Species and Status	Mammals (excluding bats)	Spotted-tailed Quoll Dasyurus maculatus V TSC E EPBC	Koala Phascolarctos cinereus V TSC	Eastern Pygmy- possum <i>Cercartetus nanus</i> V TSC



B-XXVIII

ad-toothed RatDense vegetation of wet grass, sedge or heath environment, stacomys fuscusAbsentNoSheltering nests of grass are built in the understorey or under logs.Sheltering nests of grass are built in the understorey or under logs.No	scies and Status low-bellied Glider aurus australis SC sh-tailed Rock- laby rogale penicillata SC SC SC SC SC PBC oky Mouse udomys fumeus SC PBC	Description of habitat⁶ Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. Den, often in family groups, in hollows of large trees. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and orth. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and overhangs and are most active at night. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Occupies heath habitat on ridge tops and slopes in sclerophyll forest, heathland and open-forest from the coast (in Victoria) to sub-alpine regions of up to 1800 metres, but sometimes and under the skirts of Grass Trees <i>Xanthorrhoea spp.</i>	Presence of habitat Absent Absent Absent Absent	Records in the Locality (10 km) No No No No	No N
	-toothed Rat scomys fuscus	Dense vegetation of wet grass, sedge or heath environment, Sheltering nests of grass are built in the understorey or under logs.	Absent	N	No



B-XXIX

Species and Status	Microbats	Eastern False Pipistrelle <i>Falsistrellus</i> t <i>asmaniensis</i> V TSC	Eastern Bent-wing- bat Miniopterus schreibersii oceanensis V TSC	Southern Myotis Myotis macropus V TSC
Description of habitat ⁸		Found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. Hunt in forested areas, catching moths and other and other flying insects above the tree tops.	Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Churchill 1998). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Churchill 1998). However the species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards 1998).
Presence of habitat		Marginal	Marginal – foraging only	Absent
Records in the Locality (10 km)		Yes. One record west of study area within Cuumbeun N.R.	Yes. Two records west and south of study area.	Yes. One record east of study area within Cuumbeun N.R., but otherwise unknown in locality.
Possible Impact		Moderate, this species is a subject species of this SIS and is assessed further within this document.	Low, however, this species is a subject species of this SIS and is assessed further within this document.	No. Not detected during surveys and not common to the locality. Not detected in other studies.



4733 Final v1.2

B-XXX

Species and Status Greater Long-eared Bat (now described as new species	Description of habitat ⁸ Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin. Records of the species are predominantly within the arid/semi-arid zone species, with focal	Presence of habitat Marginal, but predominantly absent.	Records in the Locality (10 km) No	Possible Impact No. No records for this species occur within the locality and the species
Corben's Long-eared Bat) <i>Nyctophilus corbeni</i> V EPBC V EPBC	areas being Pilliga Scrub and Murray mallee areas in SW NSW & NW Vic. Inhabits a variety of vegetation types, including mallee, bulloke <i>Allocasuarina leuhmanni</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW. Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground.			is not known or predicted for the ACT o Queanbeyan LGA. Mosi records lie west of the Great Dividing Range. One known record has been recorded by GHD (2009), but the species not known to be a regular visitor to the locality.
Wetland Birds				
Magpie Goose Anseranas semipalmata V TSC	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes.	Absent	N	No
Blue-billed Duck <i>Oxyura australis</i> V TSC	Deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover.	Absent	No	No
Freckled Duck Stictonetta naevosa V TSC	Permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water.	Absent	Q	No

B-XXXI





4733 Final v1.2

B-XXXII

act				
Possible Imp	°2	õ	N	õ
Records in the Locality (10 km)	2	N	Q	N
Presence of habitat	Present	Present	Present	Present
Description of habitat ⁸	In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Occur over most types of habitat but most often recorded above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks. The species has been recorded roosting in trees in forests and woodlands, both among dense foliage in the canopy or in hollows.	Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. Also common in cleared and semi-cleared habitats and is regularly recorded in other disturbed habitats including roadside vegetation. It has also been recorded in towns and suburbs.	Rainforests, eucalypt woodlands, coastal scrub and damp gullies. May also be found in more open woodland when migrating.	Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Satin Flycatchers mainly inhabit eucalypt forests, often near wetlands or watercourses. They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest.
Species and Status	White-throated Needletail <i>Hirundapus</i> caudacutus M EPBC	Rainbow Bee-eater <i>Merops ornatus</i> M EPBC	Black-faced Monarch <i>Monarcha melanopsis</i> M EPBC	Satin Flycatcher <i>Myiagra cyanoleuca</i> M EPBC

B-XXXIII





ords in the Locality Possible Impact (m)	Q	Q	Q		Q	Q
Presence of habitat [10]	Present No	Absent No	Marginal		Marginal	Absent No
Description of habitat ⁸	Usually recorded in wet sclerophyll forests, but may also been found in drier sclerophyll forests and woodlands with a shrubby or heath understorey.	Range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs.	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer.		Clear rocky streams to slow flowing, turbid rivers and billabongs. Usually found near complex structural cover such as large rocks, snags, overhanging vegetation and other woody structures.	Prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks.
Species and Status	Rufous Fantail <i>Rhipidura rufifrons</i> M EPBC	Great/White Egret <i>Ardea alba</i> M EPBC	Cattle Egret <i>Ardea ibis</i> M EPBC	Fish	Murray Cod Maccullochella peelii V EPBC	Macquarie Perch <i>Macquaria</i> <i>australasica</i> E FMA E EPBC

ngh environmental

B-XXXIV

APPENDIX C FIELD SURVEY RESULTS



C.1 FLORA

The following provides a list of flora species that were recorded within the study area and locality during the quadrat and random meander based surveys. Relative abundance is given by a cover abundance scale (modified Braun-Blanquet) as described by Rehwinkle 2007 according to the vegetation type (random meanders) or quadrat they were found in:

- r <5% cover and solitary (<4 individuals)
- + <5% cover and few (4-15 individuals)
- 1 <5% cover and numerous/scattered (>15 individuals)
- 2 5 25% cover
- 3 26 50% cover
- 4 51 75% cover
- 5 >75% cover

Vegetation community abbreviations are as follows:

- DSF Tablelands Dry Shrub/Tussock Grass Forest
- GW Tableland Dry Grassy Woodland

Cover/abundance scores for broad vegetation types relate to general abundance over the area surveyed, not to representative quadrats.

Species of conservation significance are highlighted. Introduced species are denoted by an asterisk (*). Weeds declared as noxious within the Queanbeyan City local control area are denoted by a triangle (\triangle). Where uncertainty exists due to the unavailability of mature reproductive material, the taxon is preceded by a question mark, or plants are identified to genus level only. Botanical nomenclature follows G.J. Harden (ed) (1990-2002) Flora of New South Wales, UNSW Press, except where recent changes have occurred.



Scientific name																				
	Common name	Family									Abunda	nce								
			GW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	PC6	LC7	LC8	I 601	LC10
TREES																				
*Acacia baileyana	Cootamundra Wattle	Fabaceae	+	L								-								
Acacia dealbata ssp dealbata	Silver Wattle	Fabaceae	1														+	1	+	
Acacia deanei ssp. paucijuga		Fabaceae		+																
Acacia falciformis	Broad-leaf Hickory	Fabaceae		-																
Acacia mearnsii	Black Wattle	Fabaceae	1	L	L			+	+						L					
Acacia pycnantha	Golden Wattle	Fabaceae	+																	
Acacia rubida		Fabaceae	1	1			+							+	+	+	-			
*Acer negundo	Box Elder	Aceraceae	+	-																
*Acer palmatum	Japanese Maple	Aceraceae	-																	
riangle *Ailanthus altissima	Tree of Heaven	Simaroubaceae	-	+																
Brachychiton populneus	Kurrajong	Sterculiaceae	-	<i>ـ</i>																
*Celtis chinense	Hackberry	Ulmaceae	+	L																
*Crataegus monogyna	Hawthorn	Malaceae	-	1			ю			-										
Eucalyptus albens	White Box	Myrtaceae										2								
Eucalyptus bridgesiana	Apple Box	Myrtaceae	-	1					+					2		-		2		
Eucalyptus macrorhyncha	Red Stringybark	Myrtaceae		1			r								r	r	r		+	
Eucalyptus melliodora	Yellow Box	Myrtaceae	1	1	L		2	2	2	L	+	L	2		2	L	+	2	+	L
Eucalyptus mannifera	Brittle Gum	Myrtaceae											2	-				L	+	
Eucalyptus nortonii	Mealy Bundy	Myrtaceae		1																
Eucalyptus polyanthemos ssp polyanthemos	Red Box	Myrtaceae	2	2	2	2							L		2	L				
Eucalyptus rossii	Scribbly Gum	Myrtaceae	L	2								L								
Exocarpos cupressiformis	Native Cherry	Santalaceae	r	L													L			
*Fraxinus sp.	Ash		L																	
*Ligustrum lucidum	Large-leaved Privet	Oleaceae	1	1			r		L											
*Malus x domestica	Apple	Malaceae	L						L											

C-III

ngh environmental

Species Impact Statement Ellerton Drive Extension

.

Scientific name Comm *Pinus sp. Pine *Populus nigra var. Lomba 'ttalica' Aprico *Prunus armeniaca Aprico *Prunus cerasifera Plum SHRUBS, SUB-SHRUBS	ion name ardy Poplar ot	Family	Ŋ								Abundar	JCe					Į		
*Pinus sp. Pine *Populus nigra var. Lomba 'Italica' Aprico *Prunus armeniaca Aprico *Prunus cerasifera Plum SHRUBS, SUB-SHRUBS	ardy Poplar ot		GW														Į		
*Pinus sp. Pine *Populus nigra var. Lomba 'Italica' Lomba *Prunus armeniaca Aprico *Prunus cerasifera Plum SHRUBS, SUB-SHRUBS Plum	ardy Poplar ot			DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4 L	C5	- LC6			9 LC10
*Populus nigra var. Lomba 'Italica' Aprico *Prunus armeniaca Aprico *Prunus cerasifera Plum SHRUBS, SUB-SHRUBS	ardy Poplar ot	Pinaceae		-															
*Prunus armeniaca Aprico *Prunus cerasifera Plum SHRUBS, SUB-SHRUBS	ot	Salicaceae																	
*Prunus cerasifera Plum SHRUBS, SUB-SHRUBS		Amygdalaceae	L																
SHRUBS, SUB-SHRUBS		Amygdalaceae	+	L															
*Acacia boormannii buowy Wattle	y River e	Fabaceae		-															
Acacia buxifolia ssp. buxifolia		Fabaceae		<i>۲</i>															
Acacia dawsonii Povert	ty Wattle	Fabaceae		+		+									1	-	۲.	-	
Acacia genistifolia Early V	Wattle	Fabaceae	+	+															
Amyema pendula a mistl	letoe	Loranthaceae	1	1		2			-		-								
Astroloma humifusum Honey	/pots	Ericaceae	-	-			-											-	
Bossiaea buxifolia		Fabaceae	+	+															
Bursaria spinosa ssp lasiophylla	horn	Pittosporaceae	1	2		2	L							+		r			
Cassinia longifolia Dogwc	poo	Asteraceae	L	+	L								r			+		Ŧ	
Cassinia quinquefaria Dogwc	poo	Asteraceae	1	+		L		L	-						L				
*Cotoneaster ?franchetii	leaster	Malaceae	L																
*Cotoneaster glaucophyllus		Malaceae		L															
<i>Cryptandra amara</i> var. amara		Rhamnaceae													-		+		
Cryptandra amara var. floribunda		Rhamnaceae	+	1															
<i>Cryptandra amara</i> var. longiflora		Rhamnaceae																	L
riangle * Cytisus scoparius Scotch	h Broom	Fabaceae		L															
Daviesia genistifolia Broom	n Bitter Pea	Fabaceae	L	2		1							r				r		
Dillwynia sericea		Fabaceae	L	1		+							r						
Dillwynia sieberi		Fabaceae	L	2															
Dodonaea viscosa ssp angustissima	hsh	Sapindaceae	+	2															
*Grevillea juniperina		Proteaceae		L															

C-IV



cies Impact Statement	llerton Drive Extension
Species	Eller

icientific name	Common name	Family									Abunda	nce								
			βŴ	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	PC6	LC7	LC8	FC9	LC10
Grevillea osmarinifolia		Proteaceae	<i>د</i>	-																
ibbertia obtusifolia	Guinea-flower	Dilleniaceae	+	1		+				-			-	L	-				+	
idigofera australis	Austral Indigo	Fabaceae	1	1																
unzea ericoides	Burgan	Myrtaceae	1	2																
Ligustrum sinense	Small-leaved Privet	Oleaceae	<u>۔</u>	-			-													
eucopogon attenuatus		Ericaceae		+																
.eucopogon fletcheri sp. brevisepalus		Ericaceae		1		+														
issanthe strigosa	Peach Heath	Ericaceae	-	1		2												-		
Melichrus urceolatus	Urn Heath	Ericaceae	-	1		L				+					-				-	+
∆ * <i>Opuntia</i> sp.	Prickly Pear	Cactaceae																		
^p imelea curviflora var. ericea	Curved Rice- flower	Thymelaeaceae	1	1	+	1				-		-			+				1	
^ə imelea glauca	Shrubby Rice- flower	Thymelaeaceae	<i>ـ</i>																	
omaderris betulina		Rhamnaceae	-	æ														-		
^o ultenaea microphylla		Fabaceae		2		2							-				-			
oultenaea procumbens		Fabaceae	<u>۔</u>	2									L		+	-	+		+	
*Pyracantha angustifolia	Firethorn	Malaceae	1	+			-		-											
∆ *Rosa rubiginosa	Sweet Briar	Rosaceae	1	1			+	-	-	-		-		-		-	-	-		-
Δ *Rubus fruticosus pp. agg.	Blackberry	Rosaceae	1	1			2						r			L	r	L		
styphelia triflora		Ericaceae	L	1												r				
ERNS																				
Cheilanthes Tustrotenuifolia		Sinopteridaceae	+							-				+						
Cheilanthes sieberi ssp ieberi	Rock or Mulga Fern	Sinopteridaceae	1	+		-						-								-
/INES AND TWINERS																				
*Araujia sericifera	Moth Plant	Asclepidialaceae	-																	
člematis leptophylla	Small-leaved Clematis	Ranunculaceae	+	1				r												
Convolvulus angustissimus		Convolvulaceae		+				+			+				L					1





AnotherAnotherAnotherAnother11 <th></th> <th>•</th> <th>Ellerton</th> <th>Drive Ex</th> <th>tension</th>																	•	Ellerton	Drive Ex	tension
Automatical constant Automatic																				
And the formation of the formation	Scientific name	Common name	Family									Abunda	ance							
Observationality Observationality Observationality Inclusionality Inclusionality <thinclusionality< th=""> Inclusionality In</thinclusionality<>				GW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	PC6	LC7	rcs ri	C9 LC10
Image: constrained	Einadia trigonus	Fish Weed	Chenopodiaceae										-							
Antionality in the second of the se	Glycine clandestina	Twining Glycine	Fabaceae	-	+											-		-		
upper listic listicand listi listi listic listic listic listic listic listic listic	Glycine tabacina		Fabaceae	1					-	+	+	-	+		-	1	-	+		-
A set of the set of	*Lonicera japonica	Japanese Honeysuckle	Caprifoliaceae	L	1			+												
Accesse of the control Exercise Interface Interface <thinterface< th=""></thinterface<>	FORBS																			
Actionation	Acaena echinata		Rosaceae	+		L		+							+	+	1		+	+
Actorbit bilancial Registration Registratin Registration Registra	Acaena ovina		Rosaceae	1	1		L		L	+	1	+			+	+		1	L	+
AuguatureAutoleageLanceII <th< td=""><td>*Acetosella vulgaris</td><td>Sheep Sorrel</td><td>Polygonaceae</td><td>1</td><td>1</td><td>1</td><td></td><td></td><td></td><td></td><td>+</td><td></td><td></td><td>1</td><td>1</td><td></td><td></td><td></td><td>-</td><td></td></th<>	*Acetosella vulgaris	Sheep Sorrel	Polygonaceae	1	1	1					+			1	1				-	
Vangatis weretisSatisfergenetisItItItVangatis weretisPredeptentiRotoleeIIItItVantationa controlPredeptentiRotoleeItItItItVantationa controlPredeptentiControlPredeptentiItItItVantationa controlPredeptentiControlPredeptentiItItItVantationa controlPredeptentiControlItItItItItVantationa controlManual UAnanactionaItItItItItItVantationa controlManual UAnanactionaItItItItItItVantationa controlManual UAnanactionaItItItItItItVantationa controlManual UAnanactionaItItItItItItVantationa controlManual UAnanactionaItItItItItItVantationaManual UAnanactionaItItItItItItItManual UAnanceItItItItItItItItItVantationaManual UAnanceItItItItItItItItManual UAnanactionManual UAnanactionItItItItItItItManual UManual UAnanaction<	Ajuga australis	Austral Bugle	Lamiaceae												-	-		-		+
YellowersionRadio flowerRadio flower<	*Anagallis arvensis	Scarlet Pimpernel	Primulaceae	+	-			-		-										
Vacuational controlutionC	*Aphanes arvensis	Parsley Piert	Rosaceae		-			-												
Arearing secprifying through minusThrough and through minusThrough and through minusthe initial matrixthe initial matrixApproximationBuild cold is cold i	*Arctotheca calendula	Capeweed	Asteraceae	-																
AttropolationalityVanilativyAntheticacea+++ $derignousdeparting themdeparting themdeparting themdeparting themdeparting themdeparting themderignouscommondeparting themdeparting themdeparting themdeparting themdeparting themdeparting themdeparting themderignouscommondeparting themdeparting themdeparting themdeparting themdeparting themdeparting themdeparting themderivativedeparting themdeparting themdeparting themdeparting themdeparting themdeparting themdeparting themdeparting themdeparting themderivativedeparting themdeparting th$	*Arenaria serpyllifolia	Thyme-leaved Sandwort	Caryophyllaceae																+	
Asparagus densificandsAsparagus fermAsparagus ferm </td <td>Arthropodium minus</td> <td>Vanilla Lily</td> <td>Anthericaceae</td> <td></td> <td>+</td> <td></td> <td></td> <td></td> <td></td> <td></td>	Arthropodium minus	Vanilla Lily	Anthericaceae												+					
Approgras officindsExplanationCommonExplanationCommonExplanation	*Asparagus densiflorus	Asparagus Fern	Asparagaceae	L																
AgendicativeCommon ModuffitCommon ModuffitCommon ModuffitImage with the second secon	*Asparagus officinalis	Edible Asparagus	Asparagaceae	L																
Brochycore diariesAsteraceeIAsteraceeIIIIIBulhue bubosaBulhue LubosaBulhue LubosaBulhue LubosaBulhue LubosaBulhue LubosaIII <td>Asperula conferta</td> <td>Common Woodruff</td> <td>Rubiaceae</td> <td>1</td> <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td>1</td> <td>-</td> <td>-</td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td>1</td> <td>-</td>	Asperula conferta	Common Woodruff	Rubiaceae	1				1			1	-	-			1			1	-
Untrince bulbesBulbine bulbesBulbine bulbesBulbine bulbesBulbine bulbesIntegration </td <td>Brachyscome ciliaris</td> <td></td> <td>Asteraceae</td> <td></td>	Brachyscome ciliaris		Asteraceae																	
Calotic scabiosfoliaRough Bur-daisyAtteracearrr"a.r. integrifoliaBurder ThistleAtteracear1r"contoursSelfor ThistleAtteraceaer1r"contoursSaffron ThistleAtteraceaer1r"contoursSaffron ThistleAtteraceaer1r"contournusSaffron ThistleAtteraceaer1r"contournusCentauryCentauryCentauryr1"contournusCentauryCentauryCentauryrr"contournusCentauryCentauryCentauryrr1"contournusCentauryCentauryCentauryrrr"contournusCentauryCentauryCentauryrrrr"contournusCentauryCentauryCentauryrrrrr"contournusCentauryCentauryCentauryrrrrr"contournusCentauryCentauryCentauryrrrrrr"contournusCentauryCentauryCentauryCentauryrrrrr"contournusCentauryCentauryCentauryCentauryrrrrr"contournusCentauryCentauryCentauryCentauryrrrrr"contournusCentaury </td <td>Bulbine bulbosa</td> <td>Bulbine Lily</td> <td>Asphodelaceae</td> <td>1</td> <td>+</td> <td>2</td> <td></td> <td></td> <td></td> <td>1</td> <td>1</td> <td></td> <td>+</td> <td></td> <td></td> <td></td> <td>1</td> <td></td> <td>т.</td> <td>+ 1</td>	Bulbine bulbosa	Bulbine Lily	Asphodelaceae	1	+	2				1	1		+				1		т.	+ 1
*Carduas bycnocephalusBinder ThistleAsteracear11*ControbundSaffron ThistleAsteracearrrr*ControbundSaffron ThistleAsteracearrrr*ControbundCentauryGentiancea11rr1*ControbundCentauryGentiancea11rrr1*ControbundCentauryGentiancea11rrrrr*ControbundMouseCentauryCentauryCentauryrrrrrr*ControbundCentauryCentauryCentauryrrrrrrr*ControbundCentauryCentauryCentauryrrrrrrr*ControbundCentauryCentauryCentauryrrrrrrr*CondresizeCentauryCentauryCentauryrrrrrrr*CondresizeCentauryCentauryCentauryrrrrrrr*CondresizeCentauryCentauryCentauryrrrrrrr*CondresizeCentauryCentauryCentauryrrrrrrr*CondresizeCentauryCentauryCentauryrrrrr<	Calotis scabiosifolia var. integrifolia	Rough Burr-daisy	Asteraceae																	
*Carthanus landSaffron ThistleAstracaeerrr*Carthanus landCentauriumCentauriumCentauriumCentaurium11r1*CentauriumCentauriumCentauriumCentauriumCentaurium11r1r1rr1rrr1rrr <td< td=""><td>*Carduus pycnocephalus</td><td>Slender Thistle</td><td>Asteraceae</td><td>L</td><td>1</td><td></td><td></td><td>r</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td></td<>	*Carduus pycnocephalus	Slender Thistle	Asteraceae	L	1			r							1					
*Centaurium exytraceaEntaury GentianceaEntaury GentianceaEntaury and Centaurium sp.II	*Carthamus lanatus	Saffron Thistle	Asteraceae	L								L								
*Centaurium Sp. Centaury Gentancee 1 <th1< th=""> 1 <th1< th=""> 1</th1<></th1<>	*Centaurium erythraea	Centaury	Gentianaceae															1		
*Cerastium sp. Mouse Chickweed Caryophyllaceae + Chamaes/ce drummordii Custic Weed Euphorbiaceae + + r r <i>drummordii</i> Castic Weed Euphorbiaceae + + r r r <i>drummordii</i> Skeleton Weed Euphorbiaceae 1 r r r r +	*Centaurium sp.	Centaury	Gentianaceae	1	1	L		+	+	1		2	L	L	+	1			+	1
Chamaesyce Caustic Weed Euphorbiaceae + + r drummondii drummondii t t t t *Chondrilla juncea Skeleton Weed Asteraceae 1 r r t	*Cerastium sp.	Mouse Chickweed	Caryophyllaceae																+	
*Chondrilla juncea Skeleton Weed Asteraceae 1 r r r r r r +	Chamaesyce drummondii	Caustic Weed	Euphorbiaceae	+	+	L			+			L			L					
	*Chondrilla juncea	Skeleton Weed	Asteraceae	1		-			-		-	-	Ŀ		-					+

C-VI

ngh environmental

Statement	Extension
÷.	R
ğ	Ľ.
ğ,	9
<u>m</u>	uo.
S	Ľ
5	le
õ	ш
S.	
•	

Scientific name		Eamily									- Churd A	0								
												2								
			GW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	LC6 I	LC7	LC8	LC9	LC10
Chrysocephalum apiculatum	Yellow Buttons	Asteraceae	2	1	2	L			1	2	1		L		1	L				1
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae	1												L	+				
*Cirsium vulgare	Black or Spear Thistle	Asteraceae	+	1							L	L	L	+		L		+		
*Conium maculatum	Hemlock	Apiaceae	-																	
*Conyza sumatrensis	Tall Fleabane	Asteraceae	1	1	-		L		L		L	-	-	-	-		-	+		-
Coronidium scorpioides	Button Everlasting	Asteraceae																	1	
Craspedia variabilis	Billy Buttons	Asteraceae																	+	
Crassula sieberiana	Australian Stonecrop	Crassulaceae	1	1	1	L	1	L	1			1			+			L		
*Crepis capillaris	Smooth Hawk's Beard	Asteraceae	L																	L
Cullen microcephalum	Dusky Scurf-pea	Fabaceae																		-
Cymbonotus sp.	Bear's Ear	Asteraceae	+	1			L			L	L	+			-	-	L	-	L	+
Cynoglossum australe	Hound's Tongue	Boraginaceae	+	+																
Cynoglossum suaveolens	Sweet Hound's Tongue	Boraginaceae	1												+					
Daucus glochidiatus	Native Carrot	Apiaceae	1	1			L		-				-	+	1				+	
Desmodium varians	Slender Tick Trefoil	Fabaceae	1	1	+			+	-	<i>ـ</i>	-	+		<i>د</i>	<i>د</i>		-		-	
Dianella longifolia	Blue Flax Lily	Phormiaceae	+						L									-		-
Dianella revoluta	Blue Flax Lily	Phormiaceae	+	1		-							+			1	+			
?Dichopogon sp.	Chocolate Lily	Anthericaceae									L									
*Dimorphotheca sp.	African Daisy	Asteraceae	L	-																
Diuris maculata	Spotted Double- tail	Orchidaceae																	L	
Diuris sulphurea	Tiger Orchid	Orchidaceae		<u>ب</u>																
∆*Echium plantagineum	Paterson's Curse	Boraginaceae	2	1	1				+	L										
Einadia nutans ssp nutans		Chenopodiaceae	1	1				L				+		r						
Epilobium hirtigerum	Willow Herb	Onagraceae	L																	L
*Erodium cicutarium	Common Storks bill	Geraniaceae	L		L															
*Erodium sp.		Geraniaceae	L																	

C-VII



Scientific name	Common name	Family									Abundan	e								
			GW	DSF	DS1	DS2	DS3	DS4 I	JS5 [S6 L	C1 I	C2 I	C3 I	C4 I	.C5 I	.се ь	27 FC	.8 L(20 FC	C10
Eryngium ovinum	Blue Devil	Apiaceae	1		+				+	+										
Euchiton gymnocephalus	Slender Cudweed	Asteraceae	+	1	-	-	+					-	1		+					L
Euchiton sphaericus		Asteraceae	1	1	1	L	L	+		+	+	+			-		+			
*Foeniculum vulgare	Fennel	Apiaceae																		
*Galium aparine	Cleavers	Rubiaceae	<i>۲</i>																	
*Galium divaricatum	Slender Bedstraw	Rubiaceae													1		-			
Galium gaudichaudii	Rough Bedstraw	Rubiaceae	+	1											-				-	
*Gamochaeta calviceps	Silver Cudweed	Asteraceae	+	+	<i>ـ</i>				L			L					+			
*Gamochaeta sp.	Cudweed	Asteraceae	+	+					+				+				+			
*Gazania sp.	Gazania	Asteraceae	<i>۲</i>																	
Geranium retrorsum		Geraniaceae	+		1												-			
Geranium solanderi var. solanderi		Geraniaceae	1	1	L		1	r	+	+			+	1	1	1				
Gonocarpus tetragynus	Raspwort	Haloragaceae	1	1	1	1	+		1	+			1	1	1		1	_	T	L
Goodenia hederacea ssp hederacea		Goodeniaceae	1	1	L	1				L			+		1				+	
Goodenia pinnatifida		Goodeniaceae	1								1	+								
Haloragis heterophylla		Haloragaceae	1						2							1	-			
*Hirschfeldia incana	Buchan Weed	Brassicaceae	1	1	+							+								L
Hydrocotyle laxiflora	Stinking Pennywort	Apiaceae	1	1				r		1		+	2	2	1	1	1		1	
Hypericum gramineum	Native St John's Wort	Clusiaceae	L	1				r		+	r		r	L			+			L
$ riangle^*$ Hypericum perforatum	St John's Wort	Clusiaceae	2	1	1		2	2	1	1	1	r	L	1	1	1	-			+
*Hypochaeris glabra		Asteraceae	1	1	2	L	+	+	1		1	2	+	1	1		Ŧ		_	H
*Hypochaeris radicata	Cat's Ear, Flatweed	Asteraceae	1	1	+		+		1	1		1	1	+	1	1	1		+	
*Lactuca serriola	Prickly Lettuce	Asteraceae	r	r					r						r					
*Lepidium africanum	Peppercress	Brassicaceae	+									r								
Leptorhynchos squamatus ssp squamatus	Scaly Buttons	Asteraceae	1	1					1	1					1	L	+			+

4733 Final v1.2

C-VIII

ngh environmental

Autor control Autor contro Autor control Autor con																					
Interface Interface <t< th=""><th>Scientific name</th><th>Common name</th><th>Family</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>Abund</th><th>ance</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>	Scientific name	Common name	Family									Abund	ance								
Independent Independent <thindependent< th=""> <thindependent< th=""></thindependent<></thindependent<>				ВW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	PC6	LC7	LC8	LC9 L	.C10
1 0.00000 0.0000 0.0000	Leucochrysum albicans ssp albicans var. tricolor	Hoary Sunray	Asteraceae	2	÷	2	+			ц.	1		-	2		-	+	1		L	
Unudo pelandon Lundo pelandon I<	*Linaria arvensis	Toadflax	Scrophulariaceae	+				-			+				Ŀ	Ŀ					-
Understruction Optimization Optimizatio	*Linaria pelisseriana	Pelisser's Toadflax	Scrophulariaceae	+	+										-	L					
Matrix line Industry l	Lythrum hyssopifolia		Lythraceae	-															-		
Wetworksige Methodes Fahrence Reductorial Reductorial <th< td=""><td>*Marrubium vulgare</td><td>Horehound</td><td>Lamiaceae</td><td>1</td><td></td><td>-</td><td></td><td></td><td></td><td></td><td>+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	*Marrubium vulgare	Horehound	Lamiaceae	1		-					+										
Microtic functionic f	* <i>Medicago</i> sp.	Medic	Fabaceae	+						-			L								
Metrois banylogi of the objection of metrois banylogiSimilar Online of metrois of metrois banding rr	Microseris lanceolata	Yam Daisy	Asteraceae		1		-									+				1	
*Monthale continueOnlower factorNon-contributed continueNon-contributed continueNon-contributed continueNon-contributed continueNon-contributed continueNon-contributed continueNon-contributed continueNon-contributed continueNon-contributed contributed contrib	Microtis parviflora	Slender Onion Orchid	Orchidaceae												-						
Wyoards discloreInterfaceInterf	*Modiola caroliniana	Orange Flowered Mallow	Malvaceae							-											
"Vertextering optime being selection being selection scortminurBiory selection being selectionBiory selection being selectionIndication being selectionIndication 	*Myosotis discolor	Forget-me-not	Boraginaceae		1			-						-					1		
α -boologitumStateaterrr <thr<< th="">rrr<thr< th="">r<thr< td=""><td>*Neatostema apulum</td><td>Hairy Sheep weed</td><td>Boraginaceae</td><td>-</td><td></td><td></td><td></td><td></td><td><u>د</u></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></thr<></thr<></thr<<>	*Neatostema apulum	Hairy Sheep weed	Boraginaceae	-					<u>د</u>												
Undenche minerBoomapeOrdantacee11++++1111Undenche minerNatue OnalisOraldacee1111+1111111Peromychia bresitionaBazilian WhitowCarophyllacee11 <td>riangle * Onopordum acanthium</td> <td>Scotch Thistle</td> <td>Asteraceae</td> <td>-</td> <td></td>	riangle * Onopordum acanthium	Scotch Thistle	Asteraceae	-																	
Dougle pertensityNative OvalideImage<	*Orobanche minor	Broomrape	Orobanchaceae	1	1						+				-	1	1				
Promoting brain bra	Oxalis perennans	Native Oxalis	Oxalidaceae	1	1	1		+		+			+	-	1	+	-	+	-		<u>۔</u>
*Petrofrigio Proficeous pris Carryopylaceae 1	*Paronychia brasiliana	Brazilian Whitlow	Caryophyllaceae	+	1	+			<u>ب</u>				1		+						
Plantago gaudichaudiiPlantaginaceeHPlantago gaudichaudiiPlantago gaudicha	*Petrorhagia nanteuilii	Proliferous Pink	Caryophyllaceae	1	1	1		+	-	+	1	r	1	+	1	1	1	1	+		1
* Plantago innecolataRibbed PlantainPlantaginaceae2122111Plantago variaPlantago variaPlantaginaceae1111111111Plantago variaPlantago variaPlantaginaceae1111111111Plantago variaFour-leavedCarvophyllaceae1111111111PolycorphyllaEucophyllaEucophylla111	Plantago gaudichaudii		Plantaginaceae	+						+									L		
Image orizitImage orizit<	*Plantago lanceolata	Ribbed Plantain	Plantaginaceae	2	1	2		1	-	1	1	1	2		2		1		1		-
*PolycarponEurileaved tetraphylumCaruleaved AllseedCaruleaved AllseedCaruleaved AllseedCaruleaved AllseedCaruleaved AllseedCaruleaved 	Plantago varia		Plantaginaceae	1	1	1						1	L			2	1				-
Poranthera Euphorbiaceae 1 + <td>*Polycarpon tetraphyllum</td> <td>Four-leaved Allseed</td> <td>Caryophyllaceae</td> <td></td> <td>-</td> <td></td> <td></td> <td>-</td> <td></td>	*Polycarpon tetraphyllum	Four-leaved Allseed	Caryophyllaceae		-			-													
Pseudographalium Lersey Cudweed Asteraceae 1 + r	Poranthera microphylla		Euphorbiaceae		Ч											+	+				
Ranuculus lappaceus Common Ranuculaceae Rumex brownii Native Dock Polygonaceae 1 1 + r r r r r *Rumex sp. Dock Polygonaceae r + r r r r r r	Pseudognaphalium Iuteoalbum	Jersey Cudweed	Asteraceae	-	+	-				+						-		-	-		
Rumex brownii Native Dock Polygonaceae 1 1 + r	Ranunculus lappaceus	Common Buttercup	Ranunculaceae											+			1		L		
*R <i>unex</i> sp. Dock Polygonaceae r	Rumex brownii	Native Dock	Polygonaceae	1	1			+	L	r		+	r	r	r		r	r	r		
	*Rumex sp.	Dock	Polygonaceae	L																	

C-IX



Species Impact Statement Ellerton Drive Extension

																	Ellerton	Drive Ext	ension
Scientific name	Common name	Family									Abund	ance							
			GW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	LC6 L	C7 10	38 FCC	9 LC10
Rutidosis leptorrhynchoides	Button Wrinklewort	Asteraceae									L								
*Salvia verbenaca	Wild Sage	Lamiaceae	1								3	1				r			L
*Sanguisorba minor ssp muricata	Sheep's Burnet	Rosaceae	+											L			L		
Scleranthus diander		Caryophyllaceae	1																
Scleranthus fascicularis		Caryophyllaceae											-		<i>ـ</i>				
Sebaea ovata		Gentianaceae	-	-					-						1		L		
Senecio microbasis		Asteraceae																	
Senecio quadridentatus	Cotton Fireweed	Asteraceae	1	-	-			-	-	+			-		-		-	1	+
*Sherardia arvensis	Field Madder	Rubiaceae		1			+												
*Silene gallica	French Catchfly	Caryophyllaceae	1	+	-			-	-			-							
*Sisymbrium officinale	Hedge Mustard	Brassicaceae	Ŀ																
<i>Solanum brownii</i> complex		Solanaceae						-											
*Solanum nigrum	Black Nightshade	Solanaceae	+		<i>۲</i>			-											
Solenogyne dominii		Asteraceae	-					-				-			-				
*Sonchus asper	Prickly Sow Thistle	Asteraceae	-	+				-	-			+		-	<i>د</i>	<i>ـ</i>			
*Sonchus oleraceus	Sow Thistle	Asteraceae	-		-	-	-				-								
Stackhousia monogyna	Creamy Candles	Stackhousiaceae	+	-															1
*Stellaria media	Chickweed	Caryophyllaceae																	
Stylidium graminifolium	Grass Trigger Plant	Stylidiaceae																L	
*Taraxacum officinale	Dandelion	Asteraceae	L																
Thelymitra pauciflora	Sun Orchid	Orchidaceae		-		-													
Thelymitra sp.	Sun Orchid	Orchidaceae													-				
*Tolpis barbata		Asteraceae	+							+									
*Tragopogon dubius	Goat's Beard	Asteraceae												L					
Tricoryne elatior	Yellow Rush-lily	Anthericaceae	1	+	+				r		+				r				
*Trifolium angustifolium	Narrow-leaf Clover	Fabaceae	+																

С-Х

ngh environmental

Scientific name	Common name	Family									Abunda	nce								
			ВW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	PC6	LC7	rc8	FC9	LC10
*Trifolium arvense	Hare's Foot Clover	Fabaceae	1	1	1		L	1		1	L	1	+	+	1	+	1	+		1
*Trifolium campestre	Hop Clover	Fabaceae	1	1	1		+	+	1		+	1	+	1	+			L		+
*Trifolium dubium	Suckling Clover	Fabaceae	+		-					1	L		L	+		1	1	+		
*Trifolium glomeratum	Ball Clover	Fabaceae	1	1	1			-			L	2	L	+						1
*Trifolium repens	White Clover	Fabaceae															L			
*Trifolium subterraneum	Sub Clover	Fabaceae	1	1	+		<i>ـ</i>			+		+								+
Triptilodiscus pygmaeus		Asteraceae	1	1			L			+					1					L
Velleia paradoxa	Spur Velleia	Goodeniaceae	1	1											1					
*Verbascum thapsus	Giant Mullein	Scrophulariaceae	1	1			-	+		+										1
*Verbascum virgatum	Twiggy Mullein	Scrophulariaceae	1	1	-									-						
*Verbena bonariensis	Purple top	Verbenaceae	1	+					+											
Veronica calycina	Hairy Speedwell	Scrophulariaceae														1				
Veronica plebeia	Common Speedwell	Scrophulariaceae	+	-										+	1			<i>۲</i>		
*Vicia villosa ssp. eriocarpa	Russian Vetch	Fabaceae	1																	
*Vinca major	Periwinkle	Apocynaceae	-																	
Viola betonicifolia	Native Violet	Violaceae														-		+		
Vittadinia cuneata var. cuneata	Fuzzweed	Asteraceae	1	1	L					1	1	+			r					+
Vittadinia gracilis		Asteraceae									+	+		+						r
Vittadinia muelleri	Fuzzweed	Asteraceae	1	7	-			2	+		+	+	+	1	+		L	-		+
Wahlenbergia communis	Tufted Bluebell	Campanulaceae	1		1			1	+	1		+		1			1			1
Wahlenbergia gracilis	Sprawling Bluebell	Campanulaceae	1		r			+												
Wahlenbergia luteola		Campanulaceae									+	+								
Wahlenbergia multicaulis	Tadgell's Bluebell	Campanulaceae	+	L		L	+			1						+		1		
Wahlenbergia stricta	Tall Bluebell	Campanulaceae		1		+				r		r	+	1	1				1	
Wurmbea dioica	Early Nancy	Colchicaceae	+							r					r					r
Wurmbea sp.		Colchicaceae																L		

C-XI



Scientific name	Common name	Family									Abundanc	е							
			GW	DSF	DS1	DS2	DS3	DS4	DS5 D)S6 L	C1 L	22 F(3 LC	4 LC	5 LC	.6 LC7	LC8	FC9	LC10
Xerochrysum viscosum	Sticky Everlasting	Asteraceae	1	2					L	+			4	-		1	+	-	
GRASSES																			
*Aira elegantissima	Hair Grass	Poaceae															-		
*Aira caryophyllea	Hair Grass	Poaceae	1	1	2	-	-		1	+		1	+			1	1		
*Aira sp.		Poaceae												1				+	
Aristida ?ramosa var. ramosa	Wire Grass	Poaceae	-		-									-					
Austrodanthonia auriculata	Wallaby Grass	Poaceae						2											
Austrodanthonia carphoides		Poaceae	1					2		2	3					1			
Austrodanthonia eriantha	Wallaby Grass	Poaceae	2	1	2			1		2		+	+	+	+		1		
Austrodanthonia monticola	Wallaby Grass	Poaceae				1					+								
Austrodanthonia pilosa var. pilosa	Wallaby Grass	Poaceae						2											
Austrostipa scabra ssp falcata	Corkscrew Grass	Poaceae	2	1	2	+		2		e.	3		m	1			-		1
Austrostipa sp.	Speargrass	Poaceae									-								
*Avena barbata	Bearded Oats	Poaceae	1		+				+		1						-		
Bothriochloa macra	Red-stem Grass	Poaceae	1		-			1			1			1					
*Briza maxima	Quaking Grass	Poaceae	2	1		1	L		1				+				3		
*Briza minor	Shivery Grass	Poaceae	1	1	L	۲.	L		1								1		
*Bromus diandrus	Giant Brome	Poaceae	1				1						1						
*Bromus hordaceus	Soft Brome	Poaceae	1	1			1		+		-	+	+				+		+
Chloris truncata	Windmill Grass	Poaceae	L		L														
Cymbopogon refractus	Barbed Wire Grass	Poaceae	L										L						
*Cynodon dactylon	Couch Grass	Poaceae	r		r														
*Cynosurus echinatus	Dog's-tail Grass	Poaceae															L		
*Dactylis glomerata	Cocksfoot	Poaceae											L		1				
Dichelachne micrantha	Common Plume Grass	Poaceae	1		L			L						L					
Echinopogon ovatus	Hedgehog Grass	Poaceae															1		

C-XII



Scientific name	Common name	Family									Abundar	ice								
			ΒW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	rc3	LC4 I	LC5	LC6 I	-C7 LI	C8 L(27 FC	10
Elymus scaber	Common Wheat Grass	Poaceae	1	1	+	+				+	1	+	1	7				T	Ŧ	+
Entolasia stricta	Wiry Panic	Poaceae																	+	
*Eragrostis curvula	African Lovegrass	Poaceae	1		L				+		-									
Eragrostis sp.		Poaceae	L															L		
*Festuca pratensis	Red Fescue	Poaceae	+																	
*Holcus lanatus	Yorkshire Fog	Poaceae	<i>د</i>						-									-		
Joycea pallida	Robust Wallaby Grass	Poaceae	1	æ		2							2					+	2	
Lachnagrostis filiformis		Poaceae																1		
*Lolium perenne	Perennial Ryegrass	Poaceae	1	1	1		-		1				1							
Microlaena stipoides	Weeping Grass	Poaceae	1	+		۲.							-	1		1		Ţ	1	7
riangle *Nassella neesiana	Chilean Needle Grass	Poaceae		1			2				-									
riangle *Nassella $trichotoma$	Serrated Tussock	Poaceae	+					+											1	L
Panicum effusum	Hairy Panic	Poaceae	1		+		L	L					L		L				1	L
*Paspalum dilatatum	Paspalum	Poaceae	L																	
*Phalaris aquatica	Phalaris	Poaceae	+										+							
Poa sieberiana var. cyanophylla		Poaceae														+				
Poa sieberiana var. sieberiana		Poaceae	1	+		+						-	+		я	2	4	m	5	e
Themeda australis	Kangaroo Grass	Poaceae	1	-	2							L			2					5
*Vulpia bromoides	Squirrel Tail Fescue	Poaceae	2	1	1		2		2	L										
*Vulpia sp.	Fescue	Poaceae									2	1		1				1		
GRAMINOIDS																				
Carex appressa	Tall Sedge	Cyperaceae	r	1										r				+		
Carex breviculmis		Cyperaceae	1				2													
Carex inversa	Knob Sedge	Cyperaceae	1	+	L								+							
Eleocharis sp.		Cyperaceae	L																	
Isolepis cernua	Nodding Club- rush	Cyperaceae																L		
Juncus bufonius	Toad rush	Juncaceae	1										-				1	+		

C-XIII



Scientific name	Common name	Family									Abunda	nce								
			GW	DSF	DS1	DS2	DS3	DS4	DS5	DS6	LC1	LC2	LC3	LC4	LC5	LC6	LC7	LC8	LC9	LC10
*Juncus capitatus		Juncaceae	L															L		
Juncus ?usitatus	Common or Tussock Rush	Juncaceae	1	1	L	L	L													
Juncus sp.	Rush	Juncaceae											+			L	+	1		
Lepidosperma gunnii		Cyperaceae	L	L																
Lomandra filiformis ssp coriacea		Lomandraceae	2	1	2	2		-		1	L	+		L	1		+	L	-	<u>ر</u>
Lomandra filiformis ssp filiformis		Lomandraceae	-																	
Lomandra multiflora ssp multiflora		Lomandraceae	1	L	L	L			L				L		L	L	r	r	r	L
Luzula meridionalis var. densiflora		Juncaceae	L	1									+	L		L		L		
Schoenus apogon		Cyperaceae	4	1	4						-				+	1	7	2		-





C.2 FAUNA

C.2.1 Overall species list for the study area

Note: rows shaded with grey indicate threatened species.

Species name	Common name
Herpetofauna	
Amphibolurus muricatus	Jacky Lizard
Crinia signifera	Common Froglet
Ctenotus robustus	Robust Ctenotus
Lampropholis delicata	Grass Skink
Lampropholis guichenoti	Garden Skink
Limnodynastes dumerilii	Southern Bullfrog
Litoria peronii	Peron's Tree Frog
Litoria verreauxii	Verreaux's Tree Frog
Pogona viticeps	Bearded Dragon
Pseudophryne bibronii	Bibron's Toadlet
Tiliqua scincoides	Blue-tongue Lizard
Uperoleia laevigata	Smooth Toadlet
Aves	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill
Acanthiza lineata	Striated Thornbill
Acanthiza nana	Yellow Thornbill
Acanthiza pusilla	Brown Thornbill
Acanthiza reguloides	Buff-rumped Thornbill
Acanthiza sp.	Thornbill sp.
Acanthorhynchus tenuirostris	Eastern Spinebill
Acridotheres tristis	Common Myna
Acrocephalus stentoreus	Clamorous Reed Warbler
Alisterus scapularis	Australian King-parrot
Anas superciliosa	Pacific Black Duck
Anthochaera carunculata	Red Wattlebird
Artamus cinereus	Black-faced Woodswallow
Cacatua galerita	Sulphur-crested Cockatoo
Cacatua roseicapilla	Galah
Cacatua sanguinea	Little Corrella
Cacomantis flabelliformis	Fan-tailed Cuckoo



Species name	Common name
Cacomantis variolosus	Brush Cuckoo
Callocephalon fimbriatum	Gang-gang Cockatoo
Calyptorhynchus funereus	Yellow-tailed Black-cockatoo
Carduelis carduelis	European Goldfinch
Chenonetta jubata	Australian Wood Duck
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo
Chrysococcyx lucidus	Shining Bronze-Cuckoo
Chthonicola sagittata	Speckled Warbler
Cinclosoma punctatum	Spotted Quail-thrush
Cincloramphus mathewsi	Rufous Songlark
Colluricincla harmonica	Grey Shrike-thrush
Coracina novaehollandiae	Black-faced Cuckoo-shrike
Corcorax melanorhamphos	White-winged Chough
Cormobates leucophaeus	White-throated Treecreeper
Corvus coronoides	Australian Raven
Corvus mellori	Little Raven
Corvus sp.	Raven
Cracticus torquatus	Grey Butcherbird
Dacelo novaeguineae	Laughing Kookaburra
Dicaeum hirundinaceum	Mistletoebird
Eopsaltria australis	Eastern Yellow Robin
Eudynamys scolopacea	Common Koel
Falco cenchroides	Nankeen Kestrel
Gerygone mouki	Brown Gerygone
Gerygone olivacea	White-throated Gerygone
Grallina cyanoleuca	Magpie-lark
Gymnorhina tibicen	Australian Magpie
Haliaeetus leucogaster	White-bellied Sea-Eagle
Haliastur sphenurus	Whistling Kite
Hirundo neoxena	Welcome Swallow
Lalage sueurii	White-winged Triller
Lichenostomus chrysops	Yellow-faced Honeyeater
Lichenostomus leucotis	White-eared Honeyeater
Malurus cyaneus	Superb Fairy-wren
Manorina melanocephala	Noisy Miner
Menura novaehollandiae	Superb Lyrebird



Species name	Common name
Melithreptus brevirostris	Brown-headed Honeyeater
Myiagra inquieta	Restless Flycatcher
Myiagra rubecula	Leaden Flycatcher
Myzomela sanguinolenta	Scarlet Honeyeater
Neochmia temporalis	Red-browed Finch
Ocyphaps lophotes	Crested Pigeon
Oriolus sagittatus	Olive-backed Oriole
Pachycephala rufiventris	Rufous Whistler
Pardalotus punctatus	Spotted Pardalote
Pardalotus striatus	Striated Pardalote
Passer domesticus	House Sparrow
Phalacrocorax sulcirostris	Little Black Cormorant
Phaps chalcoptera	Common Bronzewing
Philemon corniculatus	Noisy Friarbird
Platycercus elegans	Crimson Rosella
Platycercus eximius	Eastern Rosella
Rhipidura fuliginosa	Grey Fantail
Rhipidura leucophrys	Willie Wagtail
Sericornis frontalis	White-browed Scrubwren
Smicrornis brevirostris	Weebill
Strepera graculina	Pied Currawong
Strepera versicolor	Grey Currawong
Sturnus vulgaris	Common Starling
Todiramphus sanctus	Sacred Kingfisher
Turdus merula	Common Blackbird
Zoothera lunulata	Bassian Thrush
Zosterops lateralis	Silvereye
Mammals (excluding bats)	
Canis familiaris	Dog
Lepus capensis	Brown Hare
Macropus giganteus	Eastern Grey Kangaroo
Macropus rufogriseus	Red-necked Wallaby
Oryctolagus cuniculus	European Rabbit
Petaurus breviceps	Sugar Glider
Pseudocheirus peregrinus	Common Ringtail Possum
Trichosurus vulpecula	Common Brushtail Possum

Species name	Common name
Tachyglossus aculeatus	Short-beaked Echidna
Vombatus ursinus	Common Wombat
Wallabia bicolor	Black Wallaby
Wallabia/Macropus sp.	Wallaby
Microbats	
Austronomus australis	White-striped Freetail bat
Chalinolobus gouldii	Gould's Wattled Bat
Chalinolobus morio	Chocolate Wattled Bat
Falsistrellus tasmaniensis	Eastern False Pipistrelle
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat
Mormopterus sp.4	Southern Freetail Bat
Nyctophilus spp	Long-eared Bat
Vespadelus darlingtoni	Large Forest Bat
Vespadelus regulus	Southern Forest Bat
Vespadelus vulturnus	Little Forest Bat



C.2.2 Hollow-bearing tree and termite mound survey results

Refer to the methods section for descriptions of size classes for hollows. HBT (out) = Hollow-bearing tree just outside of the study area. DBH = Diameter at breast height.

Note: 'Potential' in Comment column indicates that one or more hollow is a potential hollow, as described in the Methods section

			Hollow Size						GPS Loca	tion
Tree ID	DBH	Small	Medium	Large	Total	Signs	QCC Tree ID	Comment	Easting	Northing
HT1	06			Ţ	1				704333	6083262
HT2	200		2		2			Potential	703514	6082566
HT3	100	1			Ţ	yes			704437	6083313
HT4	120	Ļ	-	H	£			Potential	704427	6083284
HT5	80		2		2				704386	6083516
HT6	70		1		7				704307	6083307
HT7	70		1	H	2			Potential	704345	6083291
HT8	70			H	Ţ				703277	6082671
HT9	06		2		2		141		703584	6082632
HT10	100		2		2			Galah	703562	6082673
HT11	80		1	Ţ	2		140	Sulphur Crested Cockatoo	703576	6082703
HT12	80		1		1		139		646607	6150988
HT13	100		4		4		132	Crimson Rosella	651675	6137486
HT14	40		1		1				703845	6082717
HT15	06	2	2		4		118		703822	6082770
HT16	06		ς		ŝ		134	Crimson Rosella	650241	6143250
HT17	50	1			1	yes		Potential	704928	6084602
HT18	80	1			1			Potential	704862	6084588
HT19	80			2	2			Potential	704851	6084536
HT20	120	1	1	1	3	yes			704809	6084532
HT21	70		1		Ļ				704795	6084486





E	Northing	6084352	6084235	6084234	6084230	6084236	6084596	6084552	6084527	6084481	6084362	6084345	6084469	6084290	6084257	6084247	6084228	6084183	6084131	6084082	6084079	6083992	6083982	6083975	6083939	6083947	6084229	6084214	6084089
GPS Location	Easting	704801	704783	704783	704800	704805	704969	704980	704904	704884	704906	704849	704872	704903	704909	704909	704802	704801	704838	704872	704868	704777	704784	704812	704798	704815	704865	704862	704919
	Comment	Potential				Potential					Potential	Potential				Potential	Potential		Worn			Scratches			Scratches				
L L L L L L L L L L L L L L L L L L L	and the in								62																				
i	Signs			yes			yes	yes					yes	yes	yes				yes			yes			yes		yes		yes
	lotal	1	2	1	1	1	1	1	2	2	2	2	1	1	1	1	1	Ļ	Ļ	1	£	1	2	1	1	2	2	1	2
	Large		1		1	1	1		Ļ	1							Ţ		Ч	Ļ	1	1	1	1		2			
Hollow Size	Medium	1	1	1					1	1		2	1								2		1		1			1	
	Small							1			2			1	1	1		1									2		2
	ЛВЧ	70	40	40	40	60	20	30	70	50	20	30	40	40	40	40	80	80	80	70	120	50	90	90	70	70	40	50	40
4	IreeID	HT22	HT23	HT24	HT25	HT26	HT27	HT28	НТ29	HT30	HT31	HT32	HT33	HT34	HT35	НТ36	HT37	HT38	НТ39	HT40	HT41	HT42	HT43	HT44	HT45	HT46	HT47	HT48	HT49

C-XX



	orthing	084076	084079	084081	084052	084045	083999	083960	083933	083879	083856	083826	083964	083960	083931	083921	083891	083879	083866	083831	083745	083768	083423	04786	04826	04831	04826	04845
Location	Z	ē	ē	ē	ē	ē	ē	ē	ē	ē	9	ē	ē	ē	ē	9	ē	ē	ē	ē	6	ē	ē					
GPS	Easting	704906	704907	704903	704922	704890	704856	704875	704811	704803	704797	704832	704844	704843	704844	704855	704895	704900	704857	704882	704850	704874	704591	6083648	6083648	6083648	6083688	6083683
	omment					otential	otential		otential	otential									Bees									
(<u> </u>					٩.	٩		٩	٩.																		
	acc tree id																											
i	Signs	yes	yes	yes									yes															
	lotal	1	Ļ	1	1	1	Ļ	2	Ч	1	Ч	1	Ч	1	1	1	1	Ч	Ļ	Ļ	1	ŝ	1	6	1	Ļ	с	2
	Large									1												-1	1				2	2
Hollow Size	Medium	1	1	1			1	2	1		1	1			1	1		1	1	1	1	2		2	1		1	
	Small				1	1							1	1			1							7		1		
	ЛВН	40	40	40	40	20	40	40	120	60	50	70	30	40	70	80	40	50	80	50	50	80	200	50	25	20	70	60
<u>؛</u> ۱	IreeID	HT50	HT51	HT52	HT53	HT54	HT55	HT56	HT57	HT58	HT59	НТ60	HT61	НТ62	HT63	HT64	HT65	HT66	НТ67	HT68	НТ69	НТ70	HT71	HT72	HT73	HT74	HT75	HT76

C-XXI



	Northing	704814	704798	704789	704788	704798	704810	704801	704797	704786	704779	704770	704787	704782	704781	704776	704780	704791	704791	704760	704745	704718	704730	704711	704704	704707	149.2555	149.2594	149.2596
GPS Location	Easting	6083729	6083730	6083733	6083731	6083694	6083679	6083660	6083657	6083659	6083658	6083660	6083689	6083695	6083777	6083778	6083786	6083814	6083830	6083750	6083710	6083701	6083673	6083673	6083672	6083664	-35.3564	-35.3595	-35.3598
	Comment	Scratches		Bees		Scratches										Used?		Used?										spout	
	arc iree in		176	175					81																				
i	Signs																												
	lotal	£	1	ß	3	3	1	1	1	ß	2	ß	2	4	ε	2	2	2	2	1	£	4	2	ъ	2	£	2	4	2
	Large		1	2		1															1								
Hollow Size	Medium	2		ε	2	1				£	2	ε	2	2	2	2	2		Ļ	1	2	1	1	ε		2	1	1	2
	Small	1			1	1	1	1	1	2		2		2	1			2	t.			ε	1	2	2	1	1		
	DBH	60	06	85	50	50	60	25	50	65	120	70	45	25	30	40	40	25	20	40	45	45	150	50	60	40	40	80	50
2	IreeID	HT78	HT79	HT80	HT81	HT82	HT83	HT84	HT85	HT86	НТ87	HT88	HT89	НТ90	HT91	НТ92	HT93	HT94	HT95	НТ96	НТ97	НТ98	НТ99	HT100	HT101	HT102	HT103	HT104	HT105

C-XXII



	Northing	149.2595	149.2596	149.2594	149.259	149.2549	149.2568	149.2569	149.2573	149.2556	149.2554	149.2557
GPS Location	ing	598	616	618	617	563	667	666	646	702	702	37
	Easti	-35.3	-35.3	-35.3	-35.3	-35.3	-35.3	-35.3	-35.3	-35.3	-35.3	-35.
	Comment	spout		deep vertical hollow		bats	bats	bats	bats	birds	bats, parrots	bats
	ALL ITEE ID											
Cices C	sugic			Yes		Yes		Yes			Yes	
Totol	I Otal	1	2	1	1	3	2	5	1	7	3	Ч
	Large		1	1				1		1		
Hollow Size	Medium		1		1	1		2	1	3	1	
	Small	1				2	2	2		æ	2	4
	Lau	40	100	70	40	70	60	80	30	120	45	150
C 0	li tee ID	HT106	HT107	HT108	HT109	HT110	HT111	HT112	HT113	HT114	HT115	HT116

ngh environmental

C-XXIII

APPENDIX D SURVEY EFFORT MAPS

D.1 FLORA

