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Lot 3 in DP 568613 and Lot 384 in DP 755952
George Evans Road, Mundamia

Proposed Residential Estate

Flora & Fauna Issues & Assessment Report

24th November 2012

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PROPOSED RESIDENTIAL ESTATE

FLORA & FAUNA ISSUES & ASSESSMENT REPORT

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TABLE of CONTENTS

PART A		INTRODUCTION & INFORMATION BASE
1	INTRODUCTION	1
1.1	Background	1
1.2	Definitions	2
1.3	Proposed Development	2
1.4	Scope and Aims of this Report	3
1.5	DEC Guidelines	4
1.6	Assumptions	5
2	INFORMATION BASE	6
2.1	Field Investigations	6
2.2	Other Sources of Information	7
2.3	Other Considerations	8
	2.3.1 Application of the DEC Guidelines	8
	2.3.2 Limitations	8
PART B		THE EXISTING ENVIRONMENT
3	EXISTING ENVIRONMENT	10
4	FLORA and VEGETATION	11
4.1	Existing Vegetation	11
4.2	Vegetation to be Removed	20
4.3	Plant Species	20
4.4	Threatened Biota	21
	4.4.1 Threatened Species	21
	4.4.2 Endangered Populations	22
	4.4.3 Threatened ecological Communities	23
4.5	Groundwater Dependent Ecosystems	23

5	FAUNA and FAUNA HABITATS	24
5.1	Fauna Habitats	24
5.2	Hollow-bearing Trees	24
5.3	Fauna Species	25
5.4	Threatened Fauna Species	28
<hr/>		
PART C	ENVIRONMENTAL CONSTRAINTS and IMPACTS ANALYSIS	
6	ENVIRONMENTAL CONSTRAINTS	30
6.1	Fundamental Considerations	30
6.2	Potential Ecological Constraints	30
6.3	Strategic Approach	31
7	POTENTIAL ENVIRONMENTAL IMPACTS	33
7.1	General Environmental Impacts	33
7.2	Vegetation to be Removed or Modified	34
8	POTENTIAL IMPACTS on THREATENED SPECIES	37
8.1	Threatened Ecological Communities	37
8.2	Threatened Species	37
8.2.1	Relevant Threatened Species	37
8.2.2	Nowra Heath-myrtle	37
8.2.3	Threatened Fauna	38
8.3	Impact Analysis	39
9	IMPACTS of the STORMWATER MANAGEMENT REGIME	41
10	IMPACTS of BUSHFIRE PROTECTION MEASURES	43
11	CUMULATIVE IMPACTS	44
12	PART 3A CONSIDERATIONS	45
12.1	Director-General's Requirements	45
12.2	Scope of the Project	45
12.3	Site Analysis	46
12.4	Objects of the EP&A Act	46
12.5	Environment Protection & Biodiversity Conservation Act	47
12.6	Impacts and Statement of Commitments	48
13	KEY ISSUES – FLORA & FAUNA	49
13.1	Key Issues	49
13.2	DEC Draft Guidelines	50
13.3	Threatened Biota	51
13.4	Biocertification of the Draft Shoalhaven LEP 2009	51
13.5	DEC Submission Area	51
13.6	Arterial Road Access	52
13.7	Wildlife Corridor Values	52

13.8	Watercourses and Wetlands	53
13.9	Impacts on Aquatic Environments	54
13.10	Protection of Aquatic and Riparian Habitats	55
13.10.1	Aquatic and Riparian Habitats	55
13.10.2	Buffers	56
13.11	Offsets for Vegetation Clearing	57
13.11.1	The Biodiversity Offset Principles	57
13.11.2	Proposed Offsets at Mundamia	57
13.11.3	Consideration of Biodiversity Offset Principles	57
14	DEC and DECC GUIDELINES	61
14.1	DEC Draft Survey Guidelines 2004	61
14.2	DEC Draft Assessment Guidelines 2005	62
14.3	Steps in the Assessment Process	62
14.4	DECC Assessment of Significance Guidelines 2007	63
14.4.1	Areas of High Conservation Value	63
14.4.2	Importance of Individual Biota	64
14.4.3	Importance of Habitat Features	66
14.4.4	Duration of Impacts	66
14.4.5	Permanent and Irreversible Impacts	68
14.5	DECC Assessment of Significance Guidelines 2007	68
15	SEPP 44 – KOALA HABITAT PROTECTION	69
15.1	Application of SEPP 44	69
15.2	Potential Koala Habitat	69
15.3	Core Koala Habitat	69
15.4	Conclusions	69
16	ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT	70
16.1	Introduction	70
16.2	Relevant EPBC Act Considerations	70
16.3	SEWPaC Decision	72
16.4	Conclusions	72
17	NOWRA-BOMADERRY STRUCTURE PLAN	73
PART D		
IMPACT AMELIORATION & ENVIRONMENTAL MANAGEMENT		
18	IMPACT AMELIORATION and ENVIRONMENTAL MANAGEMENT	74
18.1	Fundamental Assumptions	74
18.2	Impact Amelioration	74
18.3	Environmental Management Measures	75
	GLOSSARY	77
	BIBLIOGRAPHY	78

FIGURES

- Figure 1 Location of the subject land at Mundamia
- Figure 2 Details of the subject land at Mundamia, and its immediate context
- Figure 3 Existing zoning on the subject land at Mundamia
- Figure 4 Proposed lot layout and *Conservation Areas*
- Figure 5 Vegetation and topography on the subject land at Mundamia
- Figure 6 Hollow-bearing trees within the development footprint
- Figure 7 Overlay of the proposal on the vegetation types at Mundamia
- Figure 8 Distribution of the Nowra Heath-myrtle on the subject land
- Figure 9 Threatened species recorded on and near the subject land at Mundamia
- Figure 10 Stormwater management regime for the subject land at Mundamia
- Figure 11 Bushfire Protection Measures around the subject land
- Figure 12 Nowra-Bomaderry Structure Plan

APPENDICES

- Appendix A Details of Investigations in 2004 (BES) and 2008 (Environmental InSites)
- Appendix B BES Mapping of the Subject Land
- Appendix C OEH Wildlife Atlas Records
- Appendix D EPBC Act Records of MNES
- Appendix E Flora Species List
- Appendix F Fauna Species List
- Appendix G Decision of the SEWPaC with respect to the EPBC Act
- Appendix H Vegetation Management Principles Plan

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PART A

INTRODUCTION & INFORMATION BASE

1 INTRODUCTION

1.1 Background

The land that is the subject of this *Flora & Fauna Issues & Assessment Report* (the “*subject land*”) consists of Lot 3 in DP 568613 and Lot 384 in DP 755952 George Evans Road at Mundamia (Figure 1). The subject land is located within the Local Government Area (LGA) of Shoalhaven City Council, and occupies a total area of approximately 43.29 hectares.

The subject land is located to the west of the township of Nowra and to the south of the Shoalhaven River (Figures 1 and 2), between:

- private land south of the Shoalhaven River (located to the immediate north);
- the main part of the town of Nowra to the east (across the forested valley of Flat Rock Creek);
- private land north of Yalwal Road (to the immediate south); and
- a Crown Road Reserve and other private land (to the immediate west).

The subject land occupies a total area of approximately 43.29ha, and is characterised by a mosaic of remnant and regrowth native vegetation (in the north and east), and substantial areas of cleared agricultural land (Figure 2). The western and southern parts of the site, which are predominantly cleared and disturbed, are the focus of development activities.

Surrounding lands are predominantly forested or contain other native vegetation (variously disturbed), although there are small areas of farmed land, occasional dwellings and formed roads, particularly to the west and north (Figures 1 and 2).

The subject land is currently zoned predominantly 1(d) – *General Rural* (Figure 3), with a strip of land up to approximately 125m wide along the eastern boundary zoned 7(d1) – *Scenic Protection*, pursuant to *Shoalhaven Local Environmental Plan 1985* (LEP 1985). The existing *Rural* land zoning occupies approximately 37.93ha (or 88% of the site), and the existing *Scenic Protection* land zoning occupies approximately 5.36ha (or 12% of the site).

1.2 Definitions

The definitions of relevant terms employed in this *Report* are:

- “*subject land*” Lot 3 in DP 568613 and Lot 384 in DP 755952 George Evans Road, Mundamia (Figures 1, 2 and 3)
- “*subject site*” the area proposed for the residential development and associated *Asset Protection Zones*
- “*locality*” an area of 10km radius around the “*subject site*”

Other terms used in this *Report* (listed in the *Glossary*) conform to the definitions contained in the relevant legislation and planning instruments (see Chapter 1.4).

1.3 Proposed Development

As noted above, the subject land at George Evans Drive, Mundamia is currently zoned predominantly 1(b) – *General Rural*, with a strip along the eastern boundary which is zoned 7(d1) – *Scenic Protection* (Figure 3).

The proposal for the land, which is the subject of this *Report*, is:

- the rezoning of the majority of the subject land (30.94ha or 71.5% of the site) for residential purposes, in accordance with the *Nowra-Bomaderry Structure Plan* (2008) and the *Draft Shoalhaven Local Environmental Plan 2009* (SLEP 2009);
- the creation of two areas to be dedicated for biodiversity conservation and (in small part) as *Asset Protection Zones* (APZs), occupying approximately 9.49ha (or 21.9% of the land);
- a residue lot of approximately 2.86ha (or 6.6% of the land); and
- the subsequent subdivision of the land and the construction of a substantial residential subdivision (of 312 Lots) with associated roads and other infrastructure (Figure 4).

Specific elements of the proposal include:

- the subdivision of the land into roads, open space and residential allotments, within a 13 stage development program;
- the retention of a single large lot with an existing residence in the eastern part of the subject land (Stage 1A);
- the provision of a peripheral road system to provide access in the event of a bushfire and to provide a management interface between retained vegetation and the residential subdivision;
- the provision of stormwater controls and management features designed *inter alia* to protect adjoining habitats and resources (as detailed in the *Report* by Martens 2011);
- the identification and dedication of land in the northern and eastern parts of the subject land for biodiversity conservation and environmental protection purposes; and
- the provision of *Asset Protection Zones* (APZs) around the proposal, which will be used for the peripheral roads, a bioretention swale system designed to maintain downslope hydrological regimes, and areas of managed native vegetation.

The area proposed for residential development (30.94ha or 71.5% of the subject land) is predominantly cleared or highly degraded agricultural land (69% of the development area), and a large residue lot (of approximately 2.86ha) is to be retained in the eastern part of the *land* (containing the existing residential dwelling). The remainder of the subject land (*ie* the northeastern and southeastern portions of the land, occupying approximately 9.49ha) is to be retained and managed for conservation purposes (in the proposed E2 – *Environmental Conservation Zone*), and for APZ purposes (Figure 4).

The proposed residential subdivision on the subject land at Mundamia has been re-designed specifically to reduce impacts on the Nowra Heath-myrtle. This has involved a reduction in the development in the northern part of the land, which significantly reduces the area of habitat for, and the number of specimens of, the Nowra Heath-myrtle which will need to be removed or affected.

1.4 Scope and Aims of this Report

The scope of this *Flora & Fauna Issues & Assessment Report* with respect to the subject land at George Evans Drive, Mundamia includes:

- the collation of any available existing relevant information regarding the subject land and adjoining lands;
- undertaking a search of the *Atlas of NSW Wildlife* (Appendix C) maintained by the then Department of Environment, Climate Change & Water (DECCW)¹;
- collating information obtained in ecological surveys of the subject land and of surrounding lands, conducted by BES for Shoalhaven City Council for the *Nowra-Bomaderry Structure Plan*, and the supplementary data collected by Environmental InSites on the subject land itself and on adjoining lands (see Chapter 2);
- incorporating data from surveys undertaken by Council *inter alia* on the subject land for the Spring Tiny Greenhood orchid;
- collating and integrating information from other relevant sources (see Chapter 2).
- considering the likely impacts of future development of the subject land on the natural environment in general, and on threatened biota and their habitats in particular; and
- addressing the following relevant statutory requirements:
 - the *Environment Planning & Assessment Act 1979* (EP&A Act);
 - the *Threatened Species Conservation Act 1995* (TSC Act);
 - relevant *Matters of National Environmental Significance* (Appendix D) listed in the Commonwealth *Environmental Protection & Biodiversity Conservation Act 1999* (EPBC Act); and
 - *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44).

¹ The DECCW (Department of Environment, Climate Change & Water) includes the National Parks & Wildlife Service (NPWS), and was previously the Department of Environment & Climate Change (DECC). The DECCW has subsequently (in early 2011) been incorporated into the Office of Environment & Heritage (OEH) within the Department of Premier & Cabinet.

The aims of this *Flora & Fauna Assessment Report inter alia* are:

- to provide an appropriate data base for the site to form the basis for addressing the potential impacts of the proposal;
- to provide input into the final subdivision design, with respect both to its footprint and its associated elements (APZs and stormwater treatment features);
- to identify a development design and footprint that satisfies both development aspirations and biodiversity conservation goals;
- to assist in designing a project that satisfies the goals of *Ecologically Sustainable Development* (ESD), as required by the legislation;
- to identify appropriate management measures which should be implemented within the conservation area on the subject land to facilitate biodiversity conservation; and
- to facilitate the realisation of the goals and planning outcomes identified in SLEP 2009.

This *Report* is based on the subdivision design illustrated in Figure 4, and assumes that all vegetation within that portion of the land proposed as *R1 – Residential Zone* (ie the “*subject site*”) will be removed. Conversely, vegetation along the eastern and northern sides of the subject land, in the proposed *E2 – Environmental Conservation Zone*, would be retained and managed primarily for biodiversity conservation purposes.

1.5 DEC Guidelines

The proposal has been assessed with respect to two sets of draft *Guidelines* prepared by the then Department of Environment & Conservation (DEC 2004, 2005):

- the *Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (2004); and
- the *Draft Guidelines for Assessment of Impacts on Threatened Species under Part 3A* (2005).

The 2004 *Draft Guidelines* were addressed in the undertaking of investigations for this *Report* and in determining threatened biota of likely potential relevance. The 2005 *Draft Guidelines* (with respect to impacts on threatened biota) have been addressed in detail in Chapter 13 of this *Report*.

It should be noted that both sets of *Guidelines*:

- remain draft *Guidelines*, notwithstanding the 7-8 year time period between their drafting and the present time; and
- are “*Guidelines*”, and therefore open to interpretation and/or application to various extents depending on circumstances. Significantly, neither constitutes “*standards*” which must be applied, but rather provide guidance as to what may be applied under relevant circumstances.

Notwithstanding the draft nature of these documents, and their inherent limitations, this *Report* has taken those *Guidelines* into account, to the extent relevant to the proposal at Mundamia.

1.6 Assumptions

For the purposes of this *Report*, a number of assumptions have been made with respect to the proposed subdivision and future development of the subject land at Mundamia, including:

- all future development activities on the subject land will be undertaken in an environmentally responsible and sensitive manner, applying 'best practice' methods to minimise or avoid unnecessary direct or indirect impacts upon the natural environment;
- all appropriate methods to protect retained native vegetation and habitats on the subject land and adjoining lands will be implemented as identified in this *Report* and as documented in the attached *Vegetation Management Principles Plan* (VMPP);
- ongoing management of the *Asset Protection Zones* (APZs), where required in retained native vegetation, will be undertaken in a manner (as described in the VMPP) which ensures the maintenance of populations of and habitat for the relevant threatened biota, particularly the Nowra Heath-myrtle *Triplarina nowraensis*; and
- the impact amelioration and environmental measures contained in this *Report* will be implemented.

It is a fundamental tenet of the principal author of this *Report* (Mr F Dominic Fanning), and of the SLR Ecology team, that the observations contained within the *Report* and the opinions expressed herein are based on an informed analysis of the relevant circumstances, and are independent of the desires or preferences of the proponent, or of any other persons or authorities. That is, the *Report* has been prepared in an objective and independent manner sufficient to satisfy the requirements of the *Uniform Civil Procedures Rules* (UCPRs) with respect to expert witnesses in the NSW Land & Environment Court.

2 INFORMATION BASE

2.1 Field Investigations

A variety of previous surveys have been undertaken within the locality (including the subject land) and its environs for flora and fauna, including:

- ecological studies of Area 5 - Mundamia for the *Nowra-Bomaderry Structure Planning Study* by BES in 2004 (Appendix A), including a supplementary survey for the endangered orchid *Pterostylis vernalis* (now known as the Spring Tiny Greenhood orchid *Specularantha vernalis*²);
- flora and fauna surveys of the Wollongong University Shoalhaven Campus (to the immediate southwest of the subject land) by BES in 2004 and 2007;
- supplementary flora and fauna surveys of the subject land and of the proposed access road to it by Environmental InSites in 2008 (Appendix A), and further supplementary inspections of those areas by Environmental InSites in 2010 and 2011;
- dedicated surveys for the threatened Spring Tiny Greenhood orchid on the subject land and at Mundamia generally by Shoalhaven City Council (SCC) and Environmental InSites in 2010; and
- a supplementary investigation of Council land to the immediate west of the subject land by BES, involving flora and fauna surveys in November/December 2009 and February 2010.

The BES surveys of the *Mundamia Urban Expansion Area* in 2004 (BES 2004a, 2004b) included an array of investigations in February – April, June and October of 2004 (Appendix A), including:

- general vegetation surveys and targeted grid searches or targeted transects for flora in general, and for a range of potential threatened species;
- supplementary dedicated surveys specifically for the threatened Spring Tiny Greenhood orchid (*Pterostylis* sp. Flat Rock Creek) in October 2004;
- diurnal habitat searches for native fauna species and for indirect evidence;
- nocturnal spotlighting and call playback for gliders, forest owls, the Bush Stone-curlew and Giant Burrowing Frog;
- nocturnal Anabat recording of microchiropteran bats;
- trapping for native fauna using a variety of trapping and other survey techniques (see Appendix A); and
- nesting assessments of hollow-bearing trees for large forest owls and the Glossy Black Cockatoo.

Further field surveys were undertaken from the 24th to the 26th of September 2008 by Environmental InSites, on the subject land at George Evans Road (Appendix A), which consisted of:

- targeted walked surveys for the threatened flora species Nowra Heath-myrtle *Triplarina nowraensis*;

² The Spring Tiny Greenhood orchid *Specularantha ventricosa* was previously known as *Pterostylis* sp. Flat Rock Creek.

- botanical surveys to verify or refine the vegetation mapping of BES (2004);
- GPS mapping of hollow-bearing trees within the proposed development and APZ areas;
- nocturnal fauna surveys including spotlighting, amphibian surveys, call playback and ultrasonic bat detection (mobile and all night recording); and
- diurnal avifauna, herpetofauna and habitat surveys, including searches for indirect evidence of threatened and other species.

In November and December 2009 and February 2010, BES (now EcoLogical Australia – ELA) conducted further flora and fauna surveys on Council land to the immediate west of the subject land at Mundamia. Those investigations included:

- dedicated transect surveys for threatened orchids known to occur in the locality;
- nesting assessments for the Gang Gang Cockatoo;
- stag watch surveys for nocturnal mammals and birds;
- nocturnal spotlighting, call playback and Anabat recording;
- 200 trap-nights for the Eastern Pygmy Possum and the White-footed Dunnart; and
- the use of remote cameras to survey particularly for Rosenberg's Goanna and the Tiger Quoll.

Additional surveys and inspections of the subject land and nearby lands have also been conducted in 2010 and 2011 by Environmental InSites, and by Shoalhaven City Council (SCC), including:

- a supplementary inspection of the proposed road alignment for access into the Mundamia residential area, on the 4th of May 2010 (Environmental InSites);
- dedicated surveys for the Spring Tiny Greenhood orchid, both on the subject land and in the immediate vicinity, by SCC and Environmental InSites (in late 2010); and
- two supplementary dedicated surveys of the subject land (in 2011) by Environmental InSites to refine vegetation mapping and to provide added information and detail regarding the distribution and densities of patches of the Nowra Heath-myrtle.

It should be noted that all investigations of any site by any competent ecologist constitute, in addition to whatever dedicated survey is being undertaken, an opportunistic additional survey for all threatened biota. That is, no competent ecologist would ignore an observation of some other threatened species during a dedicated investigation for a single threatened species. On that basis, all flora and fauna investigations constitute surveys, however allegedly limited, for the full array of threatened species that might be present on any site.

2.2 Other Sources of Information

In addition to the field investigations of the subject land (detailed above), additional information has been obtained from or on the basis of:

- the published scientific literature, particularly with respect to threatened biota;

- the experience and knowledge (local and general) of the SLR Ecology team, including that of the principal author of this *Report* and previously of Gunninah Environmental Consultants and of Environmental InSites;
- the information contained in the *Reports* from previous investigations (as documented above); and
- surveys for the Spring Tiny Greenhood orchid by Shoalhaven Council in 2010.

2.3 Other Considerations

2.3.1 Application of the DEC Guidelines

As noted above (Chapter 1.5), the field surveys undertaken for this *Report* by various ecological consultants (Appendix A) were carried out in accordance with the *Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004), to the extent that those *Guidelines* are relevant in the circumstances of the proposal and the subject land.

In that regard, the combination of the surveys undertaken for the *Nowra-Bomaderry Structure Plan* by BES in 2004 (and supplementary investigations in 2007, 2009 and 2010), and the investigations undertaken by Environmental InSites (in 2008, 2010 and 2011), provide a comprehensive and appropriate information base with respect to the ecological characteristics of the subject land, and the distribution of threatened biota and their habitats.

In addition, as the majority of the development is to be on cleared and highly degraded agricultural land, the array of resources or potential habitat for threatened biota is relatively limited. No such habitats or resources are confined to the development area (*ie* the “*subject site*”).

As a consequence, many of the survey requirements detailed in the DEC 2004 *Guidelines* are either inappropriate or excessive. Furthermore, the experience and knowledge of the survey teams (both from the BES and from InSites) has been applied in determining the appropriate levels of field investigation and surveys required.

2.3.2 Limitations

It is a simple fact that all ecological investigations have inherent limitations. In particular, ecological surveys undertaken at any one point of time will necessarily fail to detect all of the species (flora and fauna) which utilise any particular site due to seasonal, climatic or temporal factors, variations in seasons and in the response of biota to seasonal conditions, variations in the detectability of certain biota, and the application of chance or happenstance.

Conversely, the conduct of investigations by different ecologists at different times increases the likelihood of detecting the presence of threatened and other native biota, as has been the case on the subject land. Investigations undertaken by BES in 2004, 2007, 2009 and 2010, and by Environmental InSites in 2008, 2010 and 2011, as well as the surveys in 2010 by SCC, provide a combined information base involving a variety of surveys of the subject land and immediately adjoining lands over a period of at least 8 years (Appendix A).

Further, the inherent limitations of ecological investigations can be overcome to a significant extent by consideration not simply of the biota which have been detected but by including consideration of species either which are known to occur in the general locality or for which suitable habitat and resources are present on the subject land. In this regard, where suitable habitat for a threatened species is present on the subject land, the likelihood of that species being present and the likelihood or otherwise of a population of that species being dependent on the subject land has been taken into consideration.

Further, an assessment of the likely impacts of developments on the subject land upon a threatened species which has not been recorded but which may potentially be present (eg the Powerful Owl) can readily be undertaken on the basis of the effects on potential habitat and/or particular resources of relevance for that species (both on the subject land and on surrounding or adjoining lands). In that instance, therefore, the potential for adverse impacts to be imposed upon such a species can be addressed based on an assumption that individuals of that species do utilise the land, even in the absence of any evidence to that effect.

Thus, the assessment of the potential for adverse impacts to be imposed on the natural environment in general, and on threatened biota or their habitats in particular, contained in this *Report* has involved a conservative approach to the issues. The recommendations contained in this *Report* assume that not all native biota have been recorded, and that an environmentally responsible approach to development of the land should be adopted.

3 EXISTING ENVIRONMENT

In broad landscape terms, the subject land (Figure 1) is located in the northeastern part of a broad plateau which is located between Flat Rock Creek (to the east), Cabbage Tree Creek (to the west) and the Shoalhaven River (to the north). Most of the subject land is located on the plateau, with the steep slopes down to Flat Rock Creek commencing along the eastern boundary of the land and further to the east, and in the northeastern corner.

The main residential area of the township of Nowra is located approximately 2km to the east of the subject land, with more recent residential development in West Nowra (across Flat Rock Creek) approximately 500m to the southeast of the subject land (Figure 1). The Nowra campus of Wollongong University is located approximately 500m to the southwest of the subject land, on the other side of George Evans Road (Figure 1).

The land is predominantly characterised by flat to gently sloping terrain, ranging in height from approximately 60m (AHD) in the southwestern corner to approximately 40m (AHD) along the eastern side, above the steeper slopes. The terrain along the eastern boundary of the land falls steeply on an easterly aspect towards Flat Rock Creek, which is situated in a steep gully on Crown Land to the immediate east (Figure 5), with the lowest part of the land below 20m (AHD) in the northeastern corner (within the *Conservation Area*). A small un-named tributary of Flat Rock Creek traverses the subject land in the northern section of Lot 3, draining to the northeast.

The subject land is vegetated by open farmland through the western half (approximately) and remnant native woodland and open forest displaying varying levels of disturbance along the eastern half and across the northern boundary (Figures 2 and 5).

Lands to the northwest, north and east of the subject land are predominantly vegetated with similar woodland and open forest communities to those present on the subject site (BES 2006; *pers obs*). Lands to the southwest and south have been variously modified for agricultural or residential purposes and for the University campus (Figures 1 and 2).

In addition to the Crown Land surrounding Flat Rock Creek, a number of nature reserves are located in close proximity to the subject land including Triplarina Nature Reserve (adjacent to Flat Rock Creek Dam to the south of Yalwal Road) and Bamarang and Wongamia Nature Reserves to the west, in the suburb of Longreach (Figure 1). In addition, there are extensive areas of vegetation in the immediate vicinity of the subject land (much of it on crown land and/or on steep slopes and cliffclines or along Flat Rock Creek). These areas are currently zoned 7(d1) – *Conservation*, and are never likely to be developed.

4 FLORA and VEGETATION

4.1 Existing Vegetation

The subject land supports six main native plant community types (Figure 5), with the majority of native vegetation being restricted to the northern and eastern portions of the land. Sampling of each native plant community was undertaken using a systematic botanical survey technique, in accordance with the draft DEC *Threatened Biodiversity Survey & Assessment Guidelines* (DEC 2004).

The plant communities identified in this *Report* are consistent with the descriptions documented in the original BES *Report* (BES 2004):

- Grey Gum – Blue-leaved Stringybark Forest/Woodland;
- Spotted Gum – Blackbutt Open Forest;
- Scribbly Gum – Bloodwood Forest;
- Paperbark Closed Forest;
- Regrowth Woodland and Scattered Trees;
- Kunzea Shrubland/Heathland; and
- Pasture.

The total area of each of those vegetation types on the subject land (Figure 5) is identified in Table 1. As indicated, the majority of the subject land consists of the cleared pasture and highly disturbed or degraded lands. The vegetation type that constitutes most of the remainder of the proposed development footprint on the subject land is the Grey Gum – Blue-leaved Stringybark Forest/Woodland community, although much of this vegetation is also to be retained within the *Conservation Area* in the northern and eastern parts of the subject land, and it is widely distributed in the immediate vicinity.

As discussed below with respect to individual communities, the peripheries of many of these vegetation types have been highly modified as a result of the agricultural activities in the cleared parts of the subject land. As a consequence, those portions of the native plant communities which are to be removed for the proposed development are in places already degraded to some extent.

Table 1 Areas of the various vegetation types on the subject land at Mundamia

Community	Ha	% of land	Comments
Grey Gum – Blue-leaved Stringybark Forest/Woodland #	16.32	37.7%	Widespread in vicinity and locality, including in reserved lands to east and in Triplarina Reserve
Spotted Gum – Blackbutt Open Forest	1.62	3.74%	Common in vicinity and locality, including along Flat Rock Creek and in Triplarina Reserve
Scribbly Gum – Bloodwood Forest	0.42	0.97%	Widespread in vicinity and locality, including in reserved lands to east and in Triplarina Reserve
Paperbark Closed Forest	0.79	1.82%	Scattered (often small) patches widely distributed and common in vicinity and locality
Kunzea Shrubland/Heathland	0.92	2.13%	Scattered (often small) patches widely distributed and common in vicinity and locality
Regrowth Woodland and Scattered Trees	0.88	2.03%	Abundant and widespread
Pasture	22.34	51.61%	Abundant and widespread
TOTAL	43.29		

Includes Highly Disturbed Grey Gum – Stringybark Woodland.

Grey Gum – Blue-leaved Stringybark Forest/Woodland

This plant community is located in the northern and eastern portions of the land (Figure 5), and is the largest and most common vegetation type within the subject land. The edges of this community adjacent to the cleared pasture and around the dwelling have been substantially disturbed or cleared, and have a modified and (in places) weedy understorey.

The upper stratum exhibits a variable cover of 25-40%, to a height of 30m. Dominant species are Grey Gum, Blue-leaved Stringybark and Red Bloodwood with less frequent Blackbutt and Spotted Gum. The upper mid-stratum contains Black She-oak with juvenile to semi-mature eucalypts.

The shrub stratum also exhibits a variable foliage cover, with disturbed regrowth areas ranging from 15% to 45% and undisturbed areas 40% to 60%. Heights range between 1m and 3m. Dominant species include Tick Bush, Nowra Heath-myrtle, Hairpin Banksia, Narrow-leaved Geebung, with Needlebush, Dagger Hakea, Nowra Tea-tree, Conesticks and Waratah occurring less frequently. Tick Bush and the Nowra Heath-myrtle are the dominant shrubs in the northern part of the land.

The lower stratum has a variable foliage cover, ranging from 25% to 75%. Variability is due to available light levels based on taller strata cover. Dominant species include Wiry Panic, Three-awn Spear-grass, Kangaroo Grass, Prickly Moses, Variable Sword-sedge, Raspwort, Many-flowered Mat Rush, Two-colour Panic, Spiny-headed Mat Rush, Pomax and Bracken.

The Grey Gum Blue-leaved Stringybark Forest/Woodland community is widely distributed in the immediate vicinity and general locality, predominantly on the mid to upper slopes at the boundaries of the plateau on which the subject land is located (BES 2006). It is not a listed “*threatened ecological community*” (TSC Act or EPBC Act).



Photo 1 Grey Gum – Blue-leaved Stringybark Forest/Woodland

Spotted Gum – Blackbutt Forest

This plant community occurs in the northeastern part of the land, and to its east (Figure 5). It is generally associated with areas of sandstone outcropping, cliffs and boulders.

The upper stratum of this community exhibits a variable foliage cover of approximately 40-55%, to a height of 25-30m. Dominant species are Spotted Gum, Blackbutt and Grey Gum, with occasional Blue-leaved Stringybark, Red Bloodwood and White Stringybark.

The mid-stratum is dominated by Tick Bush, Nowra Heath-myrtle, Old Man Banksia, Dagger Hakea, Narrow-leaved Geebung, Needlebush, Nowra Tea-tree, Waratah and Slender Tea-tree.

The lower stratum exhibits a foliage cover of approximately 40-75%. Dominant species include Kangaroo Grass, Wiry Panic, Three-awn Spear Grass, Variable Sword-sedge, Blue Flax Lily, Raspwort, Many-flowered Mat Rush, Two-colour Panic, *Glycine clandestina*, Spiny-headed Mat Rush, Pomax and Bracken.

The Spotted-Gum – Blackbutt Forest is located at lower to mid-slope locations and along the major watercourses through the general area, including along Flat Rock Creek to the immediate east of the subject land. Again, this community appears well distributed in the general locality.

This community is not a listed “*threatened ecological community*” (TSC Act or EPBC Act).



Photo 2 Spotted Gum – Blackbutt Forest

Scribbly Gum – Bloodwood Forest

This vegetation type is located along the western boundary as a thin band along the fenceline, but extends for a considerable distance to the west and south of the land (Figure 5).

The upper stratum of this community is dominated by the Hard-leaved Scribbly Gum with variable numbers of Red Bloodwood, as well as a number of other eucalypts scattered throughout. The canopy has foliage cover of 25-40%, and the trees in the upper stratum are to 20m in height.

The mid-stratum of this community is generally of xeric (dry) shrub species, and also includes patches of dense Tick Bush *Kunzea ambigua* which (where the tree canopy is absent) constitutes the Kunzea Shrubland/Heathland communities. Other mid-storey and shrub layer species include several Tea-tree and Wattle species, Dagger Hakea and Narrow-leaved Geebung.

The groundcover (or lower) stratum is characterised by a scattering of native grasses, herbs and small shrubs, including species such as Wallaby Grass, Kangaroo Grass, Wombat Berry and Ivy-leaved Violet.

The Scribbly Gum – Bloodwood community is not a “*threatened ecological community*” (TSC or EPBC Act).



Photo 3 Scribbly Gum – Bloodwood Forest

Paperbark Closed Forest

This community occurs in the central northern portion of the subject land (Figure 5), and is associated with a small drainage swale at this location. Soils in the upper part of the swale are peaty and shallow. Once the drainage line begins to descend over exposed sandstone (below the Paperbark Closed Forest), it becomes more incised.

The upper stratum is dominated by Snow-in-Summer with a foliage cover of 50-75% and heights of 8-12m. The mid-stratum is variable based on available light levels associated with the upper stratum cover, with the main species being Prickly Tea-tree, Lemon-scented Tea-tree, Cheese Tree, Nowra Heath-myrtle, Sydney Golden Wattle, Narrow-leaved Geebung and Mock Olive.

The lower stratum consists of a diverse range of grasses, herbs, sedges and ferns including Tall Saw-sedge, Bracken, *Oplismenus aemulus*, Mat Rush, Blady Grass, Bordered Panic, Common Silkpod, Sweet Morindia, False Bracken Fern, Common Couch, Pennywort and Climbing Guinea Flower.

The Paperbark Closed Forest community was not mapped elsewhere within the urban release area addressed by BES (2004). Nevertheless, this plant community is widely distributed in the Shoalhaven LGA (*pers obs*), and is regularly recorded in relatively small patches along drainage lines where soil moisture levels are high.

This is not a listed “*threatened ecological community*” (TSC Act or EPBC Act - see Chapter 4.3).



Photo 4 Paperbark Closed Forest along drainage swale

Regrowth Woodland and Scattered Trees

Around the periphery of the cleared agricultural land, and along existing fence lines, there are scattered stands and individuals of native trees and shrubs, many of which are relatively young regrowth.

These areas of vegetation, including the narrow band of trees and shrubs along the fence line dividing the two existing lots (Figure 5), are of extremely limited ecological value, although they would be used by birds such as the Willie Wagtail, Grey Fantail and Rosellas which utilise perches adjacent to cleared grassland for foraging and shelter purposes.

The species present are a mix of the native plant species found in adjoining areas of native vegetation, as well as a number of introduced species including noxious weeds. In some places, a modest heath understorey of Tick Bush *Kunzea ambigua* is present, although few of these areas are located in areas of impeded drainage or high soil moisture.

This vegetation type does not constitute a “*threatened ecological community*” (TSC Act or EPBC Act), and is not regarded as of any particular conservation value or significance.



Photo 5 Regrowth Woodland and Scattered Trees

Kunzea Shrubland/Heathland

This vegetation type is restricted to three patches in the northeastern and central eastern portions of the subject land (Figure 5), associated with areas of exposed sandstone and shallow skeletal soils.

These communities are relatively treeless, although a small number of scattered Grey Gum, Red Bloodwood and Blue-leaved Stringybark are present, with a foliage canopy cover of less than 5%. The shrub stratum is dominated by White Kunzea, Needlebush, Nowra Tea-tree, *Epacris microphylla*, Dagger Hakea, Stiff Bottlebrush, Hairpin Banksia, Bushy Parrot-pea and *Acacia subtilinervis*.

The lower stratum exhibits a variable foliage cover ranging from 30-65%. Dominant species include Scale Rush, Wiry Panic, Three-awn Spear Grass, Oats Spear Grass, Prickly Moses, Nowra Heath-myrtle, Mat Rush, Slender Rice-flower, Two-colour Panic, *Melaleuca thymifolia*, and Silky Purple-Flag.

The Kunzea Shrubland/Heathland community is present only in small patches on the subject land at Mundamia. It occurs in various sized patches in the immediate vicinity and general locality, and is widely distributed throughout the Shoalhaven LGA.

There are scattered specimens of the Nowra Heath-myrtle in this community, and it constitutes potential habitat for the “*endangered*” Spring Tiny Greenhood orchid. However, no specimens of this species have been recorded on the subject site (see Chapter 4.4.1).

This vegetation type is not a listed “*threatened ecological community*” (TSC Act or EPBC Act).



Photo 6 Kunzea Shrubland/Heathland

In some places, where there is exposed bedrock adjacent to the Kunzea Shrubland, small 'moss gardens' are present. These appear to be sustained, to some extent at least, by groundwater discharges along the top of the sub-surface bedrock, but are not strictly part of the Kunzea Shrubland community (although they are often, but not exclusively, located amongst or at the upper extremities of stands of Kunzea).

These small 'moss gardens' are the typical habitat of the endangered Spring Tiny Greenhood orchid. Dedicated surveys for this species by Shoalhaven City Council (SCC) and Environmental InSites in 2010 and 2011 identified populations of this species in 'moss gardens' to the south, west and northwest of the subject land.

However, none of the investigations by either Council or Environmental InSites recorded any specimens of the Spring Tiny Greenhood orchid on the subject land at Mundamia.



Photo 7 Exposed bedrock with 'moss gardens'

Pasture

Detailed systematic botanical surveys were not conducted within this community, due to the scarcity of native plant species and dominance of exotic pasture grass species.

The agricultural (pasture) areas of the subject land, occupying the western half approximately of the land (Figures 2 and 5), have been cleared of most native vegetation. They now consist predominantly of pasture grasses and herbs, and an array of weed species. Native species are uncommon, with some scattered shrub regrowth and narrow bands of trees and tall shrubs along fence lines.

This vegetation is not a listed “*threatened ecological community*” (TSC Act or EPBC Act).



Photo 8 Cleared pasture

4.2 Vegetation to be Removed

Of the total area proposed for residential development of the subject land at Mundamia (occupying a total of 31.03ha, or 71.68% of the land), the majority (21.41ha or 69%) is land which has already been substantially modified, cleared or highly distributed for agricultural purposes (Table 2). A further 0.67ha consists of regrowth and scattered trees.

The land was previously identified in the *Nowra-Bomaderry Structure Plan* (see Chapter 16) as an appropriate location for future residential development activities around the Nowra-Bomaderry area, given that there is a requirement for further residential land to be made available. Similarly, the subject land is identified as appropriate for rezoning for those purposes in SLEP 2009, and in the *South Coast Regional Strategy* (DoP 2006).

In addition to development of the grazing lands, small areas of several native plant communities are also to be removed for the proposed development (Figure 7; Table 2). None of those vegetation types, however, are “*threatened ecological communities*” listed in either the TSC Act or the EPBC Act (see Chapter 4.4). Further, all of those communities are well represented in the immediate vicinity and general locality, including in the extensive conservation reserves in the vicinity and elsewhere within the Shoalhaven LGA.

Table 2 Areas of the various vegetation types to be removed in the development area

Community	Ha	%	Comments
Grey Gum – Blue-leaved Stringybark Forest/Woodland #	6.84	39.5	Extensive areas to be retained in <i>Conservation Area</i> and nearby
Spotted Gum - Blackbutt Open Forest	-	0	Widely distributed and common in vicinity and locality
Scribbly Gum – Bloodwood Forest	0.41	100	Widely distributed and common in vicinity and locality; highly degraded on site
Paperbark Closed Forest	0.71	89	Scattered and widely distributed in vicinity and locality
Kunzea Shrubland / Heathland	0.92	100	Scattered patches throughout vicinity and locality; widespread; common
Regrowth Woodland and Scattered Trees	0.65	76.1	Widespread and of extremely limited ecological value
Pasture	21.41	95.8	Widely distributed and of no ecological value

Includes Highly Disturbed Grey Gum – Stringybark Woodland.

% Percentage of the community present on the subject land.

4.3 Plant Species

A total of 269 plant species have been recorded within the *Nowra-Bomaderry Structure Plan Study Area 5, Mundamia, West Nowra* (BES 2004), of which the subject land is a part (Appendix E). Systematic botanical surveys conducted as part of this *Report* have recorded a further 22 native plant species in addition to those recorded by BES (2004).

One threatened flora species, the Nowra Heath-myrtle *Triplarina nowraensis* (which is listed as “*endangered*” in Part 1 of Schedule 1 of the TSC Act, and also as “*endangered*” in the EPBC Act), was recorded on the subject land (as discussed in Chapter 4.4 of this *Report*).

Three *Rare Or Threatened Australian Plants* (ROTAP) have been recorded on the subject land - *Acacia subtilinervis* (3RCa), *Leptospermum epacridoideum* (2RC) and *Leptospermum sejunctum* (2K). One species of regional significance within the Shoalhaven LGA (*Acacia hispidula*) has also been recorded from the subject land (see BES map in Appendix B). However, none of these species have any statutory protection, pursuant to either NSW or federal legislation.

Whilst individuals of some of these species, and habitat of known or potential relevance, is to be removed for the proposed residential development on the subject land at Mundamia, the *Conservation Area* proposed on the subject land will also contain individuals and/or suitable habitat for those species. The vegetation to be removed along the eastern and northeastern parts of the subject land for the proposed residential development is the same as that to its immediate east, northeast and north, and there are further substantial areas of similar habitats in the immediate vicinity and general locality.

Given those circumstances, it is not likely that these species will be significantly adversely affected by the proposed development. As noted above, these species are not of particular biodiversity conservation concern.

4.4 Threatened Biota

4.4.1 Threatened Species

Only one threatened plant species listed in the TSC Act has been recorded on the subject land at Mundamia to date.

The Nowra Heath-myrtle *Triplarina nowraensis* is listed as “*endangered*” in Part 1 of Schedule 1 of the TSC Act, and as “*endangered*” in the EPBC Act.

This species is a small erect shrub (to 3.5m in height) with creamy-white tea-tree flowers. The Nowra Heath-myrtle is currently only known from five populations, three of which are located west of Nowra in the vicinity of the subject land. The other two populations are southwest of Nowra in the Boolijong Creek Valley, and on the plateau above Bundanon north of the Shoalhaven River (DECC 2008).

Habitat for the Nowra Heath-myrtle has been described as vegetation types that exhibit either a very open tree canopy or are treeless. Whilst the species occurs in areas of impeded drainage, it is not confined to such areas. And also occurs in drier woodland and shrubland communities..

The greatest stand of the Nowra Heath-myrtle on the subject land is located in the northern part of the subject site, on a quite xeric slope. Whilst the DECC (2008) suggest that this species is generally located along drainage channels or on poorly drained flat to gently sloping sandstones of the Nowra group, the populations on the subject site are not confined to such areas.

Within the subject land, a large number of specimens of the Nowra Heath-myrtle have been recorded scattered across the Grey Gum – Blue-leaved Stringybark Forest/Woodland, Paperbark Closed Forest and Kunzea Shrubland/Heathland vegetation types. The largest patches of the Nowra Heath-myrtle were observed in disturbed areas of Grey Gum – Blue-leaved Stringybark Forest/Woodland in the northern portion of the land (Figure 8), which had been slashed a few years previously. It appears that this species favours disturbed areas with increased available light levels, and its apparent ability to resprout from lignotubers means it can benefit from the slashing of vegetation (eg for the provision of APZs).

The vast majority of specimens of and habitat for the Nowra Heath-myrtle will be retained as part of this proposal in the proposed *E2 – Environmental Conservation Zone* (Figure 8). The northern boundary of the residential area has been re-designed (in response to recommendations provided by the principal author of this *Report*) to substantially increase the retention of the Nowra Heath-myrtle, including all of the main northern patch of this species.

In addition to retaining approximately 95% of the Nowra Heath-myrtle population on the subject land, the ongoing management of the bushfire *Asset Protection Zones* and parts of the *Conservation Area* will be directed towards the protection and enhancement of this species. The experience in the northern part of the land where the slashing had occurred (see photograph below), indicates that relevant parts of the *Conservation Area* should be managed using that technique. The proposal has also been designed to maintain the pre-development hydrological regimes immediately adjacent to the proposed development (Storm Consulting 2012), particularly with respect to soil moisture levels.



Photo 9 Stand of regrowth Nowra Heath-myrtle in north of subject site

4.4.2 Endangered Populations

No “*endangered population*” of any flora species has been recorded as part of this study, or during any previous investigations within the subject land (BES 2004).

4.4.3 Threatened ecological Communities

No “*threatened ecological communities*” have been recorded within the subject land.

The Paperbark Closed Forest vegetation on the subject land is not an example of the Swamp Sclerophyll Forest on Coastal Floodplains community, because the land is neither on nor is “*associated with*” a “*coastal floodplain*”. Any “*coastal floodplain*” in the vicinity would be confined to the immediate floodplain of the Shoalhaven River and the lower parts of Flat Rock Creek. The subject land is not “*associated with*” those landscape features in any relevant way.

4.5 Groundwater Dependent Ecosystems

The *NSW State Groundwater Dependent Ecosystems Policy* (GDE Policy) identifies ‘Groundwater Dependent Ecosystems’ (GDEs) as “*ecosystems which have their species composition and their natural ecological processes determined by groundwater*”. Of the vegetation types and ecosystems present on the subject land at Mundamia, only two are considered possible or likely to be dependent, in part at least, on groundwater discharges.

The nature of the subject land (as detailed in the *Hydrogeological Assessment Report* by Martens – February 2011) creates a close connection between surface waters and groundwater, because of the thin soils present and the relatively impervious sandstone bedrock (which is located generally less than 0.5m below the soil surface). Given that circumstance, much of the groundwater which could potentially traverse the subject land would be intercepted by plant roots, and would be transpired.

Of the two potential GDEs present on the subject land (the Swamp Paperbark Forest and the ‘moss gardens’), only the latter is likely to be particularly dependent upon groundwater flows. However, given the interaction between surface flows and groundwater, even that ‘dependence’ is arguable. The Swamp Paperbark community (in the northeastern part of the subject site) is located at a low point along a drainage swale in this part of the land, and is likely to depend more on overland flows and incipient rainfall than on groundwater flows *per se*.

The ‘moss gardens’, by contrast, are located at the periphery of areas of soil where the sandstone bedrock is exposed (generally in large flat sheets). ‘Moss gardens’ constitute a narrow layer of thin moss vegetation sitting directly on top of the bedrock (see page 18), and it is assumed that at least some of the moisture required to maintain the ‘moss gardens’ is derived from groundwater flows which express themselves on top of the bedrock, where the surface soil ceases.

The ‘moss gardens’ tend to be located in the vicinity of stands of Kunzea Shrubland, but the Kunzea itself is not typically associated with areas of groundwater expressions. The Tick Bush *Kunzea ambigua* typically occurs on ridge tops and rock outcrops, and is not located in areas where the soil is permanently moist. Thus, it is not the Kunzea Shrubland that would constitute a GDE, but rather the ‘moss gardens’ which are in places coincident with Kunzea Shrublands.

The proposed development will remove some of the ‘moss gardens’ along the eastern boundary of the development, but will retain others. It is likely that additional areas of ‘moss gardens’ will develop naturally as a result of the bioretention swales along the eastern boundary of the development.

5 FAUNA AND FAUNA HABITATS

5.1 Fauna Habitats

Vegetation on the subject land at Mundamia (as described above) consists in part of open farmland with scattered trees and in part of open forest and woodland with a generally dense shrubby understorey.

The open farmland is structurally simple and provides only very limited habitat opportunities for native fauna. Mammals (such as the Eastern Grey Kangaroo) and birds (such as the Australian Magpie Lark, Masked Lapwing, Willie Wagtail and Australian Magpie) which can use disturbed and/or more open environments were frequently observed in this part of the subject land, along with a number of introduced species (including the Red Fox and European Rabbit). Two small farm dams are also present within the open farmland, as well as a large 'sediment dam' in the southern part of the land, (a legacy of previous quarry operations (SLR consulting 2012)). These provide habitat for amphibian species which can use artificial environments (such as Haswell's Frog, the Striped Marsh Frog and Common Eastern Froglet).

The open forest within the northern and eastern parts of the subject land is structurally complex, and provides a diversity of habitat niches for forest-dependent native fauna, including threatened species such as the Yellow-bellied Glider. This vegetation has distinctive lower, middle and upper strata, and consequently there are abundant and varied foraging resources and shelter, nesting or roosting opportunities for a wide diversity of native fauna. There is a moderate number of tree-hollows of varying sizes, and an expansive sandstone outcrop area along the eastern boundary of the subject land and beyond (to the east), containing numerous small caves and rock overhangs.

5.2 Hollow-bearing Trees

The positions of all hollow-bearing trees within the development area and the immediately adjacent *Asset Protection Zone* (APZ) were mapped in the field with a PDA/GPS running the ArcPad GIS software package (Figure 6). It is to be noted, however, that not all of the hollow-bearing trees on the land have been identified, and that the proposed *Conservation Area*, and adjoining lands to the east and north, support abundant tree-hollows.

The information collected (Table 3; Appendix F) includes:

- tree species;
- tree height (m);
- Diameter at Breast Height Over Bark (DBHOB);
- the number and size of visible hollows;
 - Small large enough for a small arboreal species (up to a Sugar Glider);
 - Medium large enough for a medium arboreal species (up a Squirrel Glider);
 - Large large enough for a large arboreal species (up to a Brush-tailed Possum);
 - Owl suitable for a large forest owl;
- type of hollow (spout, stem, trunk, base, fissure); and
- geographical location (Easting and Northing - GDA 1994; AMG Zone 56).

As indicated in Table 3, a number of hollow-bearing trees are present within the development area (the “*subject site*”) at Mundamia, within the proposed APZs (Figure 6). More hollow-bearing trees are present (at similar densities) within the areas not surveyed and which are to be zoned *E2 – Environmental Conservation*, especially in the northeastern and eastern portions of the subject land, and on lands beyond, particularly the substantial reserved land to the east along Flat Rock Creek (Figures 2 and 4).

Table 3 Summary of tree-hollows recorded on the subject site and in APZs

Tree Species	Number Surveyed	Hollow Size				Total
		Small	Medium	Large	Owl	
<i>Corymbia gummifera</i>	9	7	11	7	0	25
<i>Eucalyptus agglomerata</i>	2	1	1	0	0	2
<i>Eucalyptus pilularis</i>	2	3	3	0	0	6
<i>Eucalyptus punctata</i>	20	28	15	4	0	47
<i>Eucalyptus sclerophylla</i>	14	10	17	16	1	44
Stag trees	13	9	12	17	3	41
Total	60	58	59	44	4	165

A total of 60 hollow-bearing trees, containing at least 165 hollows, were recorded in the development and APZ areas, with the majority of hollows in the Grey Gum *Eucalyptus punctata*, Scribbly Gum *E. sclerophylla* and stag trees. Of these, 39 hollow-bearing trees would need to be removed to accommodate future residential development (Figure 6). However the proposal will involve the implementation of a ‘*Hollow-Bearing Tree Protocol*’ (See Chapter 17) which will ensure that there is no nett loss of tree-hollows as a consequence of the proposal .

Further, all hollow-bearing trees are to be retained within the APZs, and a substantial number of hollow-bearing trees will also be retained with the *E2 – Environmental Conservation* area. In addition, there are substantial hollow-bearing tree resources in the immediate vicinity and locality, including for example in the Triplarina Reserve (to the southeast) and along Flat Rock Creek (to the immediate east).

5.3 Fauna Species

Field investigations on the subject land and on adjoining lands by SLR Ecology and by Environmental InSites and others (including BES) over a number of years have identified a fauna assemblage of 120 native species (7 amphibians, 7 reptiles, 74 birds and 25 mammals) and 7 introduced/domestic mammal species (Appendix F).

The number of species recorded is reflective of the habitat types present on the subject land and in the immediate vicinity. The forested sections of the subject land and adjoining lands in particular provide resources for forest-dependent fauna species (such as gliders and many of the bird species), whilst the cleared pasture areas provide habitat and resources for only a limited suite of native species.

Amphibians

Amphibian habitats on the subject land consist of two small farm dams and one large 'sediment' dam, an area of swampy ground and impeded drainage in the central part of the site, and the small sandstone creekline in the northeastern of the subject land (Figures 2 and 5). As noted above, seven amphibian species have been recorded within and surrounding the subject land, all of which are common in the habitat types present.

Two threatened amphibian species are known to occur in the local area (DECC 2008). Whilst the small sandstone creekline provides some limited potential habitat for the Giant Burrowing Frog, surveys by both BES (2004) and Environmental InSites (2008) have not recorded this species. In any case, potential habitat for this species would be retained within the proposed *E2 – Environmental Conservation Area*.

No evidence for the Green & Golden Bell Frog has been recorded from the Mundamia area during any investigations undertaken to date (BES 2004a, b, c, 2007, 2011; Environmental InSites 2009a, b, 2010, 2011; SLR Ecology - this *Report*). Whilst it is theoretically possible for Green & Golden Bell Frogs to utilise the farm dams present on the subject land, there has been no evidence on any such activity to date.

Reptiles

Seven reptile species have been recorded on and around the subject land (Appendix F), all of which are common in the area. Given the structural diversity of habitats across the subject land, particularly within the eastern section along the sandstone escarpment, the reptile assemblage is likely to be more diverse than so far identified.

Two threatened reptile species are known from the locality (Rosenberg's Goanna and the Broad-headed Snake).

With respect to Rosenberg's Goanna, none of the development area on the subject land supports any termite mounds (or 'termitaria'), and this species has not been recorded in the vicinity (BES 2004a, c, 2007, 2011; Environmental InSites 2008, 2009, 2010; SLR Ecology - this *Report*). Investigations for Rosenberg's Goanna on the adjoining land to the immediate west (BES/ELA 2011), and specifically for the access road required for the Mundamia residential area (Environmental InSites 2009), as well as for this *Report*, provide no evidence of this species at this location. In addition, there are no records of Rosenberg's Goanna in the vicinity, or even nearby (Appendix C; Sass 2008).

With respect to the Broad-Headed Snake, there are no records of this species on subject land or on other lands in the vicinity. Potential habitat for the Broad-Headed Snake on the subject land is of marginal quality, and in any case is essentially confined to the *E2 - Environmental Protection area*.

Avifauna

Seventy-four bird species have been recorded within and surrounding the subject land (Appendix F), the vast majority of which are common to abundant, and widespread, and would utilise relevant habitats present within and adjoining the subject land.

The broad guilds of birds that have been recorded on or around the subject land at Mundamia include:

- species characteristic of open grasslands and agricultural pastures (eg the Masked Lapwing, Australian Magpie, Magpie-lark, Willie Wagtail and Galah);
- species typical of woodland environments (such as the Crimson Rosella, Glossy Black Cockatoo, Gang Gang Cockatoo, Rainbow Lorikeet, honeyeaters, thornbills and butcherbirds);
- raptors and carnivorous species (such as the Powerful Owl, Southern Boobook, Kookaburra and Square-tailed Kite);
- the smaller and more cryptic bird species which utilise dense shrubs and mid-storey vegetation for shelter (eg the Eastern Yellow Robin and Superb Fairy Wren); and
- wetland birds (ducks, grebes and herons), which would utilise the farm dams and areas of flooded pasture following heavy rains.

An array of additional bird species, beyond those listed in Appendix F, would be likely to utilise the subject land over a period of decades, particularly under different climatic or seasonal circumstances. However, given that the majority of the area proposed for development activities is cleared pasture, the number of such additional species which would be dependent upon those parts of the site proposed for development purposes is extremely limited.

Mammals

Thirty-one mammal species have been recorded within and adjacent to the subject land (Appendix F). Of these, four are listed as “*vulnerable*” pursuant to the TSC Act, one of which is also listed as “*vulnerable*” pursuant to the EPBC Act (Table 6). Of the mammals recorded, 23 are native, three are feral introduced species and five are domestic mammal species.

Of the 23 native mammal species recorded on the subject land and in the vicinity by BES and by Environmental InSites:

- two are macropods, which would utilise the forest and woodland for shelter and the open pasture for grazing purposes;
- the three small terrestrial mammals (the Agile Antechinus, Swamp Rat and Long-nosed Bandicoot) would predominantly utilise areas of open forest and woodland;
- arboreal species (the Sugar Glider, Yellow-bellied Glider, Common Brushtail Possum and Common Ringtail Possum) would utilise woodland and forest areas for both shelter (hollow-bearing trees for the gliders and Brushtail Possum, and dense canopy for the Ringtail Possum) and areas of trees and shrubs for foraging purposes; and
- the Grey-headed Flying Fox would utilise the land to only an extremely limited extent, possibly when some trees are in flower; and
- the remaining 12 species are microchiropteran bats which would utilise the forest and woodland canopy for foraging purpose. In addition, most (but not all) of those microchiropteran bats would utilise tree-hollows on the subject site (as well as other such resources which are widely distributed through the landscape) for roosting purposes.

As indicated, six microchiropteran bat species were positively identified within the subject land, and a further six species were recorded to a lesser degree of certainty (Table 4). For most of these species, tree-hollows and or exfoliating bark on large trees constitutes the preferred or required roosting habitat, and the forest canopy constitutes appropriate foraging habitat. Only a small proportion of such resources on the subject land, and a minute proportion of those present in the vicinity, will be affected by the proposed development.

Two threatened microchiropteran bat species were recorded on the land, although there is only a low level of certainty in respect of the Common Bent-wing Bat, due to the poor quality of the call sequences (Table 4). In any case, little or no potential roosting habitat for this species would be disturbed as a result of the proposed development. Extensive foraging habitat for this and other microchiropteran bat species will be retained in the proposed *E2 - Environmental Conservation Zone* on the periphery of the land, and in the substantial other forested lands in the vicinity.

Table 4 Summary of results of ultrasonic bat detection surveys.

Common Name	Scientific Name	Status	Calls	Accuracy		
				Def	Pro	Pos
Eastern Free-tail Bat	<i>Mormopterus norfolkensis</i>	V	2	1		1
White-striped Free-tail Bat	<i>Tadarida australis</i>		1	1		
Eastern Horseshoe Bat	<i>Rhinolophus megaphyllus</i>		5	5		
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		10	3	7	
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		1		1	
Common (Eastern) Bent-wing Bat	<i>Miniopterus schreibersii oceanensis</i>	V	5			5
Long-eared Bat	<i>Nyctophilus</i> sp.		6	6		
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>					6
Gould's Long-eared Bat	<i>Nyctophilus gouldi</i>					6
Large Forest Bat	<i>Vespadelus darlingtoni</i>		43			43
Southern Forest Bat	<i>Vespadelus regulus</i>		3			3
Little Forest Bat	<i>Vespadelus vulturnus</i>		27	15	11	1

Key to Accuracy

Def	No doubt about the identification of the species making the call (Definite)
Pro	Most likely the species named, but there is a low probability of confusion with other species with similar calls (Probable)
Pos	The call is comparable with the listed species, but there is a moderate to high probability of confusion with species that emit similar calls (Possible)

5.4 Threatened Fauna Species

Four threatened bird species have been recorded utilising the subject land (Table 5), each of which are wide-ranging and highly mobile. None of these species (nor indeed even an individual of any such species) could be dependent on the subject site for their survival at this location. In any case, most of the highest quality habitat for these species would be retained in the proposed *E2- Environmental Conservation Zone* on the subject land, complementing the extensive areas of such habitat in the immediate vicinity and in the locality.

Table 5 Threatened bird species recorded within the subject site at Mundamia

Family	Species	Common Name	TSC	BES 2004	InSites 2008-2011
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite	V	x	
Cacatuidae	<i>Callocephalon fimbriatum</i>	Gang Gang Cockatoo	V	x	
Cacatuidae	<i>Calyptorhynchus lathami</i>	Glossy Black Cockatoo	V	x	x
Strigidae	<i>Ninox strenua</i>	Powerful Owl	V	x	

*TSC = *Threatened Species Conservation Act* (TSC Act)

V = Vulnerable

The threatened mammal species recorded on the subject land at Mundamia are all forest-dependent, indicating that the most important habitat within the subject land is that within the northern and eastern portions of the subject land. The majority of that habitat will be retained in the proposed *E2 - Environmental Conservation Zone* on the land (Figure 4), with significant additional areas of suitable habitat on surrounding lands (Figure 2).

Of the four threatened species identified, the Yellow-bellied Glider is likely to be a long-term resident of the subject land and surrounding lands. The other three species are highly mobile and more wide-ranging, although some microchiropteran bats could readily reside within the subject land.

Table 6 Threatened mammals recorded within the subject land at Mundamia

Family	Scientific Name	Common Name	Legal status*	BES 2004	InSites 2008
Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider	V (TSC)	x	x
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	V (TSC) V (EPBC)	x	
Molossidae	<i>Mormopterus norfolkensis</i>	East-coast Free-tail Bat	V (TSC)		x
Vespertilionidae	<i>Miniopterus schreibersii oceanensis</i>	Common Bent-wing Bat	V (TSC)	x	x

*TSC = *Threatened Species Conservation Act 1995* (TSC Act)

V = Vulnerable

EPBC = *Environmental Protection & Biodiversity Conservation Act 1999* (EPBC Act)

V = Vulnerable

Both the Yellow-bellied Glider and East-coast Free-tail Bat utilise tree-hollows for denning or roosting purposes. There are extensive tree-hollow resources within the northern and eastern portions of the subject land, the majority of which would be retained in the *E2 - Environmental Conservation Zone*. Further, as detailed in Chapter 17, the *Hollow-Bearing Tree Protocol* will ensure that there is no nett loss of tree-hollows as a result of the proposal. Qualitative assessment of the adjacent land further to the east and north (and elsewhere in the vicinity) indicates that there are also extensive tree-hollow resources surrounding the subject land.

As indicated above, a total of 8 threatened fauna species have been recorded within and surrounding the subject land (Appendix F). Habitat for these species within the subject land is largely confined to the forest and woodland vegetation in the eastern and northern portions of the land, the majority which will be retained in the proposed *E2 - Environmental Conservation Zone*. Significant areas of additional habitat for these species is also located on other lands to the east, north and southeast of the subject land, and in DECC and Forest NSW estates within 10-15km of the subject land (involving approximately 6,700ha of forested habitat).

6 ENVIRONMENTAL CONSTRAINTS

6.1 Fundamental Considerations

Development of the subject land at Mundamia will inevitably involve the imposition of some impacts upon elements of the natural environment in general, including on individuals of and/or habitat for a number of threatened biota.

On the other hand, the planning and impact assessment process requires the determination of an appropriate balance between development opportunities and biodiversity conservation outcomes. This approach involves the consideration of benefits which may be derived from the appropriate management of relevant portions of the land, as well as consideration of the adverse impacts (including the loss of habitat or resources for threatened biota) which will or may arise.

In this regard, it is not a requirement of any legislation that there be no adverse impacts on either the natural environment in general or upon threatened biota in particular. The mere presence of individuals of threatened species, or of habitat for such species, does not constitute an absolute constraint to development opportunities. Rather, these matters need to be taken into account when considering the extent of development (including the clearing of or loss of specimens or habitat for such biota which would ensue) and appropriate balance between the necessary urban development and biodiversity conservation aspirations.

6.2 Potential Ecological Constraints

The potential ecological constraints to development opportunities on the subject land at Mundamia include:

- individuals and patches of the threatened Nowra Heath-myrtle *Triplarina nowraensis*;
- the potential presence of the Spring Tiny Greenhood orchid, although this species has not been recorded on the site either by Council or by the authors of this *Report*;
- hollow-bearing trees, which provide potential habitat for a number of threatened species;
- the loss (albeit relatively small) of foraging habitat and/or some potential roosting habitat (open forest/woodland and tall shrubland) for a number of threatened fauna species; and
- the potential direct and indirect impacts upon habitat for or individuals of a number of threatened biota.

Whilst *Groundwater Dependent Ecosystems* (GDEs) may theoretically constitute a constraint to development activities, the areas of vegetation which could potentially constitute GDEs on the subject land either are not solely dependent upon that water source or are not of particular significance.

The Swamp Paperbark Forest in the northeastern part of the land would not be entirely dependent upon groundwater discharges. The 'moss gardens' along the eastern side of the subject land are considered likely to be more dependent on groundwater (given their location), but would also be dependent (in drier times) on incipient rainfall. However, neither ecosystem is (in any case) restricted to the subject land.

Given the circumstances on the subject land, the presence of possible GDEs is not regarded as a constraint proposed to the development activities. The potential areas to be affected are small, and the ecosystems present are neither restricted in distribution nor restricted to the subject land. In any case, the stormwater management regime for the project includes measures designed specifically to maintain groundwater regimes downslope of the development.

It should be noted that the majority of the development area (approximately 70%) is already cleared and highly disturbed agricultural land. That portion of the subject land does not represent a relevant constraint to the development activities as proposed.

Further, that part of the proposed development footprint which contains either individuals of or habitat and resources for threatened species (predominantly confined to the eastern and north-eastern portions of the proposed development footprint) represents only an extremely small proportion of such species, populations or habitats in the immediate vicinity or locality (Figures 1 and 2). Given the extent of adjoining and nearby conservation reserves, the area of any resources or habitat for any such species to be affected is extremely small.

6.3 Strategic Approach

Consideration of the likely or probable biodiversity constraints to development opportunities on the subject land, and the assessment of impacts which will or may arise from the proposed development, are discussed in further detail in subsequent chapters of this *Report*.

In the first instance, however, it needs to be noted that the majority of the development activities are to be undertaken within the existing highly disturbed and modified agricultural parts of the subject land (69%) and/or in disturbed vegetation around the periphery of the agricultural areas. Most of the high quality habitats and/or resources for threatened biota present on the subject land have been retained within those parts of the land to be zoned *E2 - Environmental Conservation* along the eastern and northern boundaries (Figure 4).

There are no relevant or significant riparian issues associated with the proposed development of the subject land at Mundamia. A single small drainage line is located in the northeastern part of the subject land, through a stand of Paperbarks and draining more steeply in the northeastern part of the land (which is to be conserved).

However, the upper parts at least of that drainage line do not relevantly constitute a “*river*” pursuant to the *Water Management Act 2000*. The drainage line is small, gentle and does not have a defined bed or banks, other than below the proposed development area. It is located within a broad drainage swale through this part of the land, although once the ‘drainage line’ reaches the areas of sandstone rock outcropping, there are elements of a ‘watercourse’ or ‘river’ present. These elements of the ‘drainage line’, however, occur outside the proposed development area.

Nevertheless, the issues of stormwater quality, water volume discharges and the maintenance of ecological values along that watercourse downstream of the subject land have been taken into account in the design of the stormwater management system for the project (for details, see the *Water Cycle Management Report* by Storm Consulting 2012).

Further, and consistent with the *Nowra-Bomaderry Structure Plan* (see Chapter 16), the proposed development of the subject land at Mundamia “*will achieve a considered balance between urban development and the protection of environmentally significant areas*”. The proposal has been designed

and amended by the applicant (on the basis of input from *inter alia* the authors of this *Report*) to reduce or minimise potential adverse impacts upon threatened biota and their habitats on the land.

A substantial area of land (9.49ha or 21.9% of the subject land) is to be dedicated for biodiversity conservation purposes, in the most appropriate parts of the land (the northern and eastern portions). These areas are adjacent to existing reserved or substantially vegetated lands, and will provide a 'buffer' to those conserved lands. They will also contribute in a positive manner to biodiversity conservation by maintaining areas of native vegetation (including habitat for and populations of threatened biota) which are to be managed for biodiversity conservation purposes.

Thus, the proposed development of the subject land at Mundamia, as currently designed, achieves an appropriate balance between development opportunities and biodiversity conservation outcomes (see following Chapters of this *Report*).

7 POTENTIAL ENVIRONMENTAL IMPACTS

7.1 General Environmental Impacts

The proposed development of the subject site at Mundamia for residential purposes (Figure 4) predominantly involves the loss of agricultural (poor quality) pasture and weeds, as well as the removal of a relatively small area (8.9ha) of mostly modified open forest and heathland (Figure 7). A minor tributary to Flat Rock Creek is present in the northeastern section of the subject land, flowing in a northeasterly direction (Figure 2). The proposed *E2 - Environmental Conservation Zone* on the land occupies a total of 9.49ha, a small part of which will need to be maintained as an APZ (Figures 4 and 7).

The removal of approximately 8.9ha of open forest and heathland (some of which is in a disturbed condition) is insignificant in relation to the large areas of high quality biodiversity value land proposed to be retained in the *E2 - Environmental Conservation Zone*, and in the undisturbed Crown Land and Reserves surrounding the subject land. The area to be removed constitutes only a minute proportion of habitat in the immediate locality (*ie* within approximately 10km) of the land.

As noted above, the majority of the vegetation which is to be removed from the proposed development portions of the subject site at Mundamia (69%) has long been highly modified for agricultural purposes. Further, much of the native vegetation which is to be removed has been disturbed by 'edge-effects' and by incursions (of weeds and stock) from the adjoining agricultural land. Higher quality vegetation within the northern section of the land and along the eastern boundary will be retained and managed, and would likely ultimately be dedicated to Council.

Whilst the proposed development (as noted above) will require the removal of some areas of native vegetation from the subject land, there are a number of relevant considerations in assessing the potential or likely impacts of the proposal. Such considerations include *inter alia*:

- the modified nature of much of the native vegetation to be removed;
- the incorporation of measures to maintain native habitats and resources on the subject land, and to ensure their long-term viability, as a direct consequence of the project design (by retaining a large area of retained vegetation in the northern and eastern parts of the v), and by the management of the project (including *inter alia* the implementation of appropriate design and stormwater management and treatment measures);
- the protection of 9.49ha of native habitats and vegetation for biodiversity conservation purposes within the proposed *E2 - Environmental Conservation Zone* along the eastern and northern sides of the land;
- the implementation of a *Vegetation Management & Habitat Restoration Plan* (VMHRP) within the proposed *E2 - Environmental Conservation Zone* to control and/or limit adverse impacts; and
- controls on indirect impacts by the avoidance of inappropriate plant species in landscaping, and by the application of appropriate stormwater and APZ management regimes.

An important further consideration is that there is no requirement or imperative for the implementation of any habitat management, protection or enhancement measures under the current land management regime. By contrast, the proposed development concept will facilitate the implementation of a comprehensive management regime over approximately 9.49ha of the subject land (or 21.9%), and its dedication for biodiversity conservation purposes in perpetuity.

As discussed in detail above (Chapter 4), that portion of the subject land at Mundamia proposed for development is characterised predominantly by open farmland. High quality vegetation is limited to the northern periphery and a narrow strip along the eastern boundary. The majority of this vegetation will be retained and managed for conservation purposes in the proposed *E2 - Environmental Conservation Zone* as part of the re-zoning of the land.

The proposed development (Figure 4) includes a perimeter road along the boundary to the *Environmental Conservation Zone*. Whilst no residential activities will be located outside the proposed perimeter road, which provides a clearly defined management and land use boundary:

- adjacent woodland in the *E2 - Environmental Conservation Zone* will be managed in places (in an environmentally sensitive manner) for bushfire protection purposes, in accordance with the requirements of the *Bush Fire Report* (ELA 2012), and in accordance with the *Vegetation Management & Habitat Restoration Plan* (VMHRP); and
- a peripheral bioretention swale system will be located on the outer edge of the perimeter road system, to maintain the existing moist soil regime by infiltration and 'over-topping' during major rainfall events (see Storm Consulting 2012; Chapter 9; Figure 9).

Given those circumstances, and given the large areas of forested and riparian areas to be retained, it cannot be construed as likely that development of the land as proposed would adversely affect native biota (flora, fauna, habitats or communities) to any significant extent.

It is also to be noted that the potential impacts arising or which may arise from development of the subject land as proposed are to be considered in the light of the impact amelioration and environmental measures for the project, which are detailed in Chapter 17 of this *Report*. It is also to be assumed and anticipated that development of the subject land (including all necessary excavation, land clearing, construction and bushfire management requirements) will be undertaken in an environmentally sensitive manner, applying all appropriate current "*best practice*" methods and measures to maintain water quality, to protect adjoining natural vegetation, and to control sediment discharge and runoff.

7.2 Vegetation to be Removed or Modified

Whilst the majority of that area proposed for residential development activities on the subject land at Mundamia (Figure 7) consists of existing cleared pasture and areas of degraded vegetation (modified open woodland with a degraded understorey and/or scattered trees or regenerating scrub), the development footprint also includes areas of extant native vegetation in poor to good condition.

All of these areas of native vegetation are located along the eastern and northern peripheries of the proposed development area (Figure 7), with the whole of the western and southern parts of the subject land (within which development activities are to occur) having long been cleared and modified for agricultural purposes. The narrow bands of 'woodland' along fencelines on the eastern side of the land and through the centre (Figures 5 and 7) are not regarded as of any conservation value.

The proposed residential development footprint (not including the *Asset Protection Zones* – APZs) will require the removal (Figure 7; Table 7) of:

- a narrow band of Scribbly Gum - Bloodwood Woodland along the western boundary fenceline (approximately 0.41ha);

- a narrow strip (approximately 5m wide) of mixed woodland across the centre of the subject land, aligned from east to west (approximately 0.36ha);
- approximately 5.99ha of Grey Gum - Blue-leaved Stringybark Woodland along the eastern side of the development area. Whilst most of this vegetation is in moderate condition, that located adjacent to the existing cleared pasture is often modified and degraded by grazing stock and/or weed infestation;
- approximately 0.86ha of highly degraded Grey Gum - Stringybark Woodland around the existing farmhouse in the northern half of the subject land;
- an area of Paperbark Closed Forest along a minor drainage line in the central part of the subject land, occupying approximately 0.71ha; and
- approximately 0.92ha of Kunzea Shrubland/Heathland along the eastern periphery of the development area. The patch of that vegetation close to the existing farmhouse in the northern part of the land is also highly modified and degraded.

Table 7 Areas of vegetation to be removed, modified and/or retained on the subject land

Vegetation Community	Removed (ha)	Modified in APZs (ha)	Retained (ha)	Total (ha)
Cleared	21.41	0.93	0	22.34
Scribbly Gum - Bloodwood Forest	0.41	0	0	0.41
Mixed Woodland Strip	0.37	0	0	0.37
Grey Gum - Stringybark Woodland	5.98	1.53	7.07	14.48
Degraded Grey Gum - Stringybark Woodland	0.86	0.42	0.46	1.74
Kunzea Shrubland/Heathland	0.92	0	0	0.92
Regrowth Woodland with Kunzea Heath	0.29	0	0.22	0.51
Paperbark Closed Forest	0.71	0	0.08	0.79
Spotted Gum – Blackbutt Forest	0	0	1.63	1.63
Total	30.95	2.88	9.46	43.29

As noted above, most of the vegetation which is to be removed for the proposed development on the subject land at Mundamia has been modified or disturbed to various degrees over a long period of agricultural activities on the land. Nevertheless, a small proportion of the areas to be cleared are in at least moderate condition, and some parts of those areas of vegetation provide relevant habitat or resources for potential or known threatened species (see below).

It should be noted that the areas of vegetation to be removed (Table 7) constitute only a small proportion of those present in the general locality. In particular:

- there are substantial tracts of Grey Gum/Blue-leaved Stringybark forest and woodland in the immediate vicinity and general locality, including extensive areas in existing reserves (eg the adjoining Thompson Reserve, Council land and the Triplarina Nature Reserve), and/or on the subject land as well as on adjacent lands;

- whilst the Kunzea Shrubland/Heathland along the eastern periphery of the proposed development in the southern half of the subject land is to be removed, that vegetation type is common and widespread in the immediate vicinity and general locality, and is not regarded *per se* as of particular ecological value;
- the small area of Kunzea Shrubland/Heathland in the northeastern part of the land, which is to be removed, is already highly modified and degraded;
- the two narrow strips of trees in the central part of the land (along the western boundary and across the centre of the land) are highly modified and of poor quality; and
- the band of Paperbark Closed Forest along the upper drainage line in the northeastern part of the subject land will mostly be removed for the proposed development.

8 POTENTIAL IMPACTS on THREATENED SPECIES

8.1 Threatened Ecological Communities

There are no “*threatened ecological communities*” (TECs) present on the subject land at Mundamia.

As discussed above (in Chapter 4.3), the Paperbark Closed Forest vegetation present in the northeastern part of the subject land is not an example of the Swamp Sclerophyll Forest on Coastal Floodplains “*endangered ecological community*” (EEC), because the subject land is not located on a “*coastal floodplain*”. Nor is it relevantly “*associated with .. a coastal floodplain*”.

8.2 Threatened Species

8.2.1 Relevant Threatened Species

As detailed in Chapters 4 and 5 of this *Report*, there are a number of threatened species which will or are likely to be affected by the proposed development on the subject land at Mundamia.

The Nowra Heath-myrtle is known to occur within the development footprint, as well as within the *Conservation Area* (see below). There are records (either direct or indirect) of several threatened fauna species, including the Yellow-bellied Glider, Glossy Black Cockatoo, Gang Gang Cockatoo, Grey-headed Flying Fox and two threatened microchiropteran bats.

Two additional threatened fauna species have been recorded in the vicinity of the development area – the Powerful Owl (recorded in the northeastern part of the subject land, in the *Conservation Area*) and the Square-tailed Kite (which was recorded flying over the land).

There will unavoidably be adverse impacts imposed upon at least some individuals of some of these various threatened biota. For the threatened fauna species, those impacts will predominantly be indirect (*ie* through the removal of resources or habitat features such as hollow-bearing trees or preferred food trees), whereas for the Nowra Heath-myrtle, there will be both direct impacts (by the loss of individuals) and indirect impacts (by the loss of some areas of habitat).

8.2.2 Nowra Heath-myrtle

With respect to the Nowra Heath-myrtle, a small area of known habitat for the species will be removed, as it is located within the proposed development footprint, including:

- approximately 0.29ha in the northern part of the proposal, where there is a dense stand of Nowra Heath-myrtle in an area which has recently been slashed (*ie* within the last 2-4 years); and
- less dense individuals in shrubby woodland and open forest along the eastern side of the development footprint, particularly in the northeast.

The greatest density of the Nowra Heath-myrtle on the subject land is located in the northern part of the property (Figure 8). Much of this patch had been contained within the previous development footprint (extending into the current *Conservation Area* to the north), and had been subjected to recent (in the last 4 years) slashing, with the subsequent removal of most of the *Kunzea* shrub layer. This portion of

the land now consists of a scattered woodland tree canopy with areas of *Kunzea* regrowth and a moderate density of Nowra Heath-myrtle, and other areas which are almost a monotypic stand of Nowra Heath-myrtle below the scattered tree canopy (Figure 8).

As a consequence of the detailed mapping of the Nowra Heath-myrtle by Environmental InSites undertaken in 2010, amendments to the northern part of the proposed residential subdivision have been made. Those amendments have enabled the retention of the overwhelming majority of the large stand of Nowra Heath-myrtle to the north of the proposed subdivision (Figure 8), and have also increased the quantum of that plant retained in the northeastern corner.

It should also be noted that most of the large stand to the north of the proposed subdivision is located upslope of the proposal and/or across slope, and will therefore not be affected by any stormwater run-off or other effects of the residential subdivision.

It is noted also that whilst there will be some loss of specimens of the Nowra Heath-myrtle as a result of the proposed development on the subject land at Mundamia, that loss is offset by:

- the retention of the majority of the population and most of the suitable habitat for the species within the *Conservation Area* on the subject land;
- the proposal to implement a dedicated *Vegetation Management Plan* within the *Conservation Area*, designed specifically *inter alia* to protect and enhance populations of the Nowra Heath-myrtle; and
- a commitment within the *Statement of Commitments* (SoC) to monitor the population of the Nowra Heath-myrtle within the *Conservation Area*, and to provide data and information to Council and/or the OEH until the *Conservation Area* is dedicated to Council or the OEH for biodiversity conservation purposes.

8.2.3 Threatened Fauna

With respect to the threatened fauna species known or likely to occur within those areas of vegetation to be cleared for the proposed residential development of the subject land:

- a small proportion of resources which are of relevance for the Yellow-bellied Glider (including some hollow-bearing trees and a few sap feed trees) are located within the development footprint;
- however, these resources are also abundant within the *Conservation Area* on the subject land and in the adjoining vegetated lands (the Thompson Reserve to the north, the crown land along Flat Rock Creek to the east, and additional crown land and the Triplarina Nature Reserve to the south and southeast);
- the total area of open forest and woodland to be removed for the proposal represents only a minute portion of that present in the locality and identified in the *Nowra-Bomaderry Structure Plan* as being retained for biodiversity conservation purposes;
- with respect to microchiropteran bats, the loss of hollow-bearing trees as roost sites and of open forest or woodland habitat for foraging purposes will represent only a minor reduction in the extent of those resources and habitats in the locality;

- further, the proposal incorporates a *Hollow-bearing Tree Protocol* (Chapter 17) which is to be implemented as part of the project to salvage, re-use and/or replace any tree-hollows which need to be removed;
- similar considerations apply to the Glossy Black Cockatoo, for which there will be a minor reduction in potential and/or recorded feed trees (*Allocasuariana* species), noting also that there are substantial such resources within the *Conservation Area* on the subject land and in other areas of vegetation which are to be retained in the locality;
- only a very few potential nest trees for the Glossy Black Cockatoo will be removed (perhaps one or two), noting also that there is no evidence for any breeding by Glossy Black Cockatoos on the subject land;
- the proposal will remove a small area of habitat within which the Powerful Owl could potentially forage on arboreal mammals. However, there are no hollow trees with suitable features for breeding by the Powerful Owl; and
- the removal of some woodland vegetation will have little or no impact upon either the Grey-headed Flying Fox or the Square-tailed Kite, given that both species are highly mobile and very wide-ranging, and that there are no specific resources of particular value for these species present on the subject land.

As is the case with the Nowra Heath Myrtle, the potential significance of the imposition of adverse impacts on those threatened fauna species needs to be considered in the light of the relevant impact amelioration and environmental management measures proposed as part of the activity, and (particularly) the protection of a substantial portion of high quality native vegetation on the subject land within a *Conservation Area*. The proximity of the subject land to other areas of native vegetation to be retained in the vicinity and locality is also of particular relevance in this case.

8.3 Impact Analysis

With respect to threatened fauna and/or habitats or resources for threatened species, the proposed development on the subject land at Mundamia will involve:

- the loss of 30-40 hollow-bearing trees of various sizes. Most of the hollow-bearing trees, however, are of only moderate size at best, and there are very few large tree-hollows which will require removal (see discussion below regarding the salvage and re-use of tree-hollows);
- the removal of a number of Yellow-bellied Glider food trees in the eastern part of the proposed development footprint;
- the loss of a number of Glossy Black Cockatoo feed trees; and
- the loss of a small proportion of the Nowra Heath-myrtle population, which extends well into the proposed *Conservation Area*, particularly in the north and northeast of the subject land (where the development has been re-designed to reduce the loss of Nowra Heath-myrtle required).

Whilst the proposed development as detailed in the *Concept Plan*, and as discussed above, will require the removal of some areas of native vegetation and of habitat and resources for threatened biota (as well as individuals of the Nowra Heath-myrtle), there are a number of relevant considerations when assessing the significance of potential or likely environmental impacts of the proposal.

In this regard, it is relevant to include consideration of:

- the extent of retention of habitat, resources and individuals of threatened biota, as well as significant areas of native vegetation, within the *Conservation Area* in the eastern and northern parts of the subject land (Figure 7);
- the extent of habitat and resources, as well as populations and individuals of threatened biota, on surrounding lands, much of which have been designated for biodiversity conservation purposes in the *Nowra-Bomaderry Structure Plan* (Figure 11; Chapter 16);
- the implementation of a program to capture and relocate threatened species during any clearing of the subject land;
- the protection of most of the Nowra Heath-myrtle population within the *Conservation Area*, including within APZs, following modifications to the design of the northern part of the proposal (Figure 8);
- the implementation of a *Hollow-bearing Tree Protocol*, including the salvage and re-use of tree-hollows which require removal for the proposed residential development, with the relocation of salvaged tree-hollows into the *Conservation Area* and/or their use as hollow logs, and the replacement by artificial nest boxes of any tree-hollows lost, in the *Conservation Area*;
- the implementation of a 'best practice' stormwater management regime within the project to ensure, both during construction and during subsequent occupation, that discharge stormwater quality and quantities are appropriate (see Chapter 9);
- the implementation of a *Vegetation Management Plan* (VMP) for the whole of the *Conservation Area* (including the APZs), designed specifically to protect and manage habitat and resources, as well as native vegetation and threatened biota, within the *Conservation Area*;
- management of APZs around the development (where located within the *Conservation Area*) to facilitate and/or to enhance habitat and resources for threatened biota; and
- the long-term management of the *Conservation Area* for biodiversity conservation purposes by its dedication to Council to expand the adjoining *Flat Rock Creek Reserve* (to the east).

Detailed consideration of the impact amelioration and environmental management measures that are included as integral parts of the project are provided in Chapter 17 of this *Report*.

9 IMPACTS of the STORMWATER MANAGEMENT REGIME

A *Water Cycle Management Report* for the subject site has been prepared by Storm Consulting (2012), which addresses issues relating to the management of stormwater during construction activities for future development on the subject site, as well as ongoing management of stormwater once residential development has been completed.

Bio-retention swales are proposed along the eastern boundary of the residential area and throughout the residential area itself (Figure 9), with individual lots being provided with rainwater gardens to return stormwater to the soil. SLR Ecology (previously Environmental InSites) had liaised with Storm Consulting in the design of the stormwater management system to ensure that the existing groundwater conditions downslope of the development are maintained, insofar as is possible. This will involve a combination of infiltration of stormwater into the groundwater layer and the 'over-topping' of the swales to maintain soil moisture and hydrological conditions with the *Conservation Area*.

As noted in the *Water Cycle Management Report* (Storm Consulting 2012), the "*Proposed Stormwater Management Strategy*" includes:

- the preparation and implementation of a *Soil & Water Management Plan* in accordance with *Managing Urban Stormwater: Soils and Construction*, "Version 4" documents (prepared by Landcom in 2004) for all construction works on the site; and
- the creation and ongoing management of an operational stormwater management regime, which includes the implementation of *Water Sensitive Urban Design* elements and specific measures for the maintenance and management of stormwater quality and quantity once development activities have commenced.

There are two vegetation types which would appear to be partially dependent upon groundwater drainage and discharges – the Swamp Paperbark community contained within and adjacent to a shallow drainage line in the northeastern part of the subject land, and some small 'moss gardens' on the eastern side of the land. Both of those communities will be partially removed as a result of the proposed development of the subject land at Mundamia.

However, neither of those communities is restricted to the subject site, and neither is regarded of particular conservation concern. Furthermore, neither is considered to be entirely reliant on groundwater, as incipient rainfall is also doubtless an important and necessary resource for both communities.

Nevertheless, vegetation adjacent to the eastern side of the subject land is proposed to be maintained by the use of bio-retention swales within and adjacent to the development. These are designed *inter alia* to maintain groundwater conditions downslope of the subject land, and would facilitate the maintenance of areas of those vegetation types which are to be retained within the *Conservation Area*.

It is noted that whilst the Nowra Heath-myrtle often occupies moist areas and areas of impeded drainage, there are many areas on the subject land where specimens of the Nowra Heath-myrtle, and substantial stands of species, are present in xeric locations. Furthermore, the overwhelming majority of the population of that species on the subject land is located to the north of the proposed development area, on a slope which is outside of the catchment of the development. Thus, there will be no adverse impacts upon the overwhelming majority of that population as a consequence of the proposal.

As noted above, the proposed stormwater management measures contained within the concept design for the residential development at Mundamia have incorporated a range of measures intended specifically *inter alia*:

- to capture and re-use stormwater throughout the development;
- to utilise on-site infiltration and bio-retention swales to return stormwater to the soil;
- to incorporate measures to minimise the discharge of phosphorus, nitrogen and other contaminants (including sediment) during construction activities and throughout occupation of the subject land; and
- to provide supplementary habitat for native biota (in bio-retention swales) and to provide for maintenance of the soil and moisture regime downslope of the development.

Whilst the proposed development will doubtless result in some impacts as a result of changes to stormwater discharges, particular attention has been paid during the design phase to limit the potential for adverse impacts by the implementation of a stormwater management regime which is cognisant of and sensitive to the potential for adverse impacts to be imposed. The proposal has sought to implement appropriate measures for the management and treatment of stormwater discharges from the development.

The stormwater management regime which is to be implemented as part of the residential development of the subject land will not involve the imposition of a significant impact on any native biota, threatened or otherwise. In particular, as noted above:

- no threatened biota listed in the TSC Act will be adversely affected to any significant extent, by virtue of the areas of vegetation to be retained both on the subject land itself and in its immediate vicinity (particularly to the east);
- the stormwater management regime is intended *inter alia* to maintain (insofar as is possible) existing soil moisture levels to the north and east of the development area; and
- there will be no significant impact upon any *Matters of National Environmental Significance* (MNES) as a consequence of the stormwater management regime for the proposed development of the subject land (see Chapter 15).

10 IMPACTS of BUSHFIRE PROTECTION MEASURES

In the northeastern and southeastern parts of the subject land, there is a requirement for the provision of *Asset Protection Zones* (APZs) in retained native vegetation within the *Conservation Area*, beyond the proposed development footprint (Figure 10). However, the APZ requirements within the *Conservation Area* (Figure 10) occupy only a narrow band in the southeast of the site, east of the perimeter road (EcoLogical 2012).

It is noted that an existing APZ is provided around the existing farmhouse on the residue lot on the subject land. Most of that vegetation is already highly modified and thinned, however, and ongoing management for the APZ will require only limited further modification of the patches of retained native vegetation.

The provision and maintenance of the APZ in the southeast will require *inter alia*:

- some (but not total) removal of trees to provide a discontinuous canopy;
- the thinning of dense shrubs and a reduction in leaf litter and fallen branches in places; and
- the ongoing maintenance of the APZs to maintain the required fine fuel levels on the ground, and to provide appropriate bushfire protection.

As documented in the *Vegetation Management Principles Plan* (VMPP) attached to this *Report* (Appendix G), the management of vegetation within the APZ is to be undertaken in a manner sensitive to the native biota present. In particular, the VMPP and the subsequent *Vegetation Management Plan* (VMP) for the *Conservation Area* will ensure that:

- hollow-bearing trees are retained within the APZ on a preferential basis;
- Yellow-bellied Glider feed trees will also be retained on a preferential basis;
- individuals and stands of the Nowra Heath-myrtle within the APZ will be identified to ensure that individuals of this species are retained, noting that an open understorey favours this species; and
- a monitoring regime within the APZ to ascertain the efficacy of the management regimes, and to provide opportunities to refine the APZ management regime.

Given the approach to be adopted with respect to the management of the APZ, and in particular the identification of individuals of and habitat and resources for the relevant threatened biota, management of the APZ does not represent a threat to the survival of any of the relevant threatened biota.

In the case of the Nowra Heath-myrtle, management of the APZ is likely to be beneficial for its ongoing survival. As is evident currently in the northern part of the land, the slashing of woodland containing this species can favour the Nowra Heath-myrtle, with this species now dominating the understorey at this location.

The preferential retention of hollow-bearing trees, and of Yellow-bellied Glider and Glossy Black Cockatoo feed trees, on a preferential basis within the APZ will also ensure that species which are dependent upon those resources will not be disadvantaged or adversely affected by the management of the APZ as proposed.

11 CUMULATIVE IMPACTS

All development involves a contribution to the imposition of “*cumulative impacts*”. More houses, more people and more infrastructure in any location inevitably lead to an increase in general impacts (both direct and indirect) on the natural environment.

However, the imposition of adverse impacts upon the natural environment in general and upon threatened biota in particular (including those present on the subject land), has been taken into account:

- in the *Nowra-Bomaderry Structure Plan*, which *inter alia* identified the subject site as an appropriate location for residential development;
- in the *South Coast Regional Strategy* (DoP 2006) which *inter alia* reinforces the development potential of the subject land; and
- in the assessment process contained in this *Report* for the current proposal.

As noted above, the Department of Planning (DoP) itself, through the vehicle of the *South Coast Regional Strategy* (the *Strategy*), is actively promoting the development for urban purposes of the subject land itself and land to its west – as Area 5 in the *Nowra-Bomaderry Structure Plan* (Figure 11).

Furthermore, as additional residential development throughout New South Wales is inevitable, it is proper to determine where are the best and most appropriate places for such development to occur. Generally speaking, it can reasonably be assumed that most further residential development would best be located adjacent or close to existing residential areas. That is precisely what is being promoted by the DoP in the *South Coast Regional Strategy* and the *Nowra-Bomaderry Structure Plan* (Figure 11).

That there will inevitably be “*cumulative impacts*” on the natural environment and on threatened biota as a result of the proposed development on the subject land, as well as on the adjoining lands to the west, is acknowledged and accepted. Each of those developments will inevitably contribute to the “*cumulative impacts*” in the locality. However, it cannot be the requirement of any one development to address and deal with the “*cumulative impacts*” of all development in the vicinity. Nor is it possible to avoid the imposition of “*cumulative impacts*” in any such development.

In any case, the proposed development of the land at Mundamia has sought to limit and/or ameliorate impacts (both potential and real) which would or might arise from the proposed urban development of the land *inter alia* so as to minimise the contribution of the project to “*cumulative impacts*”.

In this regard, the proposed development:

- has been confined substantially to areas which had previously been identified in the *Nowra-Bomaderry Structure Plan* as being appropriate for residential development;
- has involved an iterative approach, which has reduced the development *inter alia* to protect additional stands and individuals of the Nowra Heath-myrtle;
- incorporates specific stormwater regime design elements intended to maintain water quality and soil moisture levels;
- is committed to a management regime for APZs around the development which preferentially protects relevant resources (hollow-bearing trees, food trees *etc*); and
- provides for an increase in conserved lands by a commitment to dedicating the *Conservation Area* to Council to expand the adjoining Council Reserve (to the east).

12 PART 3A CONSIDERATIONS

12.1 Director-General's Requirements

A set of *Director-General's Environmental Assessment Requirements* (DGEARs) for the residential subdivision on the subject land at Mundamia was provided by the then Department of Planning (DoP Ref: 08_0141; 10/09324).

The DGEARs were provided by the DP&I³ (then the DoP) pursuant to Part 3A of the EP&A Act, and to identify *inter alia* that the *Environmental Assessment* for the proposal must include the consideration of a set of “*General Requirements*”, which include *inter alia*:

- “an outline of the scope of the project” - (Chapter 1.4; Figures 4 and 7);
- a “thorough site analysis, including constraints mapping and description of the existing environment”;
- “Consideration of the consistency of the project with the objects of the *Environmental Planning and Assessment Act 1979*”;
- “Consideration of impacts, if any, on matters of National Environmental Significance, under the *Environment Protection and Biodiversity Conservation Act 1999*”; and
- an “assessment of the potential impacts of the project and a draft *Statement of Commitments*, outlining environmental management, mitigation and monitoring measures to be implemented to minimise any potential impacts of the project”; and

The DGEARs also require an “assessment of the key issues specified” in the DGEARs (see Chapter 13).

These “general requirements” are addressed in the main *Environmental Assessment Report* for the proposal, and relevant material with respect to ecological matters contained in the “general requirements” is also provided in this *Report*. In addition, the “key issues” regarding ecological matters (contained in item 9 of the DGEARs) are addressed in detail in Chapter 13 of this *Report*.

Item 9 of the DGEARs requires *inter alia* an assessment of the proposal with respect to “flora and fauna”, and the preparation of a “*Flora and Fauna Assessment Report*” (see Chapter 13.1).

12.2 Scope of the Project

As discussed in Chapter 1.3 of this *Report*, and as detailed in the *Environmental Assessment Report* prepared by Cowman Stoddart (2012), the proposal at George Evans Road, Mundamia is for a residential estate occupying approximately 30.94ha (or 71.5% of the subject land).

The proposed development of the subject land will involve:

- development of approximately 71.5% of the land for residential and urban purposes, in accordance with the *Nowra-Bomaderry Structure Plan* (2008) and the draft *Shoalhaven Local Environmental Plan 2009* (SLEP 2009);

³ The DoP is now the Department of Planning & Infrastructure (DP&I).

- the dedication of approximately 9.49ha (or 21.9% of the land) for biodiversity conservation purposes and (in small part) for *Asset Protection Zones* (APZs); and
- the incorporation of an array of management regimes and stormwater management measures to avoid, minimise or control adverse impacts upon retained vegetation around the subject development site.

12.3 Site Analysis

This *Report* provides a “*thorough site analysis, including constraints mapping and description of the existing environment*”, both within the subject land itself and on surrounding lands.

In this regard:

- Chapters 3 (*Existing Environment*), 4 (*Flora and Vegetation*) and 5 (*Fauna and Fauna Habitats*) provide a detailed “*description of the existing environment*” with respect to ecological and riparian matters;
- Chapter 6 (*Environmental Constraints*), as well as the remainder of the *Report*, provide a thorough site analysis; and
- the potential and likely ecological constraints to development of the subject land are discussed in Chapters 6 - 11, and are identified in Figures 2, 5, 6 and 8, of this *Report*.

12.4 Objects of the EP&A Act

The relevant “*objects*” of the EP&A Act with respect to ecological issues are:

- “*the proper management, development and conservation of natural and artificial resources ... for the purpose of promoting the social and economic welfare of the community and a better environment*”;
- “*the promotion and co-ordination of the orderly and economic use and development of land*”;
- “*the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats*”; and
- the achievement of “*ecologically sustainable development*”.

Given those considerations, the proposed development on the subject land at George Evans Drive, Mundamia would satisfy the “*objects*” of the EP&A Act, particularly with respect to:

- the conservation of biodiversity in New South Wales;
- the protection and conservation of threatened biota and their habitats; and
- the achievement of “*ecologically sustainable development*” (ESD) outcomes.

The “*objects*” of the EP&A Act seek to achieve an appropriate balance between development opportunities (undertaken in an environmentally responsible manner) and biodiversity conservation aspirations. The intent of the EP&A Act, therefore, is to facilitate both development and conservation outcomes, rather than to guarantee one at the expense of the other.

The proposed residential development of the subject land at Mundamia has been designed in part to protect populations of, and habitat for, the Nowra Heath-myrtle, as well as to provide for the protection and long-term management of areas of habitat and resources for an array of other threatened biota. The stormwater management regime which has been designed for the project is intended *inter alia* to mimic existing soil moisture regimes in retained areas of habitat and vegetation, and to facilitate the survival of populations of species such as the Nowra Heath-myrtle.

The majority of the proposed development is contained within existing modified and degraded agricultural land. Further, the majority of suitable habitat and resources for threatened species, as well as for other more common native fauna and flora, is to be retained within the substantial *Conservation Area* on the subject land, as well as in extensive areas of vegetation adjacent to the property.

The proposed residential development at Mundamia will require the removal of only relatively small areas of modified or disturbed native vegetation (particularly along the eastern side of the development). These areas are, however, already somewhat modified and/or infested by weeds as a consequence of long-term agricultural practices on the subject land.

The proposed development of the subject land for residential purposes provides an appropriate balance between development opportunities and conservation goals, and provides for the “*effective integration of economic and environmental considerations*”. The combination of a re-design of the northern parts of the proposed development to protect greater numbers of and habitat for the Nowra Heath-myrtle (Figure 8), as well as the long-term management and maintenance of the retained conservation areas on the subject land (including implementation of the *Hollow-bearing Tree Protocol*) facilitate an appropriate and reasonable outcome on the subject land.

Thus, the proposed development of the subject site at Mundamia satisfies the relevant “*objects*” of the EP&A Act, including the achievement of ESD outcomes and satisfaction of the *Precautionary Principle*.

12.5 Environment Protection & Biodiversity Conservation Act

The DGEARs require a “*consideration of impacts, if any, on Matters of National Environmental Significance, and the Environment Protection & Biodiversity Conservation Act 1999*”.

A full and detailed consideration of the relevant *Matters of National Environmental Significance* (MNES), pursuant to the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act) is contained in Chapter 16 of this *Report*.

It is the conclusion of this *Report* that the proposal is not “*likely*” to impose a “*significant impact*” upon any MNES.

The proposal, nevertheless, has been referred to the Commonwealth Department of Sustainability, Environment, Water, Population & Communities (SEWPaC). The Department has determined that the proposed development is not a “*Controlled Action*” pursuant to the EPBC Act, and that consequently no approval from the Federal Minister for the Environment is required (Chapter 16.3; Appendix G).

12.6 Impacts and Statement of Commitments

The DGEARs require *inter alia* an “assessment of the potential impacts of the project” (relevantly) on native biota and ecosystems, and riparian areas and habitats. The bulk of this *Report* (Chapters 6 to 17 inclusive) contains a detailed and thorough analysis of the potential impacts of the proposal at Mundamia on native biota and their habitats, and riparian areas and ecosystems, as well as consideration of impact amelioration and environmental management measures (in Chapter 18).

It is the conclusion of this *Report* that the proposed development is appropriate in the circumstances of the subject land, having regard both to ecological issues and constraints and to the requirements of appropriate and proper planning in the Shoalhaven LGA. In particular, it is the conclusion of this *Report* that:

- the development of the subject land as proposed is appropriate and reasonable having regard to the relevant issues to be taken into account pursuant to the DGEARs and the “objects” and assessment criteria of the EP&A Act; and
- the proposed development will not impose any significant adverse impacts upon native (including threatened) biota or their habitats at a local, state or federal level.

A comprehensive *Statement of Commitments* is provided in the *Environmental Assessment Report* prepared by Cowman Stoddart (2012). That *Statement of Commitments* includes, as appropriate, the impact amelioration and environmental management measures which are identified in Chapter 18 of this *Report*.

13 KEY ISSUES – FLORA & FAUNA

13.1 Key Issues

The DGEARs identify *inter alia* a series of “key issues” with respect to flora and fauna, and their associated habitats, that need to be addressed in the *Environmental Assessment* for the proposal (Table 8).

These issues are addressed in detail either (or both) below in ensuing parts of this Chapter of the *Report* and/or in other parts of the *Report* (as indicated in Table 8).

Table 8 Key Issues identified in the DGEARs for the Culburra West urban development area – MP08-0141 in respect of ecological, biodiversity and habitat considerations

Item	Issue in DGEARs	Where Addressed
9.1	<ul style="list-style-type: none"> Prepare a Flora and Fauna Assessment Report in accordance with the <i>Draft Guidelines for Threatened Species Assessment</i> (DEC, DPI, Jul 2005), <i>Threatened Biodiversity Survey and Assessment Guidelines Working Draft</i> (DEC, 2004), and the <i>Threatened Species Assessment Guidelines: The Assessment of Significance</i> (DECC Aug 2007). Address potential impacts of the development on the flora and fauna of the site and setting in the landscape, particularly impacts on any threatened species, populations, threatened ecological communities (EECs), and/or critical habitat, and any relevant recovery plan, with particular regard for relevant EECs or threatened species where known (bearing in mind DECC’s letter dated 30 September 2008, attached, particularly its comments in relation to Attachment A and the proposed development envelope). Surveys should target the <i>Triplarina nowraensis</i> and the assessment should demonstrate that the proposal will have minimal impact on that species. Provide measures for the conservation of flora and fauna, habitats and communities, where relevant, including the provision of adequate vegetated buffers, particularly on the eastern side bordering the Flat Rock Creek gully. 	<ul style="list-style-type: none"> The whole <i>Report</i> Chapters 2 – 5, 14, 15 and 18 The 2007 Guidelines are not relevant – see Chapters 13.2 and 14.3.2 Chapters 6 – 16 regarding potential impacts on threatened biota and the natural environment Chapter 18 regarding impact amelioration Chapter 13.5 regarding the DECC 2008 letter Chapter 2 re surveys Chapters 8 – 11, 13, 14, 16 and 18 regarding impacts Chapters 7, 8, 10 13 and 18
9.2	<ul style="list-style-type: none"> Address the potential bio-certification of the Draft Shoalhaven comprehensive LEP 2009. Any native vegetation proposed to be removed within the area identified by DECC’s submission dated 30 September 2008 (attached), needs to be offset in accordance with the principles of ‘maintain or improve environmental outcomes’ in DECC’s 2005 Draft Guidelines (above). 	<ul style="list-style-type: none"> No longer relevant (see Chapter 13.4) Chapter 13.5

Item	Issue in DGEARs	Where Addressed
9.3	<ul style="list-style-type: none"> Resolve the provision of arterial road access for the proposal and any impacts on threatened species assessed using the 'avoid, mitigate or offset' framework in DECC's 2005 Draft Guidelines. 	<ul style="list-style-type: none"> Not relevant (see Chapter 13.6)
9.4	<ul style="list-style-type: none"> Outline measures for the conservation of existing wildlife corridor values and/or connective importance of any vegetation on the subject land. Address the conservation and enhancement of the remnant line of trees running east-west across the property by the provision of a wildlife corridor from the creek to the forest. Investigate opportunities to conserve or enhance local and regional corridors and important habitats, such as creek lines, in the design of the proposal. 	<ul style="list-style-type: none"> Chapter 13.7 Chapter 13.7 Chapters 13.7, 13.8 and 13.10
9.5	<ul style="list-style-type: none"> Describe all aquatic environments (watercourses, wetlands) located on or adjacent to the site, and their regional significance. 	<ul style="list-style-type: none"> Chapters 3, 6, 7, 9 and 13.8
9.6	<ul style="list-style-type: none"> Predict impacts upon aquatic environments on or adjacent to the site (both temporary and permanent). Predict any temporary and permanent impacts upon water quality and aquatic threatened species, populations or ecological communities listed under the <i>Fisheries Management Act 1994</i> (NSW). 	<ul style="list-style-type: none"> Chapters 7, 9 and 13.9 Chapters 7, 9 and 13.9
9.7	<ul style="list-style-type: none"> Address measures and safeguards to protect adjacent aquatic habitats, including SEPP 14 wetlands and riparian habitats; and provide full details and widths of proposed riparian buffer zones for Flat Rock Creek. 	<ul style="list-style-type: none"> Chapters 13.8, 13.10 and 18

13.2 DEC Draft Guidelines

Item 9.1 of the DGEARs requires that a "*Flora and Fauna Report*" be prepared "*in accordance*" with *Guidelines* prepared by the DEC and the DECC.

This *Flora & Fauna Issues & Assessment Report* for the proposed development at Mundamia has been prepared in accordance with the DEC *Draft Guidelines for Threatened Species Survey* (dated 2004) and the DEC *Draft Guidelines for Assessment of Impacts on Threatened Species Under Part 3A* (dated 2005), as appropriate.

The DECC *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC Aug 2007) are not relevant to a project being assessed pursuant to Part 3A of the EP&A Act. Nevertheless, the relevant matters in Section 5A have been taken into account in addressing the potential for impacts to be imposed on threatened biota and their habitats (see Chapters 7 – 14).

A detailed consideration of the applicability or otherwise of the DEC/DECC *Guidelines* identified in Item 9.1 of the DGEARs is provided in Chapter 14 of this *Report*.

13.3 Threatened Biota

Item 9.1 of the DGEARs addresses further matters with regard to threatened species surveys, impact analysis and “*measures for the conservation of flora and fauna, habitats and communities, where relevant*”. With respect to these matters (as detailed in Table 8):

- dedicated surveys for and accurate mapping of the Nowra Heath-myrtle *Triplarina nowraensis*, as well as an array of other relevant or potentially relevant biota, have been undertaken for this *Report* (see Chapters 2, 4 and 5; Appendices A – F);
- the potential impacts of the proposal on threatened biota and their habitats has been considered throughout this *Report*, and the development has been re-designed at the behest of the principal author of this *Report* to reduce impacts on the Nowra Heath-myrtle and its habitat;
- suitable ‘buffers’ are provided to the north and east of the proposed development area to protect Flat Rock Creek and its environs (see below, Chapter 14 and Chapter 18); and
- the matters raised by the DECC (now OEH) in its correspondence of 2008 are addressed in Chapters 13.4 and 13.5 below.

13.4 Biocertification of the Draft Shoalhaven LEP 2009

Item 9.2 of the DGEARs requires that the “*potential bio-certification of the Draft Shoalhaven Comprehensive LEP 2009*” be considered.

It had been suggested that the *Nowra-Bomaderry Structure Plan* and any future associated LEP may be able to be ‘bio-certified’ pursuant to the *Threatened Species Conservation Act 1995* (TSC Act).

Attachment A of the DECC letter (dated the 30th of September 2008) shows a designated development area surrounded by a blue line. That correspondence states that “*if the development envelope is located within the blue line [on the attached plan] ... no further threatened species assessment is needed for this part of the proposal*”, subject to the resolution of several “*outstanding issues*”. Further consideration of the area identified in that correspondence is provided below (in Chapter 13.5).

It should be noted that ‘bio-certification’ for the subject land is not a relevant consideration with respect to Part 3A of the EP&A Act. However, that approach does provide an indication of the considerations of Council and the DECC/OEH in the zoning of the lands, and in determining the perceived development opportunities and constraints of the land.

Further, Council had determined not to proceed with biocertification of the Mundamia area or the *Nowra-Bomaderry Structure Plan*. However, the relevant ecological information, as contained in the *Flora & Fauna Assessment* of the Mundamia area (Area 5) for the *Nowra-Bomaderry Structure Plan* (BES 2004), has been incorporated into this *Report*.

13.5 DEC Submission Area

The DECC correspondence of the 30th of September 2008 (to the DoP) regarding this proposal addresses discussions and agreements with Shoalhaven City Council regarding ‘bio-certification’ of the LEP and areas identified by the then DECC as not requiring further threatened species assessment

(pursuant to the 'bio-certification' process). The correspondence provides a map of those areas, as well as of areas that the DECC considers "*should be conserved in perpetuity*", identified by the DECC as "*areas within the red line*" on the attached map (but presumably outside of the blue line).

As there is no 'bio-certification' process for the subject land or for the LEP, the underlying rationale for the DECC areas no longer exists. Further, the proposed subdivision design has been prepared in cognisance of the actual ecological values on the land, and following comprehensive surveys and investigations.

As noted elsewhere, the northern parts of the proposal have been re-designed at the behest of the principal author of this *Report* in order to reduce and minimise impacts on the Nowra Heath-myrtle. In addition, a substantial area of land is to be dedicated and managed primarily for biodiversity conservation purposes, in perpetuity.

Whilst the current design does not conform to the desires of the DECC/OEH (as represented in their 2008 correspondence), it is the position of this *Flora & Fauna Issues & Assessment Report* that the proposal represents an appropriate and reasonable balance between residential needs and opportunities on the one hand and biodiversity conservation goals on the other.

13.6 Arterial Road Access

Item 9.3 addresses "*the provision of arterial road access for the proposal*".

The original concern of the DECC/OEH was in respect of a mooted "*arterial road access*" across Flat Rock Creek (or the Shoalhaven Gorge). No such access is now proposed, and there is already Council approval for the access road past the University campus to the south, from Yalwal Road.

There is no requirement for any further impact amelioration or offsets for the access road to the proposed subdivision.

13.7 Wildlife Corridor Values

Item 9.4 of the DGEARs requires:

- the consideration of "*measures for the conservation of existing wildlife corridor values and/or connective importance of any vegetation on the subject land*";
- "*the remnant line of trees running east-west across the property*"; and
- "*opportunities to conserve or enhance local and regional corridors and important habitats*".

The proposed development will not impinge upon any relevant existing corridors within the subject land itself, or in the immediate vicinity (Figure 2).

In this regard, the subject land is located on the western fringe of a large urban area and the Flat Rock Creek Reserve, but is separated from the suburbs of Nowra by a deep vegetated valley containing Flat Rock Creek, which extends from the Shoalhaven River (in the north) to the Triplarina Nature Reserve (to the south of Yalwal Road). Lands to the north of the subject land are also largely forested, although with scattered dwellings.

Whilst there are also areas of native vegetation to the west and south of the subject land, these are fragmented and do not constitute relevant or effective habitat links (or so-called 'wildlife corridors'), other than through vegetated lands to the north or south of the subject land.

Further, the area proposed for development is predominantly cleared agricultural land, and the proposal will maintain bands of vegetated land along its northern and eastern sides, contiguous with adjoining vegetated lands.

The *Nowra-Bomaderry Structure Plan*, endorsed by both Shoalhaven City Council and the then DoP (Figure 11), had identified a 'wildlife corridor' to the west of the lands considered appropriate for development activities. No 'wildlife corridor' is identified in the *Structure Plan* within those areas proposed for residential development on the subject land, and no such 'wildlife corridor' is either present or likely to be affected.

The narrow band of trees running east-west across the middle of the subject land provides only marginal habitat, at best, and then only for highly mobile species. There are no hollow-bearing trees within this line of vegetation, and there are no other particularly relevant resources for native fauna (Appendix B).

The loss of this narrow disjunct band of trees will not impede the movement of any fauna within the local area. Substantial intact areas of vegetation are present immediately to the north and east of the subject land, as well as to the south, which will maintain the east-west connectivity in the local context. Highly mobile species (such as bats and birds) will still be able to move across the land, even after residential development.

Further, it would be totally inappropriate for a thin, ineffective and ecologically meaningless east-west 'wildlife corridor' to be provided at this location through the middle of any area. Even if retained, the narrow band of trees would provide little (or more likely no) benefit for any fauna.

The proposed development of the subject land will have no adverse impacts upon any local, regional or other real, or purported, "*wildlife corridors*" or vegetated linkages through the landscape. The most relevant vegetation on the subject land (in the eastern and northern parts of the land) is to be retained. These areas are contiguous with adjoining areas of native vegetation, and have the potential to contribute in a meaningful sense to the maintenance of "*wildlife corridors*" or vegetated linkages through the immediate landscape.

The proposed development will not adversely affect the protection and maintenance of any "*wildlife corridors*", or other vegetated linkages, through the general landscape or in the immediate vicinity.

13.8 Watercourses and Wetlands

Item 9.5 of the DGEARs requires a description of "*all aquatic environments (watercourses, wetlands) located on or adjacent to the site, and their regional significance*".

The watercourses and wetlands on the subject land (limited as they are) are described in Chapters 3 – 5 of this *Report*.

The only "*wetlands*" in the area proposed for development purposes on the subject land are artificial farm dams, although there is an area of moist soils and apparently impeded drainage at the head of the

small watercourse located in the northeastern part of the land. There are a variety of wetlands along the Shoalhaven River and doubtless others along Flat Rock Creek, but these are at some considerable distance from the land, and will not be affected by the development as currently proposed.

The small watercourse in the northeastern part of the land (as noted above) does not flow continuously, and the upper parts of the watercourse support a band of Swamp Paperbark, as well as mesic groundcover species and part of a patch of the Nowra Heath-myrtle (Figure 5). Although possibly in part sustained by groundwater, this area of vegetation doubtless also depends on incipient rainfall and overland flows during and following high rainfall events.

The lower parts of this watercourse will be retained in the proposed *Conservation Area*, and the stormwater management regime devised by Storm Consulting (2012) is proposed to protect water quality within that drainage feature.

There are two small vegetated farm dams and a large 'sediment dam' on the subject land at Mundamia. Of these, the 'sediment dam' is of little or no environmental value, and the two small farm dams provide only extremely limited habitat or resources for native biota.

Whilst the proposed development of the subject land for residential purposes will require the removal of the three farm dams, those features are not regarded as of particular ecological or environmental value. There is no likelihood that any threatened biota would be present in or dependent on those features, and it is not considered likely that any significant adverse environmental impact will result from the removal of the farm dams.

Flat Rock Creek is the only notable local watercourse in the immediate vicinity of the proposed development which has the potential to be affected by activities associated with the proposed development. However, this watercourse is some considerable distance from the development area (140 – 300m), and will be protected by broad bands of intervening native vegetation. In addition, the stormwater management regime has been designed to mitigate any potential adverse impacts which could potentially or theoretically arise from the proposal.

The proposal will have no adverse impacts upon the Shoalhaven River or upon any habitats associated with that watercourse. Further, there are no SEPP 14 Wetlands in the vicinity of the subject land, and there is no likelihood of adverse impacts being imposed upon any SEPP 14 Wetlands in the locality.

13.9 Impacts on Aquatic Environments

Item 9.6 of the DGEARs requires a prediction of the *"impacts upon aquatic environments on or adjacent to the site"* and *"upon water quality and aquatic threatened species, populations, ecological communities"*.

As discussed above, there are no *"aquatic environments"* on the subject land, other than three artificial farm dams.

The only *"aquatic environments"* of note in the vicinity are the Shoalhaven River and downstream parts of Flat Rock Creek, as well as the large dam in the upper part of the Flat Rock Creek (to the southeast of the subject land). The proposed development of the subject land will have no adverse impacts upon those *"aquatic environments"*.

13.10 Protection of Aquatic and Riparian Habitats

Item 9.7 of the DGEARs requires:

- information regarding “*measures and safeguards to protect adjacent aquatic habitats*”; and
- “*full details and widths of proposed riparian buffer zones for Flat Rock Creek*”.

13.10.1 Aquatic and Riparian Habitats

As discussed above, the only “*aquatic*” and “*riparian*” habitats present within the subject land itself (Figure 2) are confined to:

- two small farm dams in the agricultural parts of the subject land;
- a large degraded and poor quality ‘sediment’ dam in the southwestern corner of the land; and
- mesic vegetation located immediately adjacent to the small drainage line in the northeastern part of the land.

None of these habitats are regarded as of conservation value or significance. In this regard:

- the ‘sediment’ dam in the southwestern corner of the subject land has essentially no vegetation, and is clearly both artificial and in very poor condition;
- the two small farm dams on the land, being artificial nature are readily re-created. In any case, these two features do not represent significant habitat for any relevant native biota; and
- the small area of riparian vegetation along the upper part of the watercourse in the northeastern part of the subject land is not of particular conservation significance, although this area does support a small part of a stand of the Nowra Heath-myrtle. Conversely, that patch constitutes only a very small proportion of the total population of Nowra Heath-myrtle on the subject land, and the riparian vegetation *per se* is not of particular significance or conservation value.

The proposed development of the subject land at Mundamia will require the removal of the farm dams and the upper part of the riparian habitat in the northeastern part of the subject land. However, those impacts are not regarded as of particular conservation significance because:

- supplementary aquatic habitat will be provided in bio-retention swales associated with the proposal;
- those artificial features will be managed specifically *inter alia* for the provision of habitat for native biota;
- the riparian habitat in the northeastern part of the subject land *per se* is not of particular relevance to any threatened biota, or any other native biota; and
- substantial areas of such habitats and resources (both aquatic and riparian) will be maintained in lands adjoining and surrounding the subject land.

Further, the proposal is not likely to impose significant impacts upon any relevant aquatic or riparian habitats in the immediate vicinity given:

- the distance to any such resources in most instances (*ie* the Shoalhaven River and Flat Rock Creek);
- the presence of intervening 'buffer' areas of native vegetation; and
- the water quality and quantity controls incorporated in the project.

13.10.2 Buffers

The need for "*buffers*" between development and retained vegetation is inversely proportional to the care taken in design of the proposal and the adequacy of impact amelioration and environmental management measures applied, as well as to the sensitivity of any habitats or resources likely to be affected. In other words, intelligent design and appropriate management measures minimise the need for "*buffers*"

In this regard, the proposed development incorporates a peripheral road and bio-retention swale system that provides a management interface between the residential development and the *Conservation Area*. This is intended *inter alia* to reduce the likelihood of impacts on the adjoining retained vegetation by:

- providing a physical break between the development and retained vegetation;
- providing for visual monitoring of the interface by residents;
- providing supplementary habitat (in the bio-retention swales) which will also absorb any discharged nutrients; and
- facilitating the appropriate management of vegetation to ensure the amelioration of potential impacts.

In some places (particularly in the southeast and in the north), *Asset Protection Zones* (APZs) are required outside the proposed development footprint. These will be carefully managed *inter alia* to act as "*buffers*" to areas of retained intact bushland on the subject land and on adjoining lands, and to protect habitat features. The areas to be managed for APZs will be carefully maintained to avoid weed incursions or other negative impacts, and will function as "*buffers*" or 'transition zones' into the intact native vegetation of the *Conservation Area*.

No further requirements for the use of 'buffers' are warranted for this proposal. Rather, the development has been designed, and will be constructed, to ensure appropriate management of the potential 'edge effects' which might otherwise be imposed.

The proposed development and management of the proposed *E2 - Environmental Conservation Area* in the eastern and northern parts of the subject land specifically provides for adequate conservation and setbacks to Flat Rock Creek (of 140m-300m). The proposed *Conservation Area* and the retained vegetation in the adjoining land (along Flat Rock Creek) provide a substantial buffer to Flat Rock Creek itself, involving both riparian areas and xeric woodland.

13.11 Offsets for Vegetation Clearing

13.11.1 The Biodiversity Offset Principles

The NSW Office of Environment & Heritage (OEH), formerly the DECC, prepared a set of *Principles for the Use of Biodiversity Offsets in NSW* as part of its *Guidelines for Biodiversity Certification of Environmental Planning Instruments*. The *Principles* are provided as “a guide for DECC when it is negotiating and developing biodiversity offsets to achieve conservation outcomes in situations where a loss of biodiversity is expected”.

The *Biodiversity Offsets Principles* state *inter alia* that:

“a biodiversity offset is one or more appropriate actions that are put in place to counterbalance specific impacts on biodiversity. Appropriate actions are long-term management activities to improve biodiversity conservation. This can include legal protection of land to ensure security of management actions and remove threats”.

There are 13 *Principles* identified in the DECC document intended to guide the use of biodiversity offsets. Those 13 *Principles* are addressed with respect to the proposed development of the subject land at Mundamia below.

13.11.2 Proposed Offsets at Mundamia

The Mundamia residential development proposal includes the dedication of 9.49ha of land in two *Conservation Areas*, to be managed predominantly for biodiversity conservation purposes. That area has been increased from the original development design by virtue of a reduction in the northern part of the residential development to protect a greater area of habitat for and specimens of the Nowra Heath-myrtle. That approach has led to the protection of in excess of 95% of the Nowra Heath-myrtle population and habitats on the subject site.

In addition to setting aside the 9.49ha of land predominantly for biodiversity conservation purposes, the proposal will involve the implementation of a *Vegetation Management Plan* in that area, designed to rehabilitating areas of weed-infestation or other disturbance, and to ensure appropriate management of *Asset Protection Zones* (APZs) so as to preserve their biodiversity conservation values.

13.11.3 Consideration of Biodiversity Offset Principles

Principle 1 Impacts must be avoided first by using prevention and mitigation measures

The proposed development at Mundamia has, to the extent of reasonably practicable, avoided impacts on the national environment by:

- concentrating development activities in areas where vegetation has been highly or moderately disturbed or modified;
- reducing the extent of development in the northern part of the site to reduce impacts upon the threatened Nowra Heath-myrtle and its habitat;
- implementing stormwater management measures designed to avoid adverse impacts on adjoining natural native vegetation; and

- identifying specific management measures for APZs intended to maintain biodiversity values and to enhance opportunities for the Nowra Heath-myrtle.

Principle 2 All regulatory requirements must be met

All regulatory and statutory requirements regarding development consent are being addressed in the Part 3A assessment process for the proposal. The offsets which have been identified are not being *“used to satisfy approvals or assessments under other legislation”*.

Principle 3 Offsets must never reward ongoing poor performance

The proposed offsets as part of the Mundamia development project have not, and will not, result in any deliberate degradation or mismanagement of offset areas *“in order to increase the value from the offset”*.

Principle 4 Offsets will complement other government programs

The proposed *Conservation Areas* adjoin an existing Council Reserve which also adjoins the Triplarina Nature Reserve. Thus, dedication of the *Conservation Areas* on the subject land for biodiversity conservation purposes will act to complement the conservation of other lands in the immediate vicinity.

Principle 5 Offsets must be underpinned by sound ecological principles

The ecological values of vegetation on the subject land have been taken into account when determining the final residential subdivision design, and in the management of both APZs for bushfire protection purposes and stormwater discharges.

In addition, the proposed offsets in the *Conservation Areas* on the subject land at Mundamia are *“suitable offsets”*, as they contain relevant *“biodiversity management actions, such as enhancement of existing habitat and securing managing land of conservation value for biodiversity”*. The proposal satisfies Principle No. 5.

Principle 6 Offsets should aim to result in a net improvement in biodiversity over time

The area of vegetation to be set aside for biodiversity conservation purposes on the subject land exceeds the area of more degraded vegetation which is to be removed. Furthermore, the biodiversity conservation areas are in better condition generally than the areas of vegetation which require removal for the project.

Other relevant matters to take into account when considering the improvements in biodiversity which will result from the proposed management of the *Conservation Areas* on the subject land at Mundamia include:

- rehabilitation works which are to be undertaken within the *Conservation Areas* to remove existing weeds and to rehabilitate any areas previously affected;

- dedicated management of APZs to ensure the protection of threatened biota (such as the Nowra Heath-myrtle);
- the dedicated management of APZs for enhancement of the Nowra Heath-myrtle and its habitat;
- the removal of grazing and other agricultural activities which constitute a threat to remaining bushland on the subject land and in the Flat Rock Creek Reserve to the east;
- the removal of weeds (including noxious species) from degraded parts of the subject land; and
- the ultimate dedication of the *Conservation Area* to Council for biodiversity conservation purposes.

Principle 7 Offsets must be enduring

The dedication and management of the *Conservation Areas* on the subject land for biodiversity conservation purposes will be “*enduring*” insofar as those lands will be rehabilitated and dedicated to Council in perpetuity.

Principle 8 Offsets should be agreed prior to the impact occurring

The proposed offsets for the development at Mundamia, and the provision of a detailed *Vegetation Management Plan* (consistent with the in-principle VMP provided in this *Report* – Appendix H) will be conditions of the approval of the proposed Mundamia residential development by the Department of Planning & Infrastructure (DP&I), pursuant to Part 3A of the EP&A Act. The offsets will be subject to scrutiny pursuant to the Part 3A assessment process, and will form part of the conditions of the approval and the commitments associated with the approval.

Principle 9 Offsets must be quantifiable

The proposed offsets contained in this *Report* have been quantified in terms of area (9.49ha of land to be dedicated for biodiversity conservation purposes) and in terms of management measures to be applied to the *Conservation Areas* (Appendix H).

Principle 10 Offsets must be targeted

As discussed elsewhere in this *Report*, the majority of the lands which are being dedicated for biodiversity conservation purposes are in better condition than those which are being removed. The proposed development area was determined, both through the previous Council/DoP process and through this investigation, by identifying degraded vegetation and land suitable for development purposes.

In this regard, as documented elsewhere in this *Report*, the vegetation present within the development footprint is already in a significantly to moderately degraded or disturbed condition, and is of less conservation value than the vegetation to be retained in the *Conservation Areas*.

Principle 11 Offsets must be located appropriately

The *Conservation Areas* on the subject site are located in the northern and eastern parts of the land, adjacent to the existing Council Reserve containing Flat Rock Creek (to the immediate east). This circumstance results in an increase in the overall area of conserved land and vegetation at this location, and the maintenance of wildlife corridor values along Flat Rock Creek and its gorge.

Principle 12 Offsets must be supplementary

The proposed *Conservation Area* offsets on the subject land at Mundamia are not currently the subject of any funding, and have no security of either tenure or management activities. The proposed development of the subject land at Mundamia will provide both funding for the rehabilitation and management of the *Conservation Areas*, and will ensure that the protection by ultimate dedication to Council.

Principle 13 Offsets and actions must be enforceable

As noted above, the offset activities and actions associated with *Conservation Areas* on the subject site will be the subject of a *Vegetation Management Plan* (VMP), the implementation of which will be a condition of approval. In addition, management of the *Conservation Areas* is part of the *Statement of Commitments* for the project, and the land is ultimately to be dedicated to Council for conservation purposes in perpetuity.

14 DEC and DECC GUIDELINES

14.1 DEC Draft Survey Guidelines 2004

This *Flora & Fauna Issues & Assessment Report* for the proposed residential development at Mundamia has been prepared in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC November 2004), insofar as they relevantly apply.

In addition to the substantial investigations which had been undertaken by BES on the subject land and in the vicinity (BES 2004a, b, 2007, 2009, 2010), field surveys undertaken for this project and *Report* have included an array of additional studies by Environmental InSites and SLR Ecology (see Chapter 2 for details), including:

- general ecological investigations on several occasions;
- supplementary targeted surveys, for threatened species, including the Nowra Heath-myrtle *Triplarina nowraensis*, Rosenberg's Goanna, the Spring Tiny Greenhood orchid and the Yellow-bellied Glider;
- surveys by Environmental InSites, SLR Ecology and the SCC for the Spring Tiny Greenhood orchid including *inter alia* on the subject land; and
- revised and refined vegetation mapping by SLR Ecology (contained in this *Report*).

Notwithstanding the substantial array of investigations which have been conducted on the subject land itself and on adjoining lands (by BES/ELA, Environmental InSites and Shoalhaven City Council), there are doubtless specific elements of the DEC *Draft Survey Guidelines* (dated 2004) which have not been satisfied 'to the letter'.

However, any such technical 'non-compliance' with those draft *Guidelines* is not considered by the authors of this *Report* to be of relevance or consequence with respect to the proposed development of the subject site Mundamia because:

- the overwhelming majority of the land proposed for development activities is highly modified, degraded and has long been used for agricultural activities;
- specific and dedicated investigations have been conducted with respect to the likely potential relevant biota since 2004 *inter alia* on the subject land;
- the accumulation of data from the various investigations by a number of ecologists (BES/ELA, Environmental InSites and Shoalhaven City Council) constitutes an appropriate and substantial information base upon which to make an analysis of the ecological values and constraints on the subject land, and the potential or likely impacts on development; and
- the proposal and this *Report* have incorporated consideration of the array of information on the OEH website and in published literature.

14.2 DEC Draft Assessment Guidelines 2005

The investigations of the subject land at Mundamia, including the incorporation of information from other sites in the vicinity, satisfactorily address the survey and assessment *Guidelines* for threatened biota prepared by the (then) Department of Environment & Conservation⁴ (DEC 2004, 2005).

The Draft *Guidelines for Assessment of Impacts on Threatened Species Under Part 3A*, prepared by the then Department of Environment & Conservation (DEC) and the then Department of Primary Industries (DPI) in 2005, have been addressed below with respect to the assessment and evaluation of likely impacts of the proposed development.

As noted above, it should be noted that the *Guidelines* identified above are:

- *Draft Guidelines* (ie they have not been finalised despite a substantial period between their initial 'release and the current time');
- are "*guidelines*", not statutory requirements or standards; and
- provide 'guidance' to the assessment process, which needs to be interpreted and applied appropriately depending on the circumstances of each individual application.

14.3 Steps in the Assessment Process

According to the 'requirements' of the *Draft Guidelines* (DEC 2005) identify a number of "*steps in the assessment process*":

- Step 1 Preliminary Assessment, which "*is primarily a desktop assessment involving searches of relevant databases .. and literature reviews to identify a list of threatened species which could potentially occur In the area*" (Chapter 2);
- Step 2 Field Survey and Assessment. The conduct of surveys for threatened biota is discussed in the DEC *Draft Guidelines*, and has been addressed in this *Report* (Chapter 2; Appendix A);
- Step 3 Evaluation of Impacts (Chapters 6-17);
- Step 4 'Avoid, Mitigate and Then Offset', which involves "*the description and justification of measures to mitigate any adverse effects*" (Chapter 17); and
- Step 5 Key Thresholds.

Step 3 of the DEC *Draft Guidelines* (2005) indicates *inter alia* that the "*magnitude and extent of impacts*", and their significance is "*related to the conservation importance of the habitats, individuals and populations likely to be affected*" by the proposal.

The *Draft Guidelines* state that the "*impacts will be more significant*" if:

- "*areas of high conservation value are affected*"; or
- "*individual animals, and/or plants and/or sub populations that are likely to be affected by the proposal play an important role in the long-term viability of the species, population or ecological community*"; or

⁴ The DEC is now, relevantly, part of the Office of Environment & Heritage (OEH), which is part of the Department of Premier Cabinet.

- “habitat features that are likely to be affected by the proposal play an important role in maintaining the long-term viability of the species, population or ecological community”; or
- “the duration of impacts are long-term”; or
- “the impacts are permanent and irreversible”.

Table 9 The DEC/DPI Draft Guidelines for Assessment of Threatened Species Under Part 3A

Relevant Items	Where and how addressed
Factors to consider when preparing a Development Application	<ul style="list-style-type: none"> • Threatened species are addressed throughout the <i>Report</i>, especially Chapters 4 and 5, Figures 8 and 9, and Appendices B, E and F. • This <i>Report</i> constitutes the “<i>threatened species assessment report</i>” required by DEC/DPI.
Steps in the Assessment Process	
Step 1 Preliminary Assessment	<ul style="list-style-type: none"> • Chapters 2, 3, 4 and 5 • Appendices A-F
Step 2 Field Survey and Assessment	<ul style="list-style-type: none"> • Surveys by BES (2004a, b, 2007, 2009, 2010), Environmental InSites (2008, 2010 and 2011) • Chapters 2, 4 and 5 • Appendix A • Figures 5, 6 and 9
Step 3 Evaluation of Impacts	<ul style="list-style-type: none"> • Chapters 6-17 • Figures 6-11
Step 4 Avoid, Mitigate and Then Offset	<ul style="list-style-type: none"> • Chapters 14 and 18 • Re-design of northern portion to retain Nowra Heath-myrtle
Step 5 Key Thresholds	<ul style="list-style-type: none"> • Chapter 14

14.4 DECC Assessment of Significance Guidelines 2007

14.4.1 Areas of High Conservation Value

The proposed development of the subject land at Mundamia has concentrated development activities primarily within those portions of the subject land which have been assessed in this *Report* as having lower conservation values by virtue of:

- the nature of the vegetation types present; and/or
- previous and existing disturbance; and/or
- the relevance of those areas of vegetation to threatened biota known or expected to occur in the general locality.

The approach which has been adopted generally retains areas of vegetation which have not been directly affected to a significant extent by previous agricultural land uses, located generally in the northern part of the subject land and along the eastern boundary. These areas contain the majority of the Nowra Heath-myrtle, as well as habitat and resources for threatened fauna species such as the Yellow-bellied Glider and the Glossy Black Cockatoo.

Given those considerations, the majority of the “*areas of high conservation value*” on the subject land have been retained in the proposed *E2 – Environmental Conservation Zone* within the northern part of the land and along the eastern boundary. The development activities on the land are appropriately located in areas of greater disturbance or modification and/or in areas of lower conservation value (eg areas of native vegetation which have been affected by adjacent agricultural activities).

Arguably, the only “*area of high conservation value*” on the subject land at Mundamia is that which supports the high densities of the Nowra Heath-myrtle. This species has a restricted distribution, unlike the other threatened species known or likely to occur on the land which are wide-ranging and highly mobile and/or are distributed much more widely through the immediate vicinity and general locality. Thus, the only “*area of high conservation value*” is in the northern part of the subject land, and the proposed development in this area has been re-designed to avoid impacts on the overwhelming majority of the Nowra Heath-myrtle population.

It is to be noted in considering the assessment of potential impacts on threatened biota that the conclusions of this *Report* by Environmental InSites reflect, in essence, the conclusions which have been reached by Shoalhaven City Council (SCC) and the then Department of Planning (DoP) with respect to the appropriate development of Mundamia for residential purposes. The *Nowra-Bomaderry Structure Plan* (which was adopted by the Council and endorsed by the DoP) recognises the appropriateness of residential development at this location (including on the subject land).

Given that circumstance, the proposed development of the subject land at Mundamia is clearly an appropriate response to the assessment of potential impacts upon the threatened biota, as had previously been considered by the SCC and the then DoP.

14.4.2 Importance of Individual Biota

As noted above, most of the important and significant habitats and resources for the relevant threatened biota are to be maintained within the *E2 – Environmental Conservation Area* in the northern and eastern sections of the subject land at Mundamia (Figure 7).

Furthermore, for those threatened species known or likely to occur on the subject land at Mundamia, there are substantial areas of suitable habitat and resources in the immediate vicinity and general locality, including extensive areas of potentially suitable habitat and resources within the Crown Land surrounding Flat Rock Creek and within Triplarina Nature Reserve and Shoalhaven State Forest to the south (Figure 1). The natural and modified habitat proposed to be removed from the subject land (*ie* approximately 9ha of native vegetation) comprises only a minute proportion of the total available habitat within an approximate 10km radius of the land in the form of National Parks Reserves and State Forests.

The most significant or “*important*” biota present on or likely to occur on the subject land at Mundamia, no doubt, are those species which have been identified as “*threatened*”, and are listed in the TSC Act and/or the EPBC Act. The proposed development of the subject land at Mundamia for residential

purposes has been particularly cognisant of those relevant threatened biota, both in the investigations conducted for the *Nowra-Bomaderry Structure Plan* (as endorsed by SCC and the DoP) and in the investigations undertaken for this *Report* for the proposed development of the subject land. Of particular relevance in this regard are the Nowra Heath-myrtle, Yellow-bellied Glider, Glossy Black Cockatoo and relevant or potentially relevant habitats and resources (such as hollow-bearing trees and specific food trees).

The most important habitat for the Nowra Heath-myrtle on the subject land (in the northern and eastern sections of the site), and the overwhelming majority of the population of the species, are to be retained and protected. This outcome is to be achieved by their inclusion in the *E2 – Environmental Conservation Zone* and by the implementation of a *Vegetation Management Plan* for the *E2 – Environmental Conservation Zone* with specific measures to enhance the survival of the species. As a consequence, it is not likely that the population of this species would be so adversely affected by the proposed development as to render the “*local population*” of that species “*at risk of extinction*”.

The majority of suitable habitat for the Yellow-bellied Glider is also contained within the proposed *E2 – Environmental Conservation Zone* in the northern and eastern parts of the subject site, particularly in the northeast. It is not likely that individuals of that species would be adversely affected by the proposed development of the land such that the “*long-term viability*” of that species and/or the “*local population*” of the species would be adversely affected.

Only very small areas of potential foraging habitat and resources for the Glossy Black Cockatoo will be removed for the proposed development of the subject land. In this regard, there are substantial foraging resources within the *Conservation Area* on the subject land and on adjoining lands, and the Glossy Black Cockatoo (in any case) is highly mobile and wide-ranging, and is abundant in the Shoalhaven LGA.

Similarly, most of the suitable foraging resources and habitat of particular value for microchiropteran bats will be retained within the *E2 – Environmental Conservation Zone*. In addition to the habitat retained within the *E2 – Environmental Conservation Zone*, there are a substantial suitable foraging habitat and roosting resources through the general locality, which will ensure that individuals of those species are not so affected as to reduce the “*viability*” of any local populations.

Given the considerations above, and the implementation of an appropriate management regime within the *E2 – Environmental Conservation Zone* on the subject land at Mundamia, it is the opinion of the authors of this *Report* that development of the subject land as proposed, with its integrated impact amelioration and environmental management measures, does not represent an activity likely to have a significant adverse impact upon either “*individual animals and/or plants and/or subpopulations*” of threatened biota or on “*the long-term viability of the [any] species, population, or ecological community*”.

It should be noted that the *Nowra-Bomaderry Structure Plan*, which was the result of a substantial investigation and analysis *inter alia* with respect to threatened biota on behalf of Shoalhaven City Council (SCC), had determined that Mundamia was an appropriate location for residential development. Those investigations and the subsequent *Structure Plan* (which have been endorsed by SCC and the then DoP) had concluded that the likely impacts on threatened biota were not such as to preclude development *inter alia* of the subject land for residential purposes. Indeed, the *Nowra-Bomaderry Structure Plan* recommends *inter alia* residential development of the subject site at Mundamia.

14.4.3 Importance of Habitat Features

Most of the relevant habitats and habitat features on the subject land at Mundamia have been retained in the *Conservation Area* within the northern and eastern parts of the land. The following habitat features are to be substantially retained and managed in the *E2 – Environmental Conservation Zone*:

- the majority of nesting and foraging habitat for the Yellow-bellied Glider;
- the majority of foraging and potential nesting resources for the Glossy Black Cockatoo;
- the overwhelming majority of individuals of and habitat for the Nowra Heath-myrtle, particularly as a result of the re-design of the northern part of the proposal; and
- most of the hollow-bearing trees within the forest communities.

Parts of the areas of the subject site at Mundamia which are proposed for development activities support some of the vegetation types and habitat resources which are present in the *E2 – Environmental Conservation Zone* on the land. However, the development area does not contain significant or important habitat or resources that will not be retained within the *E2 – Environmental Conservation Zone*. Further, many of those habitats and habitat features which are to be removed have been modified or disturbed, in any case.

The array of investigations which have been undertaken on the subject land demonstrate that the development will not involve the removal of any wildlife habitats or the loss of any resources which are regarded as of particular “importance” for any native, including threatened, species. In addition, the long-term management of the *E2 – Environmental Conservation Zone* will ensure that the relevant “habitat features” of the subject land are retained and protected for biodiversity purposes. That situation constitutes a significant nett environmental benefit over current circumstances.

The biodiversity conservation value of various habitat features and resources, both on the subject site itself and in its immediate vicinity, have been considered in determining the appropriate development footprint of the subject land at Mundamia. In addition, those matters and features had been taken into account in the *Nowra-Bomaderry Structure Plan* (as adopted by SCC and endorsed by the then DoP), which determined *inter alia* that development of the subject land, essentially as now proposed, was an appropriate outcome.

On the basis of the various investigations which have been undertaken on the subject site (by SCC, BES/ELA, Environmental InSites and SLR Ecology), an appropriate balance between sensible development opportunities and the conservation of important habitat features has been achieved.

14.4.4 Duration of Impacts

In respect of those parts of the subject land proposed for development, the impacts (in terms of the removal of habitat and resources) will obviously be permanent. The relevant issues, therefore, are:

- whether those impacts are acceptable; and
- whether additional permanent or long-term impacts will be imposed on adjoining habitats.

The proposed development of the subject land at Mundamia has been designed, and is to be undertaken, in an environmentally sensitive manner. The *Concept Plan* has been designed *inter alia* to

avoid the imposition of long-term adverse impacts upon the retained natural environment on the subject land and/or upon adjoining habitats and resources for native (including threatened) biota.

Implementation of the design features of the proposal, and of the *Vegetation Management Plan* (VMP) within the retained portions of the land would ensure that the areas of land to be retained, protected and enhanced are not adversely affected in either the short-term or the long-term.

As discussed above with respect to various matters, the *Nowra-Bomaderry Structure Plan* (which has been adopted by SCC and which was endorsed by the then DoP) has identified the subject site *inter alia* for development purposes. That analysis and assessment (by SCC and the then DoP) had taken into account and considered the likelihood of ongoing impacts of urban development, and clearly had concluded that, on balance, development of the subject land was appropriate.

As also discussed in some detail above, the proposed development of the subject land at Mundamia has, *inter alia*:

- addressed the importance and/or significance of adverse impacts which might be imposed upon the natural environment;
- been designed specifically to limit or ameliorate those potential adverse impacts;
- been modified and amended in an iterative process that has been sensitive to the environmental constraints of the land;
- involved a development design which predominantly uses previously modified and/or disturbed degraded areas of the subject land for residential purposes; and
- deliberately and specifically incorporates a range of impact amelioration and environmental management measures designed in particular to minimise or limit adverse impacts upon the natural environment, and upon threatened biota and their habitats.

Those outcomes reflect the expectations contained within the *Nowra-Bomaderry Structure Plan* (as adopted by SCC and endorsed by the then DoP), and in the *South Coast Regional Strategy* (recently promulgated by the DoP/DPI).

14.4.5 Permanent and Irreversible Impacts

As with “*cumulative impacts*”, the impacts upon habitats and resources within the development footprint of the subject land at Mundamia will be “*permanent and irreversible*”. That is an inevitable, and obvious, consequence both of the proposal and of the considerations contained in the *Nowra-Bomaderry Structure Plan* (as adopted by SCC and endorsed by the DoP), and is a matter which had been taken into account by those authorities. Further, that matter has been taken into consideration in addressing the significance of the likely or potential impacts of the proposed development on the natural environment in general, and on threatened biota in particular, as documented in this *Report*.

In respect of both the “*duration of impacts*” and the imposition of “*permanent or irreversible impacts*”, the proposed development design has been cognisant of the ecological constraints imposed by important elements of the environment on the subject land, and adjacent to it. The project has:

- identified areas of relatively ‘*high conservation*’ value;
- confined the proposed development to those areas which are of lesser conservation significance or value; and
- incorporated an array of environmental management and impact amelioration measures (see Chapter 17) which are designed specifically to avoid the imposition of adverse impacts upon retained natural vegetation and habitats, both on the subject land itself and in the immediate vicinity.

The only threatened plant species present on the subject land is the Nowra Heath-myrtle, which is addressed in Chapters 4, 6 and 7 of this *Report*. The majority of the population of and habitat for this species is being conserved with the *E2 - Environmental Conservation Zone* (Figure 7). Further, the stormwater bioretention swales have been designed to minimise any effect on this species in the northeastern portion of the land. That approach will both protect individuals of the species, and ensure the maintenance of soil moisture conditions necessary for its survival.

Relevant threatened fauna species are addressed in Chapters 5 and 6 of this *Report*. Whilst the proposed development will doubtless remove some areas of habitat for a number of threatened fauna species, no such species would be confirmed to the proposed development area. The relevant threatened fauna are highly mobile and wide-ranging and/or are widely distributed in the locality, including on adjoining lands. Thus, adverse impacts on those species will be localised and limited, given the extent of habitat in the locality.

There are no “*threatened ecological communities*” or “*ecological populations*” present, and no *Recovery Plans* are of relevance to the land or the threatened biota which are known or likely to be present.

14.5 DECC Assessment of Significance Guidelines 2007

The *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC Aug 2007) provide guidance in the application of Section 5A of the EP&A Act in determining whether a “*significant effect*” is “*likely*” to be imposed upon threatened biota or their habitats.

Whilst Section 5A does not apply to Part 3A applications, the relevant considerations regarding the potential for impacts to be imposed on threatened biota and/or their habitats have been taken into account in the assessments contained in this *Report*.

15 SEPP 44 – KOALA HABITAT PROTECTION

15.1 Application of SEPP 44

State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44) aims to protect the Koala and its habitat by identifying matters for consent authorities to consider during the assessment of relevant *Development Applications* (DAs) or proposals. In particular, SEPP 44 contains definitions of “*potential koala habitat*” and “*core koala habitat*” to be applied in the consideration of developments within those Local Government Areas (LGAs) listed in Schedule 1 of the *Policy*.

The Shoalhaven LGA is listed in Schedule 1 of SEPP 44 as an area to which the *Policy* applies, and the subject land is greater than 1ha in area. Consequently, SEPP 44 applies (at least theoretically) to the subject land.

15.2 Potential Koala Habitat

SEPP 44 defines “*potential koala habitat*”, as native vegetation in which trees listed in Schedule 2 of the SEPP “*constitute at least 15% of the total number of trees in the upper or lower strata of the tree component*”.

Schedule 2 of SEPP 44 provides a list of tree species which are recognised as food trees utilised by the Koala. Only one of the relevant tree species is present on the subject land at Mundamia (the Grey Gum *Eucalyptus punctata*), but this species does not constitute more than 15% of the “*tree component*” of the forested parts of the land. As a consequence, the subject land does not constitute “*potential koala habitat*”, as defined in SEPP 44.

15.3 Core Koala Habitat

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

There are no recent records of Koalas on the subject land or in the locality. There is, consequently, no “*resident population*” of Koalas. The subject land cannot therefore constitute “*core koala habitat*”.

15.4 Conclusions

The subject land does not represent “*potential koala habitat*” as defined in SEPP 44, or “*core koala habitat*” as defined in the SEPP. Given those circumstances, there is no requirement pursuant to SEPP 44 for the preparation of a *Koala Plan of Management* (KPoM) for the subject land.

16 ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT

16.1 Introduction

The *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), of the Commonwealth of Australia, seeks *inter alia*:

- “to provide for the protection of the environment, especially those aspects of the environment that are *Matters of National Environmental Significance*”;
- “to provide ecologically sustainable development”; and
- “to promote the conservation of biodiversity”.

Implementation of the EPBC Act requires *inter alia* consideration as to whether a development or activity is likely to impose a “*significant impact*” on “*Matters of National Environmental Significance*” (MNES), which include:

- listed threatened biota (ecological communities and species);
- alleged “*migratory species*” listed in international treaties (JAMBA, CAMBA, the Bonn Convention);
- actions relating to “*nuclear activities*”;
- actions on Commonwealth lands or Commonwealth marine areas;
- actions in or affecting RAMSAR Wetlands; or
- activities in or which affect World Heritage sites.

16.2 Relevant EPBC Act Considerations

The proposed development of the subject land at Mundamia will have no relevant effect with respect to nuclear activities, Commonwealth lands, World Heritage properties, Ramsar wetlands or the Commonwealth marine environment.

A search of the EPBC Act website for *Matters of National Environmental Significance* (MNES) has identified an array of items listed on the EPBC Act within 10km of the subject land (Appendix D). However, the overwhelming majority of those MNES are of no relevance to the subject land, or the proposed development thereon, because either:

- many of the MNES are distant from the subject land and will not be affected in any way;
- there is no habitat of any relevance present for most of the listed threatened species or ‘migratory’ species listed;
- the proposal will have no impact upon the species or their habitats (eg in the case of “*listed marine species*”); and/or
- there is no evidence for, and little likelihood that, even individuals of most of those species would occur on the subject land.

The Grey-headed Flying Fox, which was recorded flying over the subject land (BES 2004a), is listed as “*Vulnerable*” on the EP&A Act, and four other species listed as “*Migratory*” on the EPBC Act have also been recorded on the land (Appendix D).

Although it is possible that development of the subject land could affect some individuals of some species which are listed as “*migratory*” on the EPBC Act, it should be noted that:

- many of those species are not in fact “*migratory*” at all, but are listed on international agreements regarding “*migratory*” species (eg the Cattle Egret and the White-bellied Sea Eagle); and
- the area of land to be affected by the proposed development constitutes either a minute fraction of that available in the locality for those species or, in some instances, does not represent preferred habitat at all.

All of the fauna species which either are or could potentially be of relevance with respect to the EPBC Act are highly mobile and wide-ranging. Many are migratory or nomadic, and none (other than individuals of extremely common and cosmopolitan species such as the Masked Lapwing) would reside in or be dependent on those portions of the subject land proposed for development.

Further, that part of the subject land proposed for development activities does not constitute a significant element of the potential resources for any individuals of the species listed on the EPBC Act within their normal home ranges. It is not likely that even an individual of any such species would be reliant on or dependent on those parts of the subject site proposed for development activities for their survival, even on a local basis (again with the exception of abundant and cosmopolitan species of no conservation concerns, such as the Masked Lapwing).

The subject land supports a substantial population of the endangered Nowra Heath-myrtle *Triplarina nowraensis*. This species occurs predominantly in the northern part of the subject land but also as scattered small patches of individuals in the northeastern part of the land.

The proposed development has been re-designed to reduce the extent of residential development in the northern parts of the land so as to ensure the retention and protection of the overwhelming majority of the species. The re-design has reduced the loss of specimens and/or habitat for the Nowra Heath-myrtle so that well in excess of 90% of the known specimens and their distribution on the subject land are now to be retained. In addition, as discussed elsewhere, management of the *Asset Protection Zones* (APZs) and of relevant parts of the *Conservation Area* on the subject land will include measures designed specifically to increase the population by selective thinning of understorey vegetation, which appears to stimulate growth of the Nowra Heath-myrtle.

Given the re-design of the proposed development to retain the overwhelming majority of the Nowra Heath-myrtle, and appropriate management of the *Conservation Area* to enhance habitat for and populations of the species, the proposed development will not involve the imposition of a “*significant impact*” on the Nowra Heath-myrtle.

A “*critically endangered*” plant species has also been recorded in the immediate vicinity. The Spring Tiny Greenhood orchid *Specularantha vernalis* has been recorded at a number of sites around the subject land, but has not been recorded on the subject land itself. Dedicated searches by officers from Shoalhaven City Council (SCC) as well as the authors of this *Report* in potentially suitable habitat did not identify even a single specimen of the Spring Tiny Greenhood orchid on the subject land. It is noted this species was recorded flowering in suitable habitat to the southeast and west of the subject land at the same time.

Given those circumstances, there will be no “*significant impact*” imposed upon the Spring Tiny Greenhood as a result of the proposed development of the subject land at Mundamia.

There is no likelihood of a “*significant impact*” being imposed on any biota listed in the EPBC Act as a result of the proposed development of the site at Mundamia.

16.3 SEWPaC Decision

It is the conclusion of the EPBC Act assessment contained in this *Report* that the proposed subdivisions and development of the site at Mundamia is not “*likely*” to impose a “*significant impact*” upon any MNES.

The proposal, nevertheless, has been referred to the Commonwealth Department of Sustainability, Environment, Water, Population & Communities (SEWPaC). The Department has determined that the proposed development is not a “*Controlled Action*” pursuant to the EPBC Act (Appendix G), and that consequently no approval from the Federal Minister for the Environment is required.

16.4 Conclusions

The potential or likelihood of the proposed subdivision and subsequent development of the subject land at Mundamia to impose a “*significant impact*” upon any MNES has been considered by the authors of this *Report*.

Given the extent of habitat and resources to be retained and protected within the *E2 – Environmental Conservation Zone*, and given the nature and condition of those parts of the subject land which have been proposed for development activities, it is not likely that a “*significant impact*” would be imposed upon any MNES as a consequence of the proposed development of the subject land.

As noted above, a *Referral* was made to the Commonwealth Department of Sustainability, Environment, Water, Population & Communities (SEWPaC), which has concluded that the proposed development is not a “*Controlled Action*” pursuant to the EPBC Act (Appendix G), and that consequently an approval from the Federal Minister for the Environment is not required.

The *Nowra-Bomaderry Structure Plan* was adopted by Shoalhaven City Council (SCC) on the 24th of October 2006, and endorsed by the then Department of Planning (DoP), now the Department of Planning & Infrastructure (DP&I), on the 26th of February 2008.

As indicated at the beginning of that document, the *Nowra-Bomaderry Structure Plan* “*is not a legal planning document but rather one that provides strategic direction and guidance*”. Nevertheless, the *Structure Plan* does identify areas that are considered appropriate by SCC and the DoP for future residential purposes (amongst other things), which had been identified through a process of investigation and survey prior to adoption of the *Structure Plan*.

The identification of lands considered appropriate for residential development activities, as documented in the *Nowra-Boundary Structure Plan*, was based *inter alia* on flora and fauna investigations of the Mundamia area. Those studies (BES 2004) included investigations of the subject land (Chapter 2; Appendix A), which have been supplemented for this *Report*.

The *Nowra-Bomaderry Structure Plan* identifies new living areas within the Nowra-Bomaderry area, included amongst which is the Mundamia area. The eastern part of the area identified as a “*future living area*” at Mundamia corresponds substantially to the development which is proposed and considered in this *Report*.

The *Structure Plan* identifies a number of features of the Mundamia area, and notes *inter alia* that:

- the “*neighbourhood of Mundamia will be a contained area of residential development to the west of Nowra, within an area of abundant native bushland. This is an asset to be preserved and protected as a significant part of the biodiversity and natural processes in the area*”;
- development at Mundamia “*will achieve a high level of environmental performance to ensure the quality of watercourses in close proximity to the neighbourhood, being the Shoalhaven River, Flat Rock Dam, Flat Rock Creek, Cabbage Tree Creek and numerous tributaries into the creeks*”; and
- the “*neighbourhood will achieve a considered balance between urban development and the protection of environmentally significant areas. Threatened species and valuable ecological communities will be retained and protected through appropriate land use zones, continuous riparian corridors, stormwater and drainage management. The natural bushland adjoining the neighbourhood will be conserved*”.

The proposed residential development of the subject land at Mundamia, addressed in this *Report*, achieves the goals established in the *Nowra-Bomaderry Structure Plan*. As discussed elsewhere in this *Report*, most of the development area is located in areas of previously highly disturbed agricultural land, and the most significant elements of the natural landscape (including threatened biota and their habitats) are to be retained and protected. In addition, the stormwater management regime has been designed *inter alia* to ensure the maintenance of soil moisture conditions and the maintenance of water quality in Flat Rock Creek and the Shoalhaven River.

18 IMPACT AMELIORATION and ENVIRONMENTAL MANAGEMENT

18.1 Fundamental Assumptions

Appropriate impact amelioration and environmental management measures would be anticipated as a standard feature of any future development of the subject land for residential purposes. This approach has been adopted notwithstanding:

- the degraded nature and condition of most of the development area on the subject land;
- the lack of unique or restricted resources or habitat features of particular relevance for (particularly threatened) native biota, within the proposed development footprint; and
- the retention of substantial areas of habitat within the subject land, and on adjoining lands (eg the Crown Land containing Flat Rock Creek to the immediate east).

It is also a fundamental assumption and approach embodied in this *Report* that, whilst impacts upon the natural environment are doubtless inevitable, it is appropriate to incorporate into both the development design and into the development concept an array of impact amelioration and environmental management measures which are designed *inter alia* to reduce, ameliorate and/or offset impacts upon the natural environment which will inevitably arise.

As discussed elsewhere in this *Report*, it is a fundamental precept of this *Report* that the identification of an appropriate balance between development opportunities and conservation aspirations and goals is required to satisfy both the requirements and expectations for biodiversity conservation in the landscape generally and the requirements (economic, social and recreational) of the local and wider Australian community.

18.2 Impact Amelioration

Impact amelioration is the process of incorporating design features and ongoing management measures into a development to limit or minimise potential adverse impacts. Elements of the proposal at Mundamia which have involved the incorporation of impact amelioration measures include:

- the design and the subsequent management of stormwater control features, both during construction activities and following completion and occupation of the land, to limit the potential discharge of contaminants and to maintain existing hydrologic regimes within the *Conservation Area*. These features will be constructed and managed according to current 'best practice' principles, and as outlined in the *Water Cycle Management Report* of Storm Consulting (2012);
- the implementation of 'Water Sensitive Urban Design' principles, including the capture and re-use of stormwater runoff, the treatment of water to be discharged from the development, and the avoidance of the use of potable water for other purposes; and
- detailed design of the peripheral bioretention swale and detention basin system to maintain soil moisture and groundwater regimes, and to provide supplementary habitat for native biota (particularly in the peripheral bioretention swale and detention basin system on the eastern side of the proposal).

The impact amelioration measures which have been incorporated into the design of the proposed development at Mundamia, using an iterative process, are intended to minimise the potential for adverse impacts to be imposed on the natural environment, and to identify an appropriate balance between development opportunities and biodiversity constraints. The approach which has been adopted with respect to the proposed residential development of the subject land at Mundamia has been one of identifying the most important biodiversity aspects of the subject land (amongst other relevant elements) and determining an appropriate development footprint based on those constraints. That approach constitutes impact amelioration as an integral element of the proposal.

18.3 Environmental Management Measures

Relevant issues and matters which have been taken into account in determining the appropriate and relevant environmental management measures for the proposed residential development at Mundamia have included:

- a desire to manage and control human access into the *Conservation Area* and into retained habitats for threatened biota;
- an opportunity for the maintenance of stormwater treatment features (outlet structures, bioretention swales *etc*) *inter alia* as habitat for native biota;
- a desire to appropriately and effectively manage interactions and interfaces between the development and the *Conservation Area*;
- a need to establish mechanisms which facilitate ongoing management of the adjoining natural environment, and
- the desirability of engaging the local community in ongoing management of the natural environment.

In addition to impact amelioration as discussed above (*ie* minimising the potential for adverse impacts to be imposed), specific environmental management measures should be incorporated into all future development activities on the subject land at Mundamia.

Specific impact amelioration and environmental management measures to be implemented as part of the proposed development at Mundamia (in addition to the retention and management of the *Conservation Area*) include:

- the use of sediment fences and other appropriate control measures during construction activities to manage and/or avoid erosion and sediment discharge or the discharge of other contaminants;
- the ongoing management of stormwater discharge volumes and water quality from the development area, both during construction activities and following completion and occupation of the site, according to current 'best practice' principles and as outlined in the *Water Cycle Management Report* of Storm Consulting (2012);
- the ongoing management of the peripheral bioretention swale system to maintain water quality, soil moisture and groundwater regimes, and to provide supplementary habitat for native biota;
- the ongoing management of the APZs to ensure that habitat and resources for, and individuals of, threatened species are protected;

- the implementation of a management regime during the construction process to ensure that no wastes (including building rubble, garbage, contaminants, fuels, oils, paints or other chemicals) are discharged from the construction area, and that all such wastes and contaminants are contained within the construction footprint and are appropriately managed;
- management of the *Asset Protection Zones* (APZs), where required, around the development to retain specimens of and habitat or resources for the relevant threatened biota, including *inter alia*:
 - the preferential and selective retention of hollow-bearing trees;
 - the preferential and selective retention of identified Yellow-bellied Glider and Glossy Black Cockatoo feed trees;
 - the slashing of shrub layer and understorey vegetation at selected locations to promote the Nowra Heath-myrtle;
- the implementation of a *Vegetation Management Plan* (VMP) for the *E2 - Environmental Conservation Zone*, in accordance with the attached *Vegetation Management Principles Plan* (Appendix H) to ensure the long-term viability of flora and fauna populations which utilise the land, particularly the Glossy Black Cockatoo, Yellow-bellied Glider and Nowra Heath-myrtle.
- the collection of native vegetation removed from development areas and its re-use within the *Conservation Area* for bushland rehabilitation and/or landscaping purposes and/or the provision of that material to Council for bushland management and rehabilitation purposes;
- the destruction or appropriate removal of weeds from the development footprint and from the *Conservation Area*; and
- the implementation of a *Hollow-bearing Tree Protocol*, involving:
 - the segmental 'dismantling' by professional tree experts of hollow-bearing trees in order to salvage tree-hollows, wherever possible;
 - the placement of salvaged tree-hollows on existing large trees or dedicated poles in the *Conservation Area*;
 - alternatively, the placement of salvaged tree-hollows on the ground as hollow log habitat, where placement in existing trees is not practical; and
 - the use of artificial nest boxes to replace tree-hollows which cannot be salvaged and to supplement that resource on the site.

GLOSSARY

Activity	Relevantly means: (a) the erection of a building; (b) the carrying out of a work in, on, over or under land; (c) the use of land or of a building or work.
AHD	Australian Height Datum
Bioregion	<i>“a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes”</i> (TSC Act)
DA	<i>Development Application</i> prepared pursuant to the EP&A Act
Development	Relevantly means: (a) the erection of a building on that land; (b) the carrying out of a work in, on, over or under that land; and (c) the use of that land or of a building or work on that land.
DEC	the Department of Environment & Conservation (part of the DECCW)
DECC	the Department of Environment & Climate Change (part of the DECCW)
DECCW	the Department of Environment, Climate Change & Water (now part of the OEH)
DoP	New South Wales Department of Planning
DPI	New South Wales Department of Primary Industries
DP&I	New South Wales Department of Planning & Infrastructure
Endangered Ecological Community	<i>“an ecological community specified in Part 3 of Schedule 1”</i> of the TSC Act
Endangered Population	<i>“a population specified in Part 2 of Schedule 1”</i> of the TSC Act
EP&A Act	<i>Environmental Planning & Assessment Act 1979</i>
Key Threatening Process	<i>“a threatening process specified in Schedule 3”</i> of the TSC Act
Locality	an area of 10km radius around the <i>“subject site”</i>
NPWS	NSW National Parks & Wildlife Service
OEH	Office of the Environment & Heritage, which is part of the Department of Premier & Cabinet, and which incorporates most of the DECCW
Recovery Plan	<i>“a plan prepared and approved under Part 4”</i> of the TSC Act
SIS	<i>Species Impact Statement</i> prepared pursuant to Sections 109, 110 and 111 of the TSC Act
Study Area	the <i>“subject site”</i> and adjoining land which will or may be affected, directly or indirectly, by the proposal
Subject Land	Lot 3 in DP 568613 and Lot 384 in DP 755952 George Evans Road Mundamia
Subject Site	The area proposed for development activities within the <i>“Subject Land”</i>
Threatened Ecological Community	<i>“an ecological community specified in Part 3 of Schedule 1, Part 2 of Schedule 1A or Part 2 of Schedule 2”</i> of the TSC Act
Threatening Process	<i>“a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”</i> (TSC Act)
Threatened Species	<i>“a species specified in Part 1 or 4 of Schedule 1 or in Schedule 2”</i> of the TSC Act
TSC Act	<i>Threatened Species Conservation Act 1995</i>

BIBLIOGRAPHY

- Benson D, Howell J and McDougall L. 1996. *Mountain Devil to Mangrove: A Guide to Natural vegetation in the Hawkesbury - Nepean Catchment*. Royal Botanic Gardens, Sydney.
- Benson D and McDougall L. 1991. *Rare Bushland Plants of Western Sydney*. Royal Botanical Gardens, Sydney.
- BES. 2004a. *Flora and Fauna Assessment Report: Nowra-Bomaderry Structure Plan – Area 5, Mundamia* unpublished report prepared by Bushfire & Environmental Services for Shoalhaven City Council (ref: 04069), July 2004.
- Briggs JD and JH Leigh. 1988. *Rare or Threatened Australian Plants*. Special Publication 14. Australian National Parks & Wildlife Service.
- Briggs JD and JH Leigh. 1996. *Rare or Threatened Australian Plants*. CSIRO, Australia.
- Brooker MIH and Kleinig DA. 1990. *Field Guide to Eucalypts Volume 1 - South-eastern Australia*. Inkata Press, Melbourne.
- Brouwer J and Garnett S (eds). 1990. *Threatened Birds of Australia: An Annotated List*. Royal Australasian Ornithologists Union Report No. 68.
- Cogger HG. 1992. *Reptiles and Amphibians of Australia*. AH & AW Reed, Sydney.
- Churchill S. 1998. *Australian Bats*. New Holland Publishers.
- DEC. 2004. *Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*. NSW Department of Environment & Conservation, Sydney.
- DEC. 2005. *Draft Guidelines for Assessment of Impacts on Threatened Species Under Part 3A*. NSW Department of Environment and Conservation, Sydney.
- Department of Housing. 2004. *Managing Urban Stormwater: Soils and Construction*. Department of Housing, Sydney.
- EcoLogical Australia. 2012. *Bushfire Protection Assessment. Proposed subdivision: Lot DP 568613 & Lot DP 755952 at Mundamia*.
- Environmental InSites. January 2009. *George Evans Road, Mundamia. Proposed Public Road. Flora & Fauna Assessment Report*. Whelans InSites, Sydney.
- Environmental InSites. May 2010. *Development Application No. DA09/1519. George Evans Road, Mundamia. Supplementary Response to Council*. Whelans InSites, Sydney.
- Fairley A and Moore P. 1989. *Native Plants of the Sydney District*. Kangaroo Press, Sydney.
- Garnett ST and Crowley GM. 2000. *The Action Plan for Australian Birds*. Environment Australia, Canberra.
- Hall LS and Richards GC. 1979. *Bats of Eastern Australia*. Queensland Museum Booklet No 12. Queensland Museum, Brisbane.
- Harden G (ed). 1992. *Flora of NSW. Vol 3*. NSW University Press, Kensington.
- Harden G (ed). 1993. *Flora of NSW. Vol 4*. NSW University Press, Kensington.

- Harden G (ed). 2000. *Flora of NSW. Vol 1 (revised)*. NSW University Press, Kensington
- Harden G (ed). 2002. *Flora of NSW. Vol 2 (revised)*. NSW University Press, Kensington
- Higgins PJ (ed). 1999. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4 - Parrots to Dollarbird*. Oxford University Press, Melbourne.
- Higgins PJ and Davies SJJF (eds). 1996. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 3 - Snipe to Pigeons*. Oxford University Press, Melbourne.
- Higgins PJ, Peter JM and Steele WK (eds). 2001. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 6 - Pardalotes to Shrike-thrushes*. Oxford University Press, Melbourne.
- Higgins PJ and Peter JM (eds). 2002. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 5 - Tyrant-flycatchers to Chats*. Oxford University Press, Melbourne.
- Higgins PJ, Peter JM and Cowling SJ (eds). 2006. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 7 Part A - Boatbill to Starlings*. Oxford University Press, Melbourne.
- Higgins PJ, Peter JM and Cowling SJ (eds). 2006. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 7 Part B - Boatbill to Starlings*. Oxford University Press, Melbourne.
- Marchant S and Higgins PJ. 1990a. *Handbook of Australian, New Zealand & Antarctic Birds. Volume 1 Part A - Ratites to Ducks*. Oxford University Press, Melbourne.
- Marchant S and Higgins PJ. 1990b. *Handbook of Australian, New Zealand & Antarctic Birds. Volume 1 Part B - Ratites to Ducks*. Oxford University Press, Melbourne.
- Marchant S and Higgins PJ (eds). 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings*. Oxford University Press, Melbourne.
- McDonald RC, Isbell RF, Speight JG, Walker J and Hopkins M. 1990. *Australian Soil and Land Survey Field Handbook* (2nd Edition). Inkata, Melbourne.
- Robinson L. 1991. *Field Guide to the Native Plants of Sydney*. Kangaroo Press, Sydney.
- Robinson M. 1994. *A Field Guide to Frogs of Australia*. Australian Museum/Reed Books, Sydney.
- Sass S. 2008. *Increasing ecological knowledge and community awareness of the threatened Rosenberg's goanna in the Shoalhaven*. ngh environmental.
- Simpson K and Day N. 1998. *The Claremont Field Guide to the Birds of Australia (5th Edition)*. Penguin Books, Australia.
- Slater P, Slater P and Slater R. 1989. *The Slater Field Guide to Australian Birds*. Weldon Publishing, Sydney.
- Specht RL. 1988. Major Vegetation Formations in Australia. In *Ecological Biogeography of Australia*. Keast A (ed). Junk, The Hague.
- Storm Consulting. 2012. *Mundamia Development. Water Cycle Management Report for proposed residential development of Lot 384 DP 755952 & Lot 3 DP 568613*. Unpublished report prepared for Twynam Property Group.
- Strahan R (ed). 1995. *The Mammals of Australia*. Reed Books, Chatswood.

Figure 1

Location of the subject land at Mundamia



LEGEND

Subject Land

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan,

01503006009001,200

Metres

N

NOTES

1. Aerial photography courtesy of Nearmap 27/11/2011

2. Map locator courtesy of ESRI basemap, Streets

3. All features are approximate only and subject to detailed survey

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Project Name:

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Prepared for:

Twynam Property Group

Project No: **610.10672**

Scale 1:30,000 @ A3

Date 29-Nov-2012

Drafted Sara Haddady

Approved Sepehr Sobhani

Figure 2

Details of the subject land at Mundamia, and its immediate context



LEGEND

- Drainage Swale
- Incised Watercourse
- Residential Footprint
- Subject Land

0 25 50 100 Metres

N

NOTES

- Aerial Photography courtesy of Nearmaps
- All features are approximate only and subject to detailed survey

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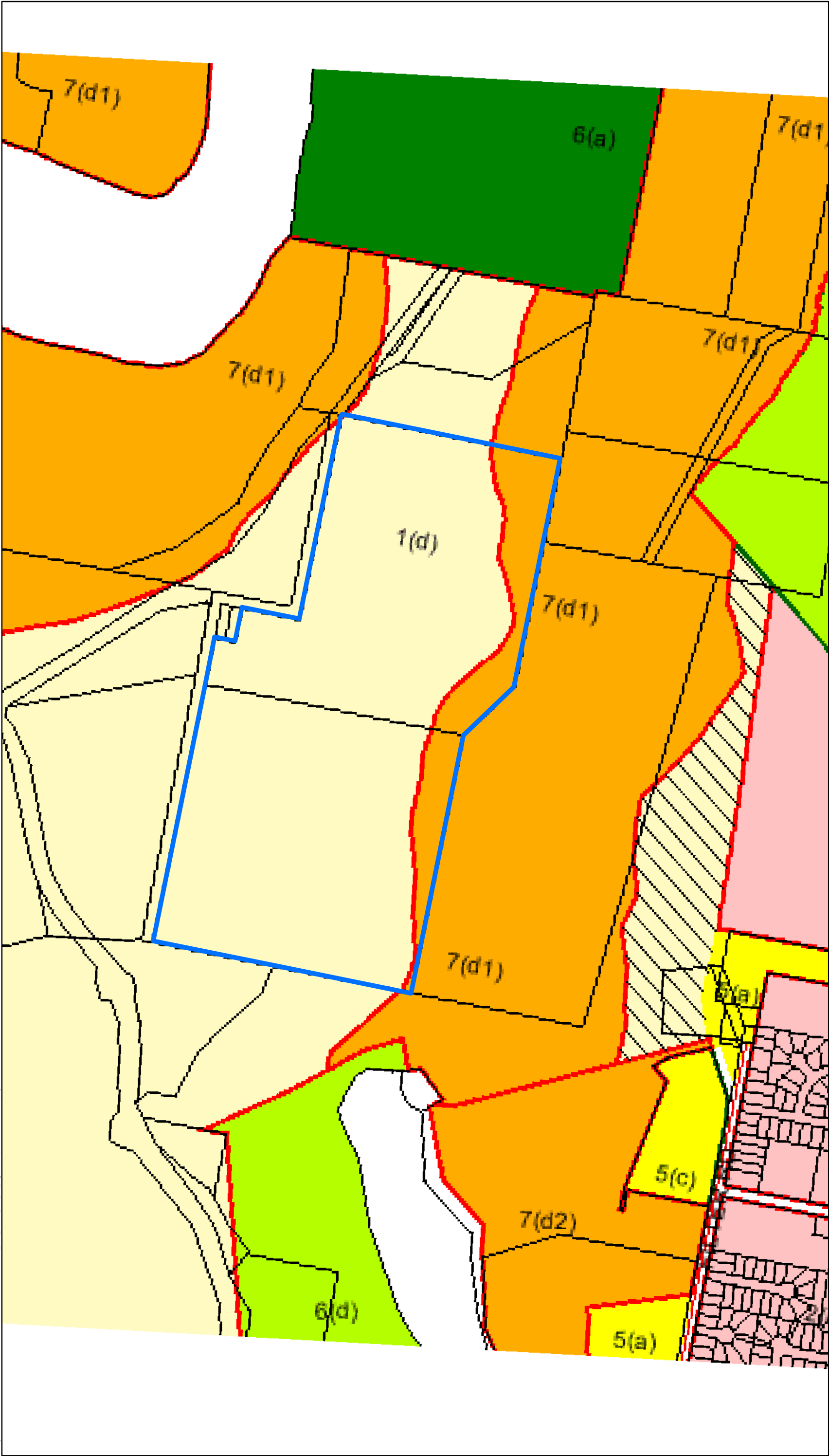
Prepared for: **Twynam Property Group**

Project No: **610.10672**


Scale 1:3,500 @ A3	Date 29-Nov-2012
Drafted Sara Haddady	Approved Sepehr Sobhani

Figure 3

Existing zoning on the subject land at Mundamia

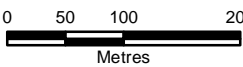


LEGEND

 Subject Land

NOTES

- 1. All features are approximate only and subject to detailed survey
- 2. Proposed zoning courtesy of MALBEC Properties
- 3. DCDB © 2006 Department Lands



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Lane Cove
NSW 2066
Australia
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F: +61 2 6287 0801
www.slrconsulting.com

Project Name:
Mundamia

Prepared for:
Twynam Property Group

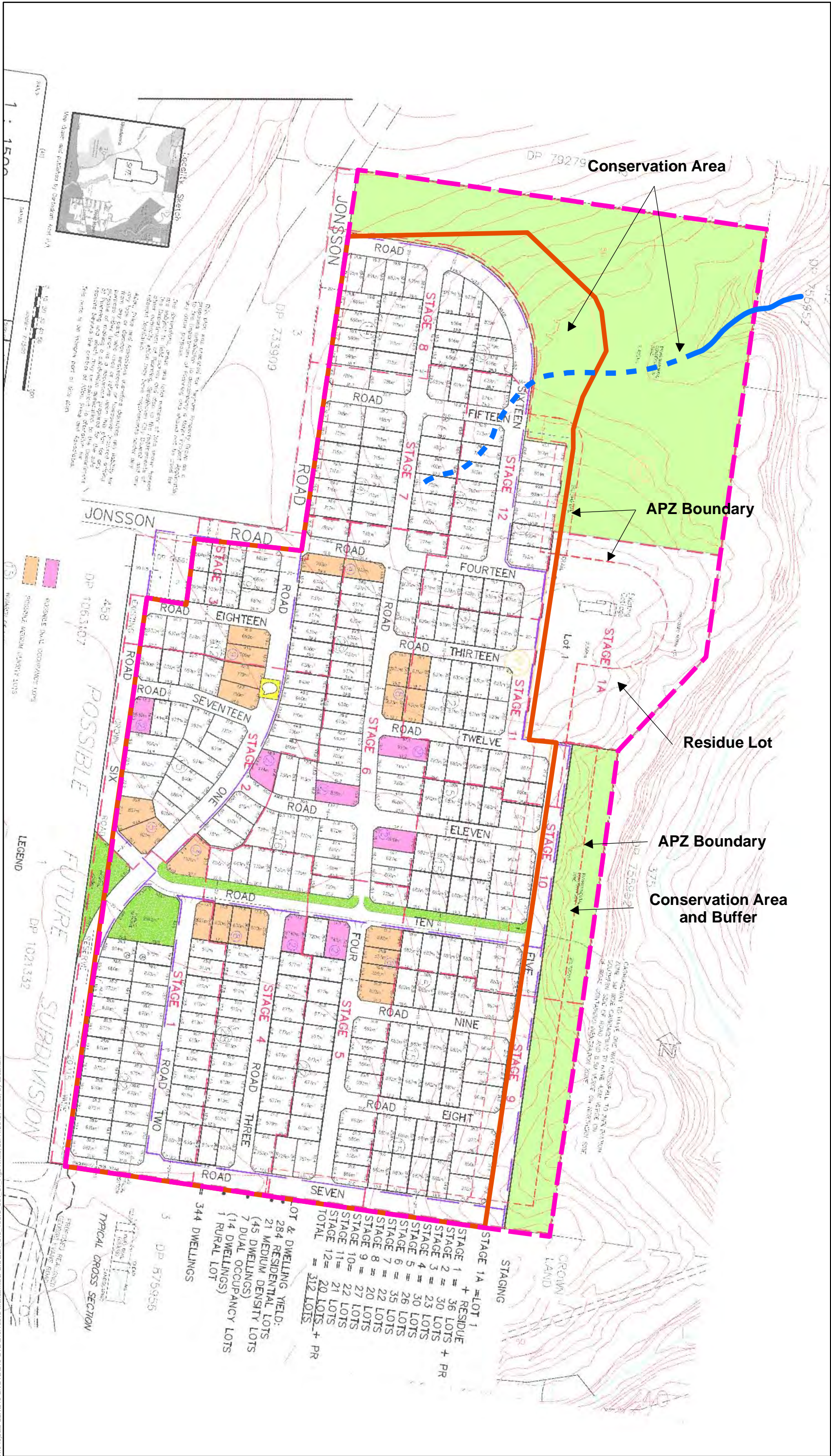
Project No: 610.10672

Scale 1:6,500 @ A3 Date 29-Nov-2012

Drafted Sara Haddady Approved Sepehr Sobhani

Figure 4

Proposed lot layout and Conservation Areas



LEGEND

- Environmental Protection Zone (E2)
- Residential Zone (R1)
- Drainage Swale
- Incised Watercourse
- Asset Protection Zones

NOTES

1. Proposed zoning courtesy of MALBEC Properties
2. DCDB © 2006 Department Lands
3. All features are approximate only and subject to detailed survey

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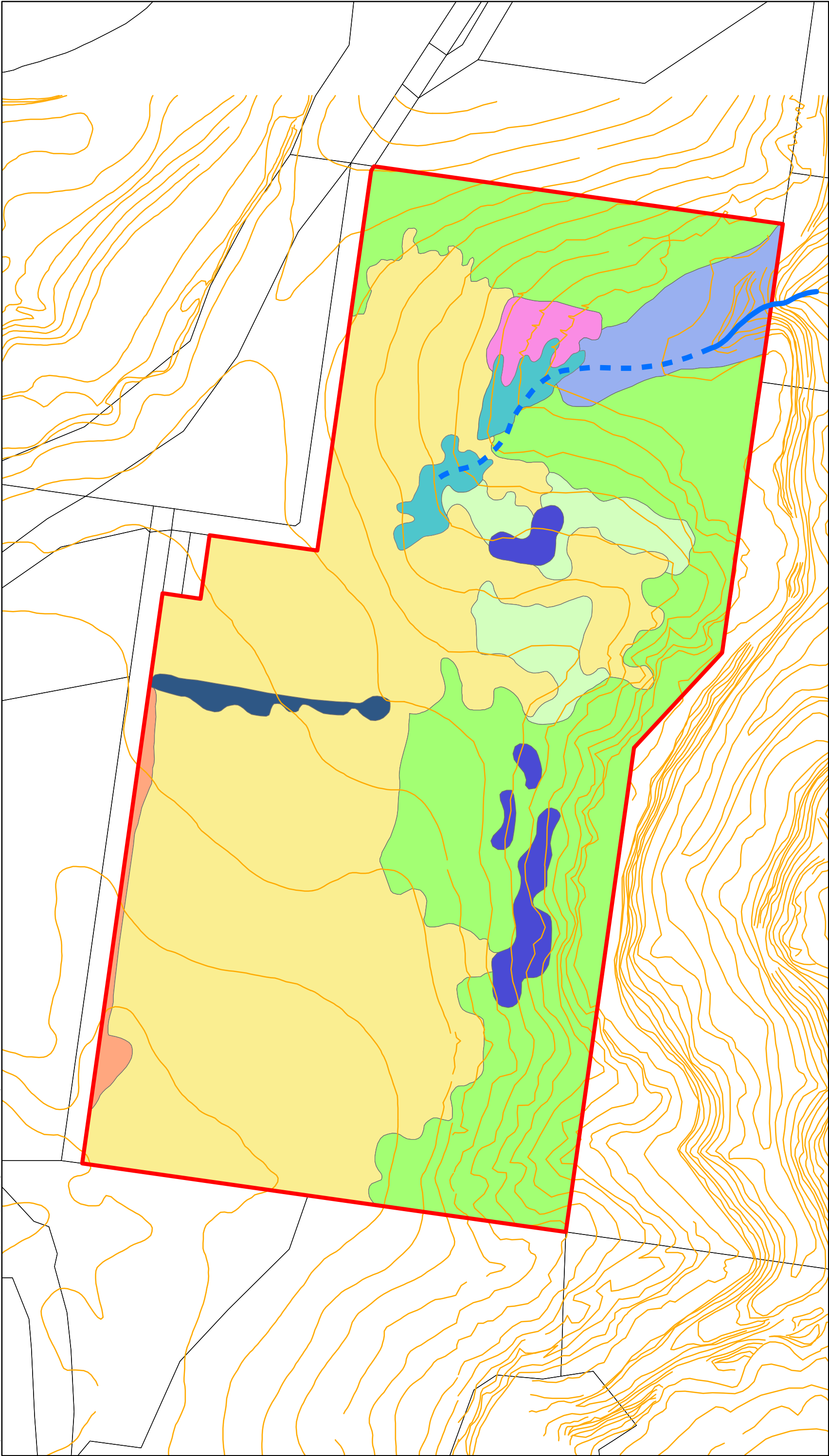
Project No: **610.10672**

Scale: 1:3,500 @ A3 Date: 29-Nov-2012

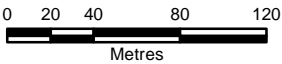
Drafted: Sara Haddady Approved: Sepehr Sobhani

Figure 5

Vegetation and topography on the subject land at Mundamia



- LEGEND**
- Subject Land
 - Contours
 - Drainage Swale
 - Incised Watercourse
 - Grey Gum - Blue-leaved Stringybark Open Forest
 - Highly disturbed Grey Gum - Stringybark Woodland
 - Kunzea Heathland
 - Paperbark Closed Forest
 - Pasture
 - Regrowth Woodland with Kunzea Heath
 - Mixed woodland strip
 - Scribbly Gum - Bloodwood Forest
 - Spotted Gum Blackbutt Forest



- NOTES**
- All features are approximate only and subject to detailed survey
 - Proposed zoning courtesy of MALBEC Properties

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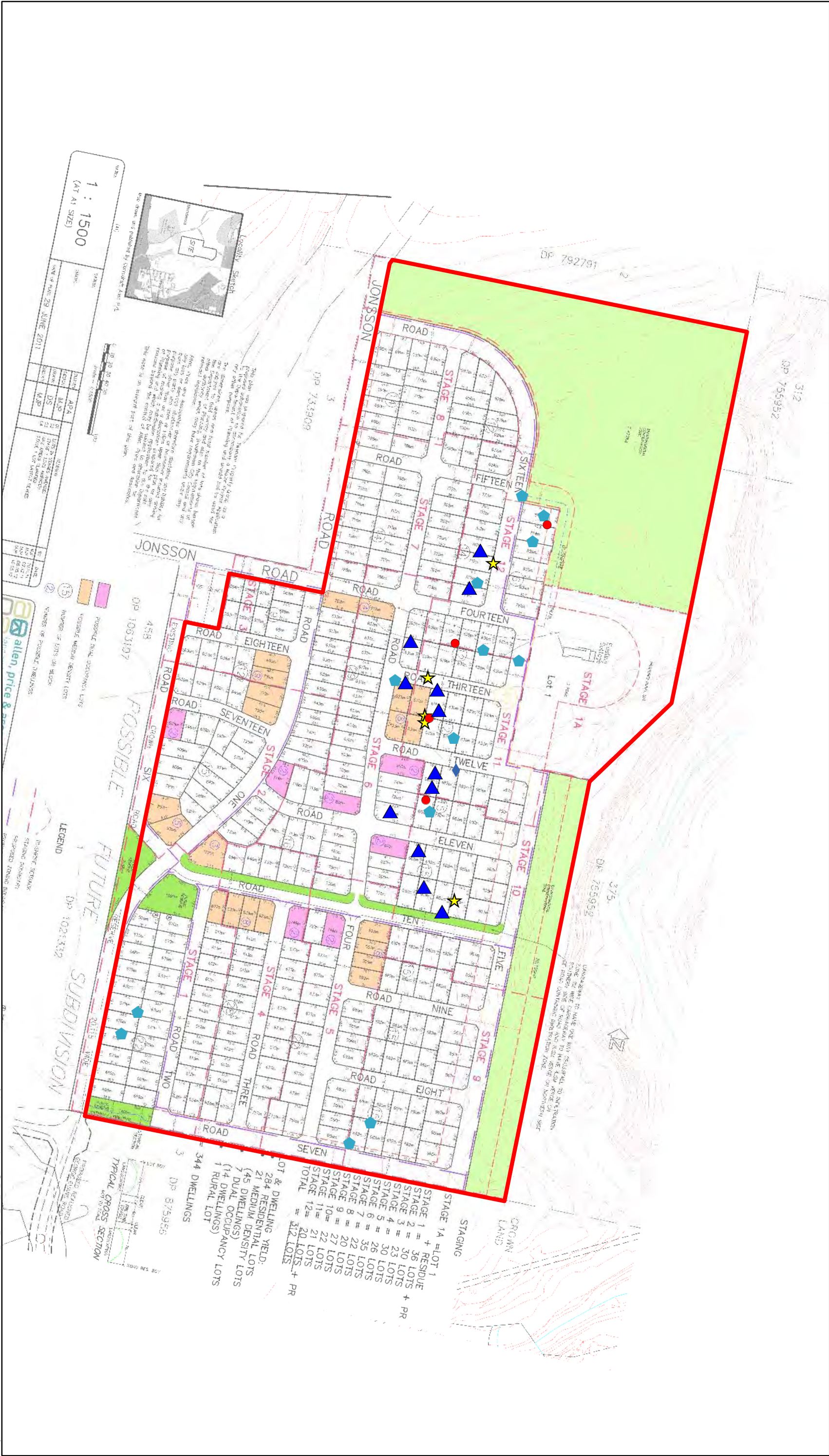
Prepared for: **Twynam Property Group**

Project No: **610.10672**

Scale 1:3,500 @ A3 Date 29-Nov-2012

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Figure 6 Hollow-bearing trees within the development footprint



LEGEND

- Subject Land
- Hollow-bearing trees
 - Red Bloodwood
 - Grey Gum
 - Scribbly Gum
 - Stag
 - Blue-leaved Stringybark

NOTES

- All features are approximate only and subject to detailed survey
- Proposed zoning courtesy of MALBEC Properties



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Figure 7

Overlay of the proposal on the vegetation types at Mundamia



LEGEND

Drainage Swale

Incised Watercourse

Subject Land

Residential Footprint

APZ

Grey Gum - Blue-leaved Stringybark Open Forest

Highly disturbed Grey Gum - Stringybark Woodland

Kunzea Heathland

Paperbark Closed Forest

Pasture

Regrowth Woodland with Kunzea Heath

Mixed woodland strip

Scribbly Gum - Bloodwood Forest

Spotted Gum Blackbutt Forest

02550100

Metres

N

NOTES

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2. Proposed zoning courtesy of MALBEC Properties

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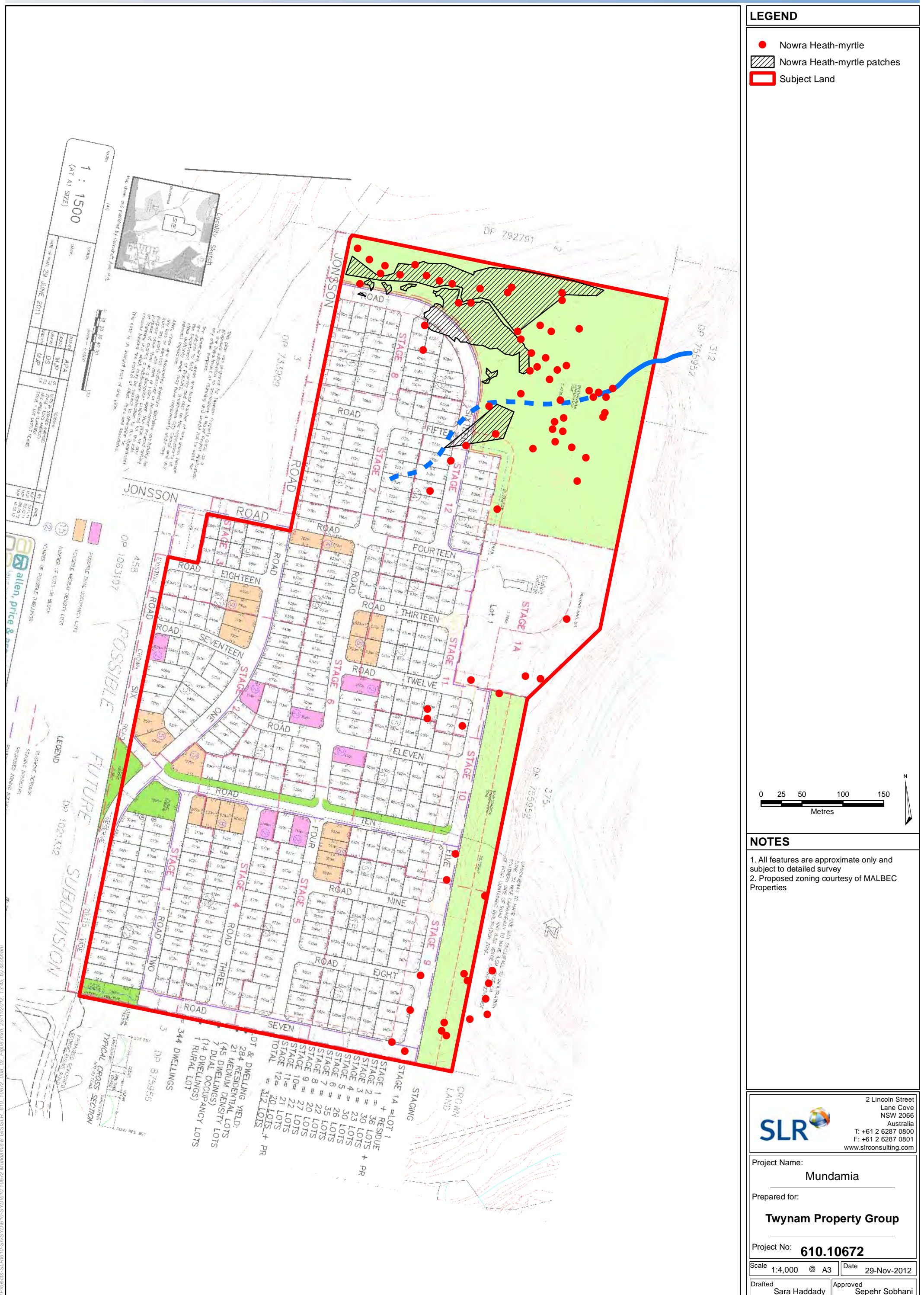
Scale 1:3,500 @ A3

Date 29-Nov-2012

Drafted Sara Haddady

Approved Sepehr Sobhani

Distribution of the Nowra Heath-myrtle on the subject land



Threatened Species recorded on and near the subject land at Mundamia

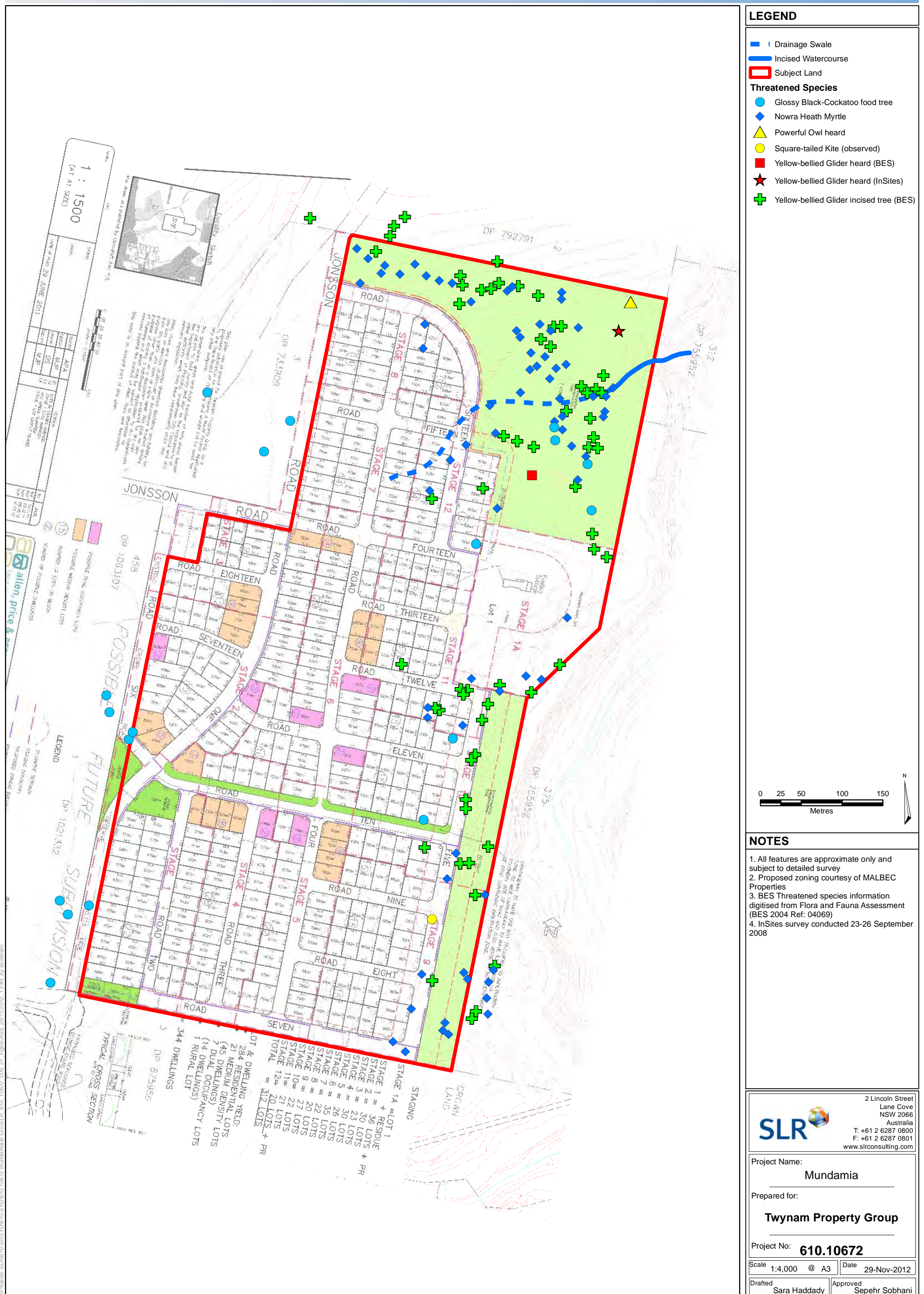
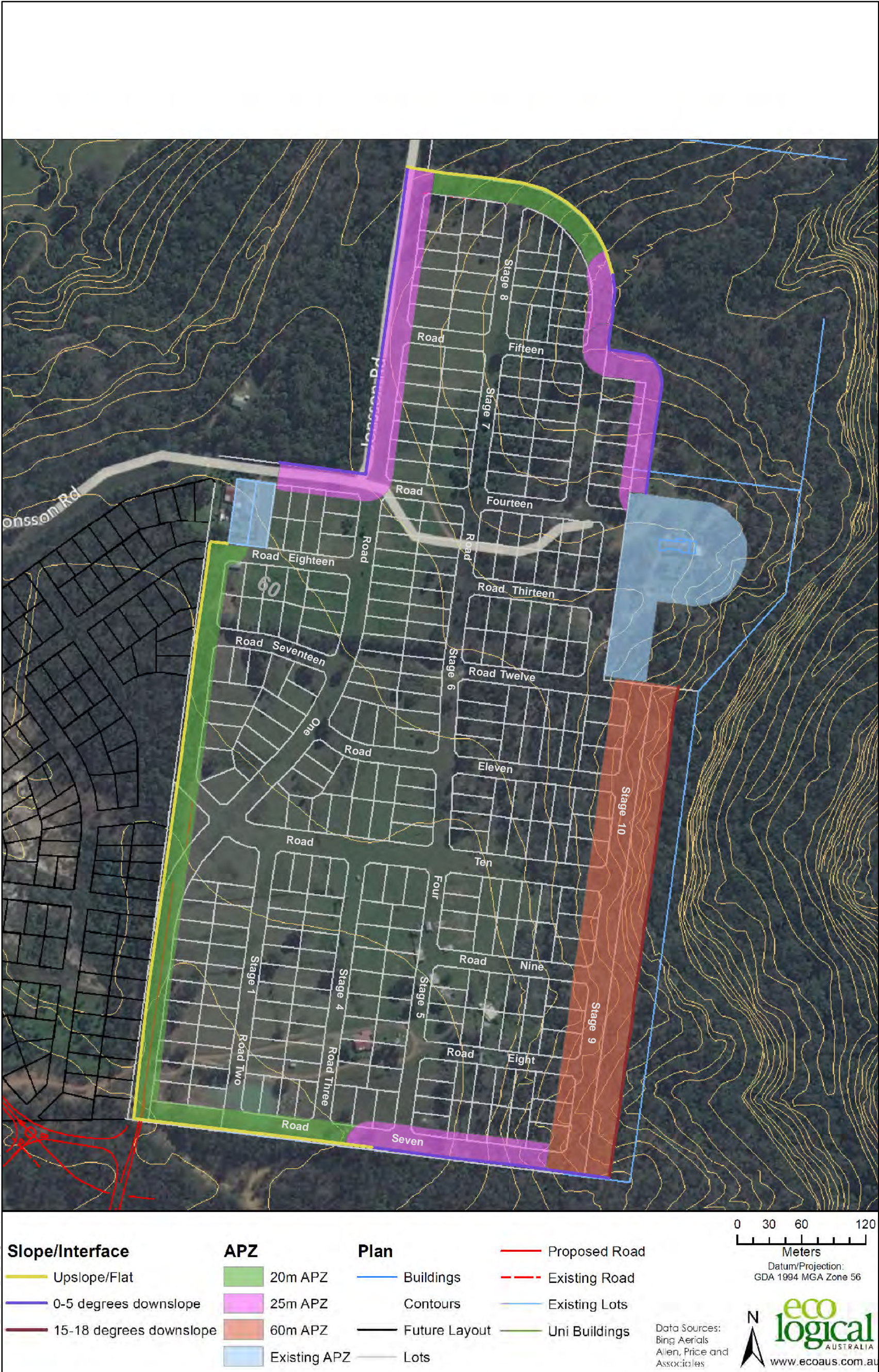


Figure 10

Stormwater management regime for the subject land at Mundamia



Figure 11 Bushfire Protection Measures around the subject land



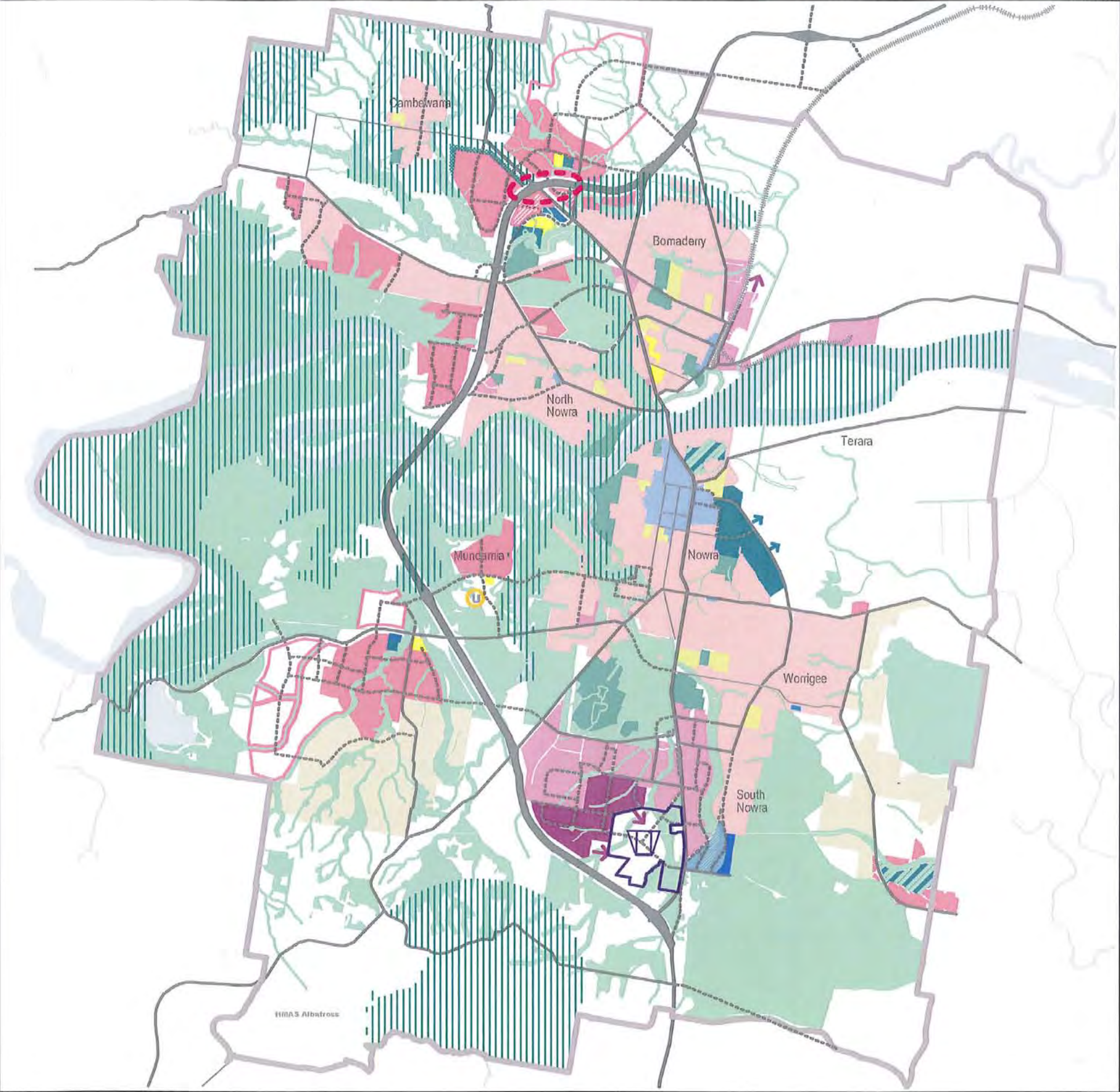
LEGEND

NOTES

1. Plan courtesy of Ecological Australia

Figure 12

Nowra - Bomaderry Structure Plan



Legend

- Structure Plan Boundary
- Existing Living Area
- Future Living Area
- Possible Future Living Area
- Future Long Term Living Area
- Existing Rural Residential
- Existing CBD Area
- Existing Neighbourhood Centre
- Future Neighbourhood Centre
- Existing Local Centre
- Future Local Centre
- Existing Other Commercial
- Future Other Commercial
- Existing Industrial Land
- Future Industrial Land
- Existing School/TAFE
- Future School
- Existing University & TAFE Campus
- Existing Active Recreation
- Future Active Recreation
- Conservation & Riparian Area
- Future Active/Passive Open Space or Conservatio
- Future Advanced Screening
- Scenic Protection Areas
- Rural Area
- Future Western Bypass
- Bypass alignment in this location subject to further investigation as part of LEP
- Main Roads
- Local Road Network
- North Nowra Link Road Options
- South Coast Correctional Centre Site

Adopted by Council on 24th October 2006 and 25th September 2007.
Endorsed by the Department of Planning 28th February 2008.

Structure Plan

February 2008

Not To Scale

Nowra Bomaderry Structure Plan

LEGEND

NOTES

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Project No: **610.10672**

Scale: N/A Date: 29-Nov-2012

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George Evans Road, Mundamia

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Flora & Fauna Issues & Assessment Report

Appendix A
Details of Investigations in 2004 (BES) and 2008 (Environmental InSites)

November 2012

1 INTRODUCTION

Field surveys for flora and fauna were conducted within the subject site and study area at Mundamia during the following survey periods:

- 26th of February 2004 to 22nd of June 2004 by BES (Table 1); and
- 24th to the 26th of September 2008 by Environmental InSites (Table 2).

Table 1 Field survey summary (BES 2004)

Year	Dates	Technique	Location	Effort	Reference
2004	26 th February; 2 nd , 18 th March.	General vegetation surveys	Area 5	30.5 hours	BES 2004
	19 th March; 27 th April	Targeted grid searches for threatened and regionally significant flora species.	Area 5	67 hours	BES 2004
	22 nd June	Targeted transects for <i>Genoplesium baueri</i>	Area 5	4 hours	BES 2004
	26 th February	Diurnal habitat search	Area 5		BES 2004
	26 th February	Nocturnal surveys including spotlighting, call playback and Ultrasonic detection	Area 5	10.25 hours	BES 2004
	26 th – 29 th February	Terrestrial Elliott Trapping	Area 5	250 trap nights	BES 2004
	26 th – 29 th February	Terrestrial cage trapping (small)	Area 5	100 trap nights	BES 2004
	26 th – 29 th February	Terrestrial cage trapping (large)	Area 5	16 trap nights	BES 2004
	26 th February to 18 th March	Arboreal hair funnels	Area 5	550 trap nights	BES 2004
	2 nd March	Diurnal habitat search	Area 5	23.5 hours	BES 2004
	2 nd March	Nocturnal surveys including spotlighting, call playback and Ultrasonic detection	Area 5	6.25 hours	BES 2004
	18 th March	Diurnal habitat search	Area 5	4 hours	BES 2004
	18 th March	Nocturnal surveys including spotlighting, call playback and Ultrasonic detection	Area 5	6.2 hours	BES 2004
	19 th March	Diurnal habitat search	Area 5	52 hours	BES 2004
	10 th & 22 nd June	Nesting assessments	Area 5	11.5 hours	BES 2004

Table 2 Field surveys undertaken by Environmental InSites for this Report

Year	Dates	Technique	Location	Effort	Reference
2008	24 th -26 th September	Targeted surveys for the Nowra Heath Myrtle <i>Triplarina nowraensis</i>	Subject Site	8 hours	Environmental InSites 2008
	24 th -26 th September	Flora surveys	Subject Site	8 hours	Environmental InSites 2008
	24 th -26 th September	Diurnal Bird Surveys	Subject Site	4 hours (dedicated) plus whole survey period	Environmental InSites 2008
	24 th -25 th September	Spotlighting	Subject Site	4 hours	Environmental InSites 2008
	24 th -25 th September	Call Playback	Subject Site	2 hours	Environmental InSites 2008
	24 th -25 th September	Ultrasonic Bat detection - Mobile	Subject Site	4 hours	Environmental InSites 2008
	24 th -25 th September	Ultrasonic Bat detection – fixed	Subject Site	20 hours	Environmental InSites 2008
	24 th -25 th September	Nocturnal Amphibian surveys	Creekline and dams within subject site	3 hours	Environmental InSites 2008
	24 th -26 th September	Hollow tree surveys	Subject Site	8 hours	Environmental InSites 2008
	24 th -26 th September	Habitat search	Subject Site	6 hours	Environmental InSites 2008

Supplementary Investigations

In November and December 2009 and February 2010, BES (now Eco Logical Australia – ELA) conducted further flora and fauna surveys on Council land to the immediate west of the subject site at Mundamia. Those investigations included:

- dedicated transect surveys for threatened orchids known to occur in the locality;
- nesting assessments for the Gang Gang Cockatoo;
- stag watch surveys for nocturnal mammals and birds;
- nocturnal spotlighting, call playback and Anabat recording;
- 200 trap-nights for the Eastern Pygmy Possum and the White-footed Dunnart; and
- the use of remote cameras to survey for Rosenberg's Goanna and the Tiger Quoll.

Additional surveys and inspections of the subject site and nearby land have also been conducted in 2010 and 2011 by Environmental InSites and by Shoalhaven City Council (SCC) including:

- a supplementary inspection of the proposed road alignment for access into the Mundamia residential area, on the 4th of May 2010 (Environmental InSites);
- dedicated surveys for the Spring Tiny Greenhood orchid, both on the subject site and in the immediate vicinity, by SCC and Environmental InSites (dates); and
- two supplementary dedicated surveys of the subject site (dates) by Environmental InSites to refine vegetation mapping and to provide added information and detail regarding the distribution and densities of patches of the Nowra Heath Myrtle.

1.1 Survey Limitations

Snapshot surveys (such as those undertaken as part of the planning and assessment process) are generally always limited by time and budget constraints and therefore it is often likely that the species recorded during a given survey only represent a portion of those which would utilise the site. To alleviate this problem surveys should be replicated during different seasons to increase the chance of recording cryptic species or species which use the site (or are only active/detectable) seasonally and/or periodically. As indicated in Table 2, the subject site and surrounding land have been surveyed over different seasons and importantly, in different years.

Given the habitats present on the subject site and the fact that the vast majority of the proposed development would occupy cleared and highly disturbed farmland, it is considered that the level of survey effort is sufficient in this instance.

2 SPOTLIGHTING SURVEYS

Spotlighting surveys were conducted throughout the subject site to target nocturnal mammals, owls, amphibians and other nocturnal fauna. Fauna species were detected both visually and aurally.

3 CALL PLAYBACK SURVEYS

Pre-recorded calls of the Squirrel Glider, Yellow-bellied Glider, Masked Owl, Sooty Owl, Powerful Owl, Barking Owl, Bush Stone-curlew and Giant Burrowing Frog were broadcast at numerous locations during the 1997 – 2008 field surveys. Surveys commenced after dusk, with each call being broadcast for 5 minutes followed by a two minute listening period. Ten minutes were spent listening for calls prior to and after playback.

4 MICROCHIROPTERAN BAT SURVEYS

Anabat II (BES 2004) and Anabat SD1 (InSites 2008) recorders were employed to detect microchiropteran bats. Anabat recorders are useful in detecting high flying microchiropteran bats that are often under-sampled by bat (harp) trapping. Anabat surveys were conducted during the spotlight traverses and from dusk till dawn using the delay system. Call analysis for this survey was undertaken using the AnalookW software package (Corben 2006) with reference to Pennay *et al* (2004) and a library of bat calls.

5 AVIFAUNA SURVEYS

Diurnal bird surveys involved the observation and identification of calls and were conducted from dawn on each survey day. In addition, bird species were recorded on an opportunistic basis during all surveys across the site. Targeted searches were undertaken for feeding signs of the Glossy Black Cockatoo and potential nesting sites for large forest owls.

6 HABITAT SEARCHES

An opportunistic habitat search was conducted throughout the subject site during other surveys. This involved actively searching piles of vegetative litter, rock shelves and crevices and human refuse. All rocks, sticks, logs or refuse disturbed were returned to their original placement following completion of the search.

7 HOLLOW-BEARING TREE SURVEY

The positions of all hollow-bearing trees were mapped in the field with a PDA/GPS running the ArcPad GIS software package (Figure 6), and the information collected (Table 1: Appendix B) included:

- tree species;
- tree height (m);
- Diameter at Breast Height Over Bark (DBHOB);
- the number and size of visible hollows;
 - Small large enough for a small arboreal species (up to a Sugar Glider);
 - Medium large enough for a medium arboreal species (up to a Squirrel Glider);
 - Large large enough for a large arboreal species (up to a Brushtailed Possum);
 - Owl suitable for a large forest owl;
- type of hollow (spout, stem, trunk, base, fissure); and
- geographical location (Easting and Northing - GDA 1994; AMG Zone 56).

8 FLORA SURVEY METHODS

8.1 Systematic Surveys

Botanical surveys were undertaken on the 23rd and 24th of September 2008. Surveys were completed in accordance with draft Department of Environment & Climate Change guidelines (DEC 2004). Systematic surveys consisted of five 20 x 20 metre plots sampling each vegetation community. Cover abundance for each species recorded within the survey plots and was allocated on the basis of a modified Braun-Blanquet scale. Flora transects of 100 metres length were associated with each community and plot survey. The Random Meander methodology also was utilised to target threatened species, as described by Cropper (1993).

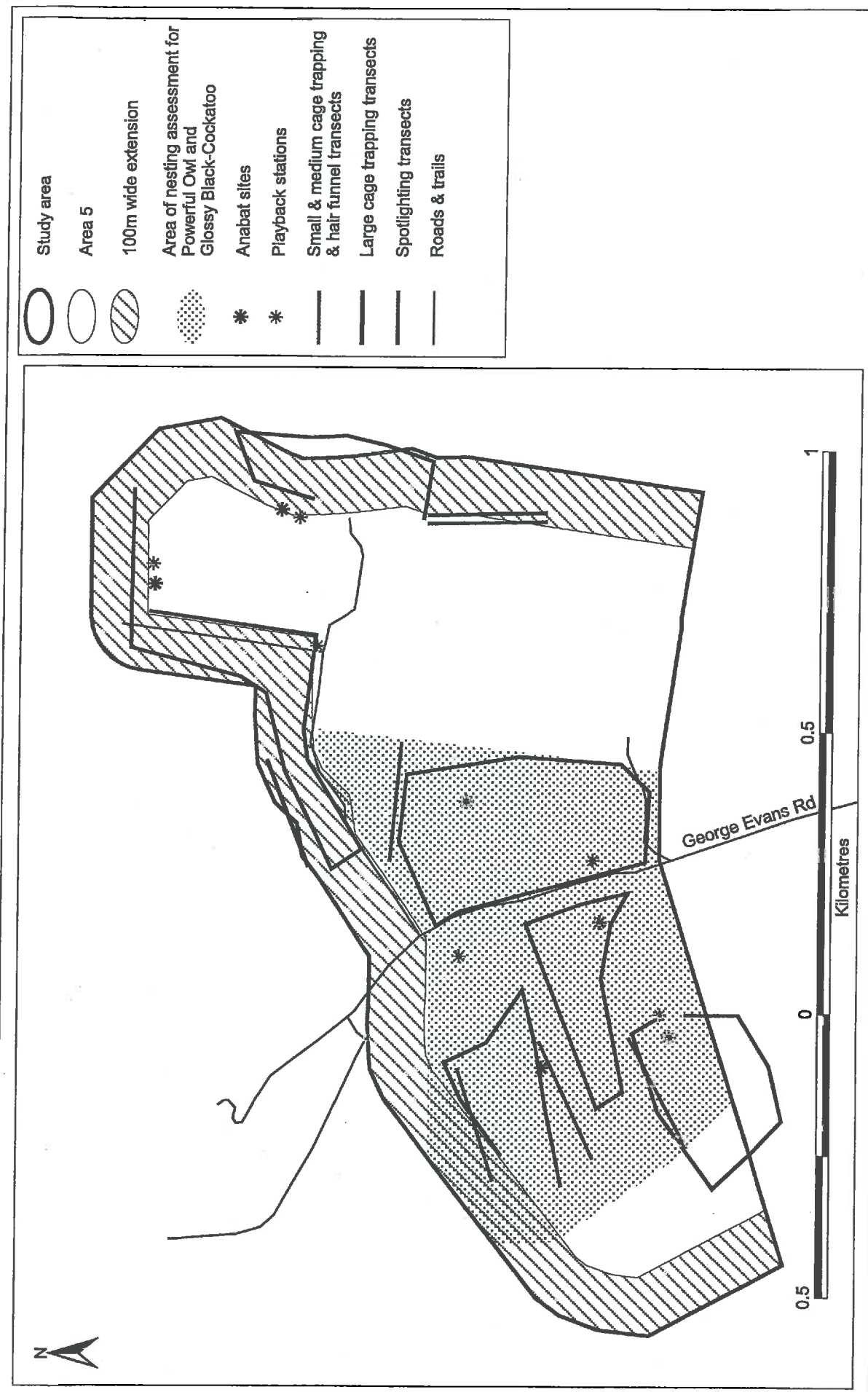
Botanical nomenclature was applied according to Harden (1990-1993) and cross-referenced against updated and accepted changes per www.plantnet.com.au or the National Herbarium of New South Wales.

Where *var.* or *subsp.* was not able to be accurately determined, specimens were listed at the base species level.

8.2 Targeted Surveys for Nowra Heath-myrtle

The Nowra Heath-myrtle *Triplarina nowraensis*, was specifically searched for during the Random Meander surveys. All habitats considered suitable for this species were searched.

Figure 3: Study area and locations of fauna surveys





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Appendix B
BES Mapping of the Subject Land

November 2012

Figure 4: Vegetation of the study area

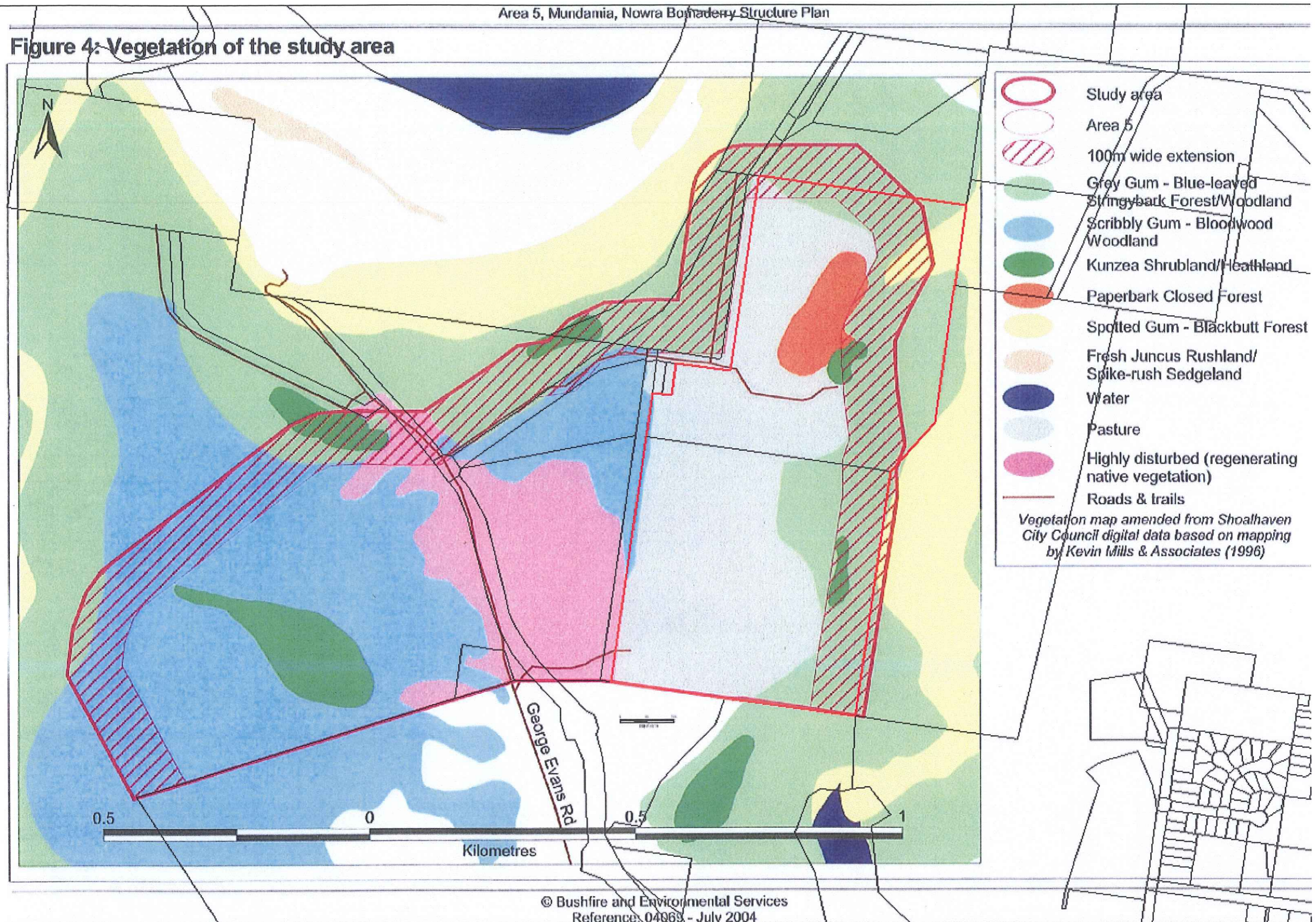


Figure 5: Locations of threatened, rare and regionally significant flora

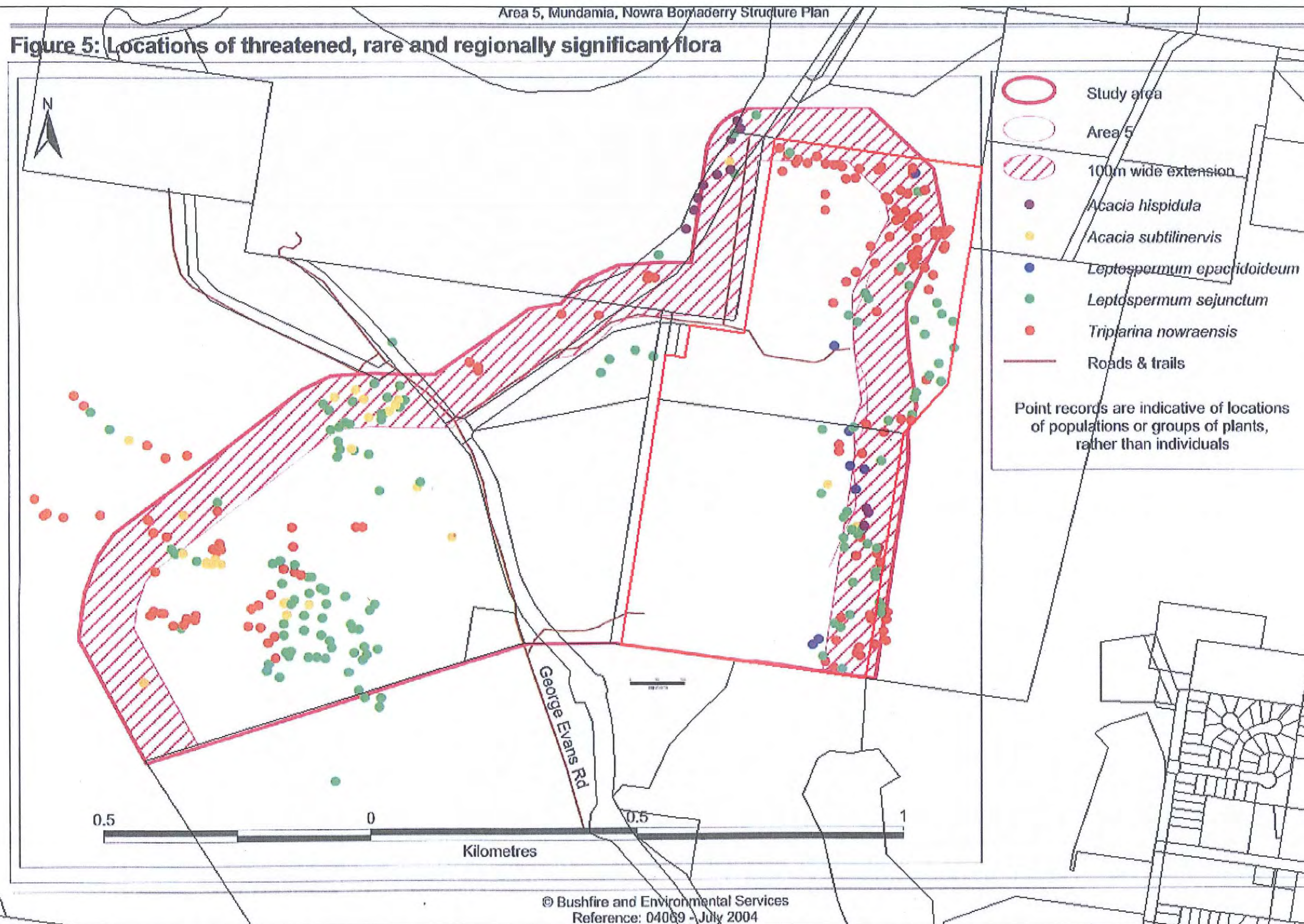
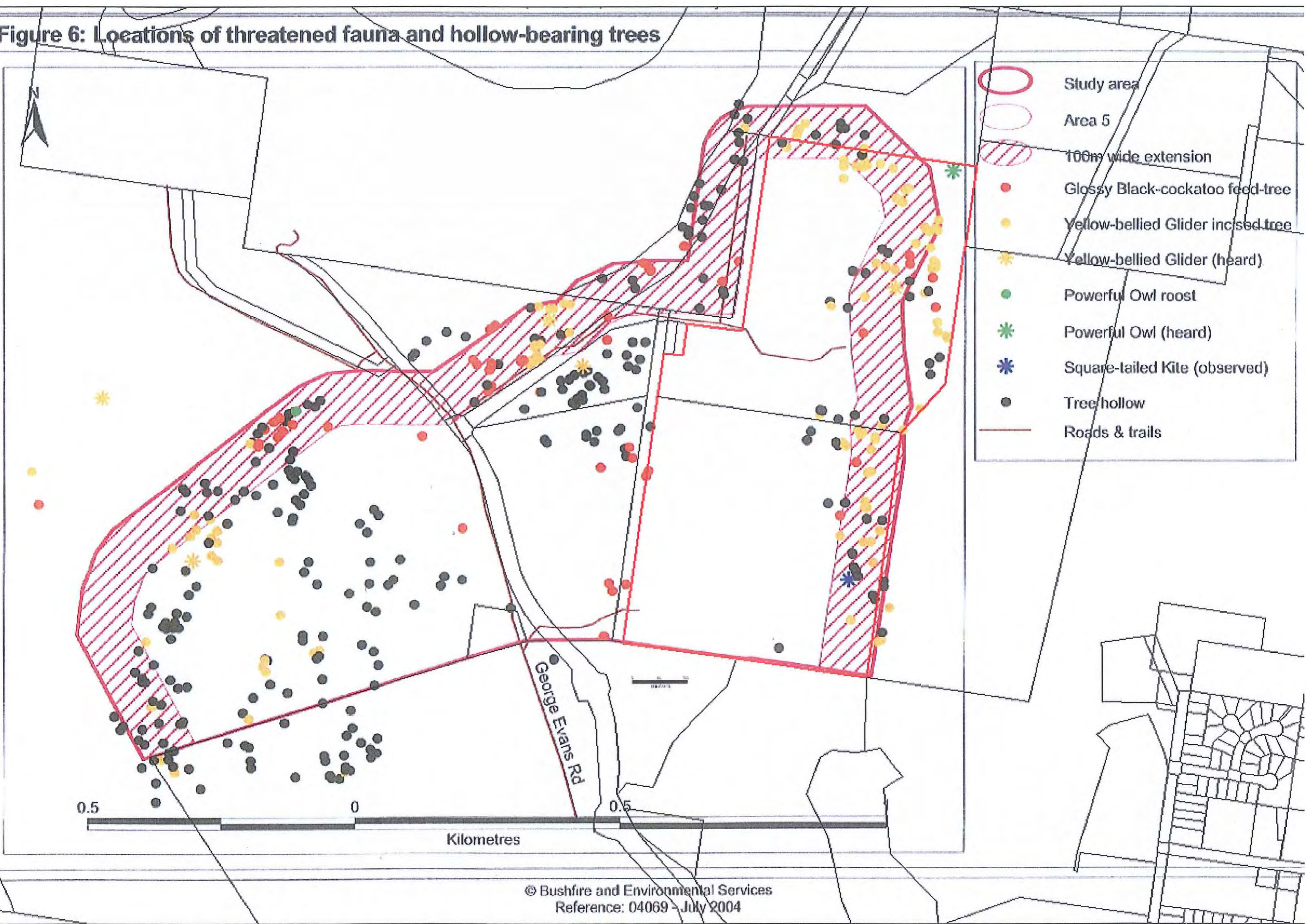


Figure 6: Locations of threatened fauna and hollow-bearing trees





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Appendix C
Wildlife Atlas Search for the Mundamia LGA

November 2012

KEY	
Status	The “ <i>threatened species</i> ” listing in the <i>Threatened Species Conservation Act 1995</i>
V	Species listed as “ <i>vulnerable</i> ”
E1	Species listed as “ <i>endangered</i> ”
E4A	Species listed as “ <i>critically endangered</i> ”
Records	The number of records of the relevant “ <i>threatened species</i> ” listed in the search area
Relevance	The potential relevance that the “ <i>threatened species</i> ” might have to the subject site.
H	Considered by SLR Ecology to have a “ <i>high</i> ” potential relevance to the subject site
M	Considered by SLR Ecology to have a “ <i>moderate</i> ” potential relevance to the site
L	Considered by SLR Ecology to have a “ <i>low</i> ” potential relevance to the subject site
N	Considered by SLR Ecology to have “ <i>no</i> ” relevance to the subject site
NOTES	
<p>The table below is based on data obtained from the recently reformed <i>Atlas of NSW Wildlife</i> website http://www.bionet.nsw.gov.au/. The following notes accompany this database:</p> <ul style="list-style-type: none"> Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°). Copyright - the State of NSW through the Office of Environment & Heritage. Search criteria: Public Report of all Valid Records of Threatened (listed on TSC Act 1995) Animals and Plants in selected area [North: -34.79 West: 150.46 East: 150.68 South: -34.97] returned a total of 1,623 records of 66 species. Report generated on 31/05/2012 12:56 PM. 	

Status	Scientific Name	Common Name	Records	Relevance
PLANTS				
Delleniaceae				
E1	<i>Hibbertia</i> sp. Nov. ‘Menai’		1	N
Euphorbiaceae				
E4	<i>Amperea xiphioclada</i> var. <i>pedicellata</i>		1	N
Fabaceae (Mimosoideae)				
E1	<i>Acacia bynoeana</i>	Bynoe's Wattle	1	N
V	<i>Acacia pubescens</i>	Downy Wattle	1	N
Myrtaceae				
V	<i>Eucalyptus langleyi</i>	Albatross Mallee	23	N
E2	<i>Eucalyptus langleyi</i>		6	N
V	<i>Eucalyptus sturgissiana</i>	Ettrema Mallee	1	N
V	<i>Melaleuca deanei</i>	Deane's Paperbark	2	N
E1	<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	1	N
E1	<i>Triplarina nowraensis</i>	Nowra Heath Myrtle	324	H
Orchidaceae				
V	^ <i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	4	N

Status	Scientific Name	Common Name	Records	Relevance
V	<i>Genoplesium baueri</i>	Bauer's Midge Orchid	9	N
E1	<i>Pterostylis gibbosa</i>	Illawarra Greenhood	76	N
E4A	<i>Pterostylis vernalis</i>		16	N
	Rubiaceae			
E1	<i>Galium australe</i>	Tangled Bedstraw	2	N
	Rutaceae			
E1	<i>Zieria baeuerlenii</i>	Bomaderry Zieria	16	N
V	<i>Zieria tuberculata</i>	Warty Zieria	2	N
	Solanaceae			
E1	<i>Solanum celatum</i>		8	N
AMPHIBIANS				
	Myobatrachidae			
V	<i>Heleioporus australiacus</i>	Giant Burrowing Frog	6	L/N
	Hylidae			
E1	<i>Litoria aurea</i>	Green & Golden Bell Frog	153	L/N
REPTILES				
	Cheloniidae			
V	<i>Chelonia mydas</i>	Green Turtle	2	N
	Varinidae			
V	<i>Varanus rosenbergi</i>	Rosenberg's Goanna	1	N
	Elapidae			
E1	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	8	N
BIRDS				
	Anatidae			
V	<i>Stictonetta naevosa</i>	Freckled Duck	1	N
	Ardeidae			
E1	<i>Botaurus poiciloptilus</i>	Australasian Bittern	2	N
V	<i>Ixobrychus flavicollis</i>	Black Bittern	4	N
	Acanthizidae			
E1	<i>Calamanthus fuliginosus</i>	Striated Fairy-wren	1	N
	Accipitridae			
V	<i>Lophoictinia isura</i>	Square-tailed Kite	24	L
V	<i>Pandion haliaetus</i>	Osprey	2	N
V	<i>Circus assimilis</i>	Spotted Harrier	1	N
V	<i>Hieraaetus morphnoides</i>	Little Eagle	2	N
V	<i>Pandion cristatus</i>	Eastern Osprey	2	N
	Burhinidae			
E1	<i>Burhinus grallarius</i>	Bush Stone-curlew	3	L/N
	Charadriidae			
E4A	<i>Thinornis rubricollis</i>	Hooded Plover	1	N

Status	Scientific Name	Common Name	Records	Relevance
Cacatuidae				
V	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	24	M
V	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	300	H
Psittacidae				
V	<i>Neophema pulchella</i>	Turquoise Parrot	6	L/N
V	<i>Glossopsitta pusilla</i>	Little Lorikeet	6	L/N
Strigidae				
V	<i>Ninox connivens</i>	Barking Owl	1	L/N
V	<i>Ninox strenua</i>	Powerful Owl	29	L
Tytonidae				
V	<i>Tyto novaehollandiae</i>	Masked Owl	7	L/N
V	<i>Tyto tenebricosa</i>	Sooty Owl	11	N
Meliphagidae				
E4A	<i>Anthochaera phrygia</i>	Regent Honeyeater	1	L/N
V	<i>Epthianura albifrons</i>	White-fronted Chat	3	N
Neosittidae				
V	<i>Daphoenositta chrysoptera</i>	Varied Sittella	15	N
Petroicidae				
V	<i>Petroica boodang</i>	Scarlet Robin	10	L/N
V	<i>Petroica boodang</i>	Flame Robin	1	L/N
V	<i>Petroica rodinogaster</i>	Pink Robin	1	L/N
MAMMALS				
Dasyuridae				
V	<i>Dasyurus maculatus</i>	Tiger Quoll	21	N
V	<i>Sminthopsis leucopus</i>	White-footed Dunnart	2	N
Peramelidae				
E1	<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot	1	N
Phascolarctidae				
V	<i>Phascolarctos cinereus</i>	Koala	4	N
Burramyidae				
V	<i>Cercartetus nanus</i>	Eastern Pygmy Possum	4	L/N
Petauridae				
V	<i>Petaurus australis</i>	Yellow-bellied Glider	356	H
Potoroidae				
V	<i>Potorous tridactylus</i>	Long-nosed Potoroo	1	N
Macropodidae				
V	<i>Macropus parma</i>	Parma Wallaby	1	N
E1	<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby	8	N
Pteropodidae				
V	<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	58	L
Emballonuridae				
V	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	5	M

Status	Scientific Name	Common Name	Records	Relevance
	Molossidae			
✓	<i>Mormopterus norfolkensis</i>	Eastern Free-tail Bat	5	M
	Vespertilionidae			
✓	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	4	M
✓	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	3	M
	<i>Miniopterus schreibersii</i>	Eastern Bent-wing Bat	12	M
✓	<i>oceanensis</i>			
✓	<i>Myotis macropus</i>	Southern Myotis	2	L/N
✓	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	8	M
	Otariidae			
✓	<i>Arctocephalus pusillus doriferus</i>	Australian Fur-seal	1	N



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Appendix D
EPBC Act Search within 10km of the Subject Site

November 2012

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

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[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	1
Threatened Species:	45
Migratory Species:	41

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

Commonwealth Lands:	10
Commonwealth Heritage Places:	1
Listed Marine Species:	42
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	20
State and Territory Reserves:	9
Regional Forest Agreements:	1
Invasive Species:	19
Nationally Important Wetlands:	1

Details

Matters of National Environmental Significance

Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area

Threatened Species		[Resource Information
Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Fairy Tern (Australian) [82950]	Vulnerable	Species or species habitat known to occur within area
FISH		
Epinephelus daemeli Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
FROGS		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
MAMMALS		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Isodon obesulus obesulus Southern Brown Bandicoot (Eastern) [68050]	Endangered	Species or species habitat known to occur

Appendix D EPBC Act Protected Matters Search

Name	Status	Type of Presence
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	within area Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus Konoom, Smoky Mouse [88]	Endangered	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
PLANTS		
Asterolasia elegans [56780]	Endangered	Species or species habitat may occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Eucalyptus langleyi Albatross Mallee [56224]	Vulnerable	Species or species habitat likely to occur within area
Genoplesium vernale East Lynne Midge-orchid [68379]	Vulnerable	Species or species habitat may occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat likely to occur within area
Pimelea spicata [20834]	Endangered	Species or species habitat may occur within area
Prasophyllum affine Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid [2210]	Endangered	Species or species habitat may occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat known to occur within area
Pterostylis pulchella Pretty Greenhood [6448]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis sp. Flat Rock Creek (D.L.Jones 15873 & K.J.Fitzgerald) Spring Tiny Greenhood [81967]	Critically Endangered	Species or species habitat known to occur

Appendix D EPBC Act Protected Matters Search

Name	Status	Type of Presence
Rhizanthella slateri		within area
Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Thelymitra sp. Kangaloon (D.L.Jones 18108)		
Kangaloon Sun-orchid [81971]	Critically Endangered	Species or species habitat may occur within area
Thesium australe		
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Triplarina nowraensis		
Nowra Heath-myrtle [64544]	Endangered	Species or species habitat known to occur within area
Zieria baeuerlenii		
Bomaderry Zieria, Bomaderry Creek Zieria [56781]	Endangered	Species or species habitat likely to occur within area
REPTILES		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hoplocephalus bungaroides		
Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Migratory Species		[Resource Information
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Marine Species		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Appendix D EPBC Act Protected Matters Search

Name	Threatened	Type of Presence
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Breeding may occur within area
Xanthomyza phrygia Regent Honeyeater [430]	Endangered*	Species or species habitat likely to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat known to occur within area

Appendix D EPBC Act Protected Matters Search

Name	Threatened	Type of Presence
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]		Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew [847]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name

Commonwealth Land -
 Commonwealth Land - Australian Postal Commission
 Commonwealth Land - Australian Postal Corporation
 Commonwealth Land - Australian Telecommunications Commission
 Commonwealth Land - Defence Housing Authority
 Commonwealth Land - Defence Service Homes Corporation
 Defence - DCO NOWRA
 Defence - HMAS ALBATROSS
 Defence - Shop 3
 Defence - Suite 18, Holt Centre

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Bundanon Trust Area	NSW	Nominated place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba		
Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]		Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris		
Great Knot [862]		Species or species habitat known to occur within area

Appendix D EPBC Act Protected Matters Search

Name	Threatened	Type of Presence
Charadrius bicinctus Double-banded Plover [895]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]		Species or species

Name	Threatened	Type of Presence
Numenius phaeopus Whimbrel [849]		habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Breeding may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area

Extra Information

Places on the RNE		[Resource Information]
Note that not all Indigenous sites may be listed.		
Name	State	Status
Natural		
Bundanon Commonwealth Land Area	NSW	Indicative Place
Bomaderry Creek Gorge	NSW	Registered
Bomaderry Creek Zieria Baeuerlenii Site	NSW	Registered
Bomaderry Creek Zieria Baeuerlenii Site 2	NSW	Registered
Cambewarra Mountain Area	NSW	Registered
Jervis Bay and Surrounds	NSW	Registered
Indigenous		

Name	State	Status
Hidden Valley Painted Shelter	NSW	Registered
Historic		
Berry District	NSW	Indicative Place
Bomaderry Public School (1893 building)	NSW	Indicative Place
Kangaroo Valley	NSW	Indicative Place
Mill Bank House and associated buildings	NSW	Indicative Place
Nowra Soldiers Memorial	NSW	Indicative Place
Nowra South African War Memorial	NSW	Indicative Place
Parma Farm and outbuildings	NSW	Indicative Place
Bundanon Including Landscape	NSW	Registered
Meroogal	NSW	Registered
Nowra Post Office (former)	NSW	Registered
Nowra Road Bridge	NSW	Registered
Plunket Street Precinct	NSW	Registered
Shoalhaven Historical Society Museum	NSW	Registered
State and Territory Reserves		[Resource Information]
Name	State	
Bamarang	NSW	
Bomaderry Creek	NSW	
Brundee Swamp	NSW	
Cambewarra Range	NSW	
Colymea	NSW	
Tapitallee	NSW	
Triplarina	NSW	
Wogamia	NSW	
Worrigea	NSW	
Regional Forest Agreements		[Resource Information]
Note that all areas with completed RFAs have been included.		
Name	State	
Southern RFA	New South Wales	
Invasive Species		[Resource Information]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit,		
Name	Status	Type of Presence
Mammals		
Capra hircus		
Goat [2]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides		
Alligator Weed [11620]		Species or species habitat likely to occur within area
Asparagus asparagoides		
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171] Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area Species or species habitat may occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area
Nationally Important Wetlands		[Resource Information]
Name		State
Shoalhaven/Crookhaven Estuary		NSW

Coordinates

-34.88092 150.57482

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Appendix D EPBC Act Protected Matters Search

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [State Forests of NSW](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.



global environmental solutions

Lot 3 in DP 568613 and Lot 384 in DP 755952
George Evans Road, Mundamia

Proposed Residential Estate

Flora & Fauna Issues & Assessment Report

Appendix E
Flora Species List

November 2012

Table A1 Floristic data for the subject site at Mundamia

KEY	
* Exotic species	
E Endangered Species	
3RCa ROTAP	
2RC ROTAP	
2K ROTAP	
BES - (BES 2004) records	
Q1-5 Systematic quadrat	
Cover abundance	
Braun-Blanquet	Score
<5% uncommon	1
<5% common	2
5-25%	3
25-50%	4
50-75%	5
75-100%	6

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	LYCOPSIDA							
	Lycopodiaceae							
	<i>Lycopodium deuterodensum</i>	Bushy Clubmoss	x					
	FILICOPSIDA							
	Adiantaceae							
	<i>Adiantum aethiopicum</i>	Common Maidenhair	x					
	<i>Cheilanthes sieberi subsp. sieberi</i>	Mulga fern	x				1	
	<i>Pellaea falcata var. falcata</i>	Sickle Fern	x					
	Aspleniaceae							
	<i>Asplenium flabellifolium</i>	Necklace Fern	x					
	Cyatheaceae							
	<i>Cyathea australis</i>	Rough Treefern	x			1		
	Davalliaceae							
	<i>Davallia pyxidata</i>	Hare's Foot Fern	x					
	Dennstaedtiaceae							
	<i>Pteridium esculentum</i>	Bracken	x	1	1	3	2	

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	Dicksoniaceae							
	<i>Calochlaena dubia</i>	Dicksoniaceae	x			2		
	Gleicheniaceae							
	<i>Gleichenia dicarpa</i>	Pouched Coral Fern	x					
	Lindsaeaceae							
	<i>Lindsaea linearis</i>	Screw Fern	x				1	
	<i>Lindsaea microphylla</i>	Lacy Wedge Fern	x					
	Polypodiaceae							
	<i>Pyrrosia rupestris</i>	Rock Felt Fern	x					
	CYCADOPSIDA							
	Zamiaceae							
	<i>Macrozamia communis</i>	Burrawang	x					
	CONIFEROPSIDA							
	Callitrichaceae							
*	<i>Callitris sp.</i>	Cypress Pine	x					
	MAGNOLIOPSIDA:DICOTYLEDONS							
	Acanthaceae							
	<i>Brunoniella australis</i>	Blue Trumpet	x					
	<i>Brunoniella pumilio</i>	Dwarf Blue Trumpet	x		1			
*	<i>Thunbergia alata</i>	Black-eyed Susan	x					
	Amaranthaceae							
*	<i>Amaranthus viridis</i>	Green Amaranth	x					
	Apiaceae							
	<i>Actinotus helianthi</i>	Flannel Flower	x					
	<i>Centella asiatica</i>	Pennywort	x		1	2		
	<i>Hydrocotyle peduncularis</i>	-	x			2		
	<i>Platysace linearifolia</i>	Narrow-leafed Platysace	x	1			2	
	<i>Xanthosia tridentata</i>	Rock Xanthosia	x					
	Apocynaceae							
*	<i>Araujia sericifera</i>	Moth Vine	x					
	<i>Parsonsia straminea</i>	Common Silkpod	x			2		
	Asteraceae							
*	<i>Ageratina adenophora</i>	Crofton Weed	x			2		
*	<i>Bidens pilosa</i>	Cobbler's Pegs	x					

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	<i>Brachycome spathulata</i>	-	x					
*	<i>Cirsium vulgare</i>	Spear Thistle	x					
*	<i>Conyza sp.</i>	A Fleabane	x					
*	<i>Conyza sumatrensis</i>	Tall fleabane			1	1		
	<i>Euchiton involucratus</i>		x					
	<i>Helichrysum collinum</i>	A Paper-dasiy	x	1				
*	<i>Hypochaeris radicata</i>	Catsear	x					
	<i>Ozothamnus diosmifolius</i>	Everlasting	x					
	<i>Senecio hispidulus</i> var. <i>hispidulus</i>	A Groundsel	x					
	<i>Senecio linearifolius</i>	Fireweed Groundsel	x			2		
*	<i>Senecio madagascariensis</i>	Fireweed	x		1			
	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	Indian Weed	x					
*	<i>Taraxacum officinale</i>	Dandelion	x	1				
	Baueraceae							
	<i>Bauera rubioides</i>	Dog Rose	x	1				
	Campanulaceae							
	<i>Wahlenbergia gracilis</i>	Sprawling or Australian Bluebell	x		1			
	Casuarinaceae							
	<i>Allocasuarina distyla</i>	-	x					
	<i>Allocasuarina littoralis</i>	Black Sheoak	x	3	2		3	1
	Chenopodiaceae							
*	<i>Chenopodium album</i>	Fat Hen	x					
	Clusiaceae							
	<i>Hypericum gramineum</i>	Small St John's Wort	x	1				1
	Convolvulaceae							
	<i>Dichondra repens</i>	Kidney Weed	x			1		
	Crassulaceae							
*	<i>Crassula multicava</i>	A Stonecrop	x					
	<i>Crassula sieberiana</i>	Austral Stonecrop	x					
	Cunoniaceae							
	<i>Ceratopetalum gummiiferum</i>	NSW Christmas Bush	x					
	Dilleniaceae							
	<i>Hibbertia monogyna</i>	-	x					
	<i>Hibbertia obtusifolia</i>	-	x					
	<i>Hibbertia scandens</i>	Climbing Guinea Flower				2		

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	<i>Hibbertia sp. aff. riparia</i>	A Guinea-flower	x					
	Droseraceae							
	<i>Drosera peltata</i>	Pygmy Sundew	x	1				2
	Elaeocarpaceae							
	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	x					
	Epacridaceae							
	<i>Epacris microphylla</i>	-	x			1		2
	<i>Epacris pulchella</i>	NSW Coral Heath	x					
	<i>Leucopogon ericoides</i>	-	x				2	
	<i>Leucopogon juniperinus</i>	Prickly Beard-heath	x	1				
	<i>Leucopogon lanceolatus</i>	Lance Beard-heath	x					
	<i>Leucopogon lanceolatus var. lanceolatus</i>	Lance Beard-heath		2				2
	<i>Leucopogon microphyllus</i>	-	x					1
	<i>Leucopogon virgatus</i>	A Beard-heath	x					
	<i>Lissanthe strigosa subsp. strigosa</i>	Peach Heath	x					
	<i>Monotoca scoparia</i>	-	x				1	
	Euphorbiaceae							
	<i>Glochidion ferdinandi var. ferdinandi</i>	Cheese Tree	x			1		
	<i>Homalanthus populifolius</i>	Bleeding Heart				1		
	<i>Phyllanthus hirtellus</i>	-	x	2	1		2	
	<i>Ricinocarpos pinifolius</i>	Wedding Bush					1	
	Fabaceae (Caesalpinioideae)							
	<i>Senna odorata</i>	Southern Cassia	x					
	Fabaceae (Faboideae)							
	<i>Aotus ericoides</i>	Aotus	x					1
	<i>Bossiaea ensata</i>	-	x					
	<i>Bossiaea heterophylla</i>	Variable Bossiaea	x					
	<i>Bossiaea obcordata</i>	Spiny Bossiaea	x				2	
	<i>Bossiaea scolopendria</i>	-	x				2	
	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	x		1		1	
	<i>Dillwynia ramosissima</i>	Bushy Parrot-pea	x	1				2
	<i>Dillwynia retorta ssp. retorta</i>	Eggs and Bacon	x	1				2
	<i>Dillwynia rudis</i>	Eggs and Bacon	x					
	<i>Dillwynia sp. 'trichopoda'</i>	Eggs and Bacon	x					
	<i>Glycine clandestina</i>	-	x	2	2			
	<i>Glycine tabacina</i>	-		2				
	<i>Gompholobium grandiflorum</i>	Large Wedge Pea	x				1	
	<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea	x					

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
3RCa	<i>Hardenbergia violacea</i>	False Sarsaparilla	x				1	
	<i>Hovea linearis</i>	Narrow-leaved Hovea	x				1	
	<i>Mirbelia rubiifolia</i>	-	x					2
	<i>Phyllota phyllicoides</i>	Heath Phyllota	x					
	<i>Platylobium formosum</i>	Handsome Flat-pea	x	1			2	
	<i>Pultenaea daphnoides</i>	Large-leaf Bush-pea	x	1	1			
	<i>Pultenaea elliptica</i>	-	x					
	<i>Pultenaea retusa</i>	-	x					
	<i>Viminaria juncea</i>	Native Broom	x					1
	Fabaceae (Mimosoideae)							
	<i>Acacia baileyana</i>	Cootamundra Wattle	x					
	<i>Acacia binervata</i>	Two-veined Hickory	x					
	<i>Acacia elongata</i>	Swamp Wattle	x					
	<i>Acacia falcata</i>	-	x					
	<i>Acacia hispidula</i>	-	x					
	<i>Acacia implexa</i>	Hickory Wattle	x				1	
	<i>Acacia irrorata subsp. irrorata</i>	Green Wattle	x					
	<i>Acacia longifolia subsp. longifolia</i>	Sydney Golden Wattle	x	1	1	2		
	<i>Acacia mearnsii</i>	Black Wattle	x					
	<i>Acacia myrtifolia</i>	Red-stemmed Wattle	x					
	<i>Acacia obtusifolia</i>	-	x					
	<i>Acacia parramattensis</i>	Parramatta Wattle	x					
	<i>Acacia stricta</i>	Straight Wattle	x					
	<i>Acacia suaveolens</i>	Sweet Wattle	x					
*	<i>Acacia subtilinervis</i>	-	x					1
	<i>Acacia terminalis</i>	Sunshine Wattle	x				1	
	<i>Acacia ulicifolia</i>	Prickly Moses	x	1	1		2	
	Gentianaceae							
	<i>Centaurium tenuiflorum</i>	-	x					
	Goodeniaceae							
	<i>Goodenia hederacea subsp. hederacea</i>	Ivy Goodenia	x				1	
	<i>Goodenia heterophylla subsp. eglandulosa</i>	Variable-leaved Goodenia	x	1				
	<i>Goodenia paniculata</i>	-	x			1		
	<i>Scaevola ramosissima</i>	Purple Fan-flower	x					
	Haloragaceae							
	<i>Gonocarpus micranthus subsp. ramosissimus</i>	-			3	2		
	<i>Gonocarpus tetragynus</i>	-	x					
	<i>Gonocarpus teucrioides</i>	Raspwort	x	2				2

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
*	Lamiaceae							
	<i>Chloanthes stoechadis</i>	Common Chloanthes	x					
	<i>Plectranthus graveolens</i>	Netted Cockspur Flower	x					
	<i>Prostanthera incana</i>	Velvet Mint-bush	x					
	Lauraceae							
	<i>Cassytha glabella</i>	Slender Devil's Twine	x					
	<i>Cassytha pubescens</i>	Common Devil's Twine	x	2				
	<i>Cinnamomum camphora</i>	Camphor Laurel	x					
	Lobeliaceae							
	<i>Lobelia alata</i>	Angled Lobelia	x					
	<i>Pratia purpurascens</i>	Whiteroot	x					
	Loganiaceae							
	<i>Mitrasacme polymorpha</i>	-	x					
	Meliaceae							
	<i>Melia azedarach</i>	Meliaceae	x					
	<i>Synoum glandulosum subsp. glandulosum</i>	Scentless Rosewood				1		
	Moraceae							
	<i>Ficus rubiginosa</i>	Port Jackson Fig	x					
	Myrsinaceae							
	<i>Anagallis arvensis</i>	Scarlet/Blue Pimpernel	x					
	Myrtaceae							
	<i>Angophora hispida</i>	Dwarf Apple	x					
	<i>Backhousia myrtifolia</i>	Grey Myrtle	x					
	<i>Baeckea brevifolia</i>	Heath-myrtle	x					1
	<i>Baeckea diosmifolia</i>	-	x					
	<i>Callistemon rigidus</i>	Stiff Bottlebrush	x					3
	<i>Calytrix tetragona</i>	Fringe Myrtle	x					1
	<i>Corymbia gummifera</i>	Red Bloodwood	x	2			3	
	<i>Corymbia maculata</i>	Spotted Gum	x		5			
	<i>Eucalyptus agglomerata</i>	Blue-leaved Stringybark	x	3			4	
	<i>Eucalyptus globoidea</i>	White Stringybark	x					
	<i>Eucalyptus imitans</i>	A Stringybark	x					
	<i>Eucalyptus pilularis</i>	Blackbutt	x				3	
	<i>Eucalyptus punctata</i>	Grey Gum	x	4	3		3	3
	<i>Eucalyptus sclerophylla</i>	Hard-leaved Scribbly Gum	x					
	<i>Eucalyptus sieberi</i>	Silvertop Ash	x					
	<i>Kunzea ambigua</i>	Tick Bush	x	4	1		2	5

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
2RC-	<i>Leptospermum continentale</i>	Prickly Teatree	x			3		
	<i>Leptospermum epacridoideum</i>	Jervis Bay Tea Tree	x					2
	<i>Leptospermum morrisonii</i>	Morrison's Tea-tree	x			1		
	<i>Leptospermum parvifolium</i>	Slender Tea-tree	x					
	<i>Leptospermum polygalifolium</i>	Lemon-scented Tea Tree	x			1		
	<i>Leptospermum rotundifolium</i>	Round-leaf Tea-tree	x					
2K	<i>Leptospermum sejunctum</i>	Nowra Tea-tree	x					2
	<i>Leptospermum trinervium</i>	Slender Tea-tree	x				2	1
	<i>Melaleuca hypericifolia</i>	Hillock bush	x					
	<i>Melaleuca linariifolia</i>	Snow-in-Summer	x		1	5		
	<i>Melaleuca thymifolia</i>	-	x					2
	<i>Micromyrtus ciliata</i>	Fringed Heath-myrtle	x					
E	<i>Syncarpia glomulifera</i>	Turpentine	x					
	<i>Triplarina nowraensis</i>	Nowra Heath Myrtle	x	3	4	2		1
	Oleaceae							
	<i>Notelaea longifolia</i>	Large Mock-olive				1		
	<i>Notelaea venosa</i>	Mock Olive	x		1			
	Passifloraceae							
*	<i>Passiflora herbertiana</i> subsp. <i>herbertiana</i>	-	x					
	Phormiaceae							
	<i>Dianella caerulea</i>	Blue Flax lily	x					
	<i>Dianella caerulea</i> var. <i>producta</i>	Blue Flax lily	x		1			
	Phytolaccaceae							
	<i>Phytolacca octandra</i>	Inkweed	x					
	Pittosporaceae							
	<i>Billardiera scandens</i>	Appleberry	x	1		1		
	<i>Bursaria spinosa</i> var. <i>spinosa</i>	Native Blackthorn	x					
	<i>Pittosporum revolutum</i>	Rough Fruit Pittosporum	x					
	<i>Pittosporum undulatum</i>	Sweet Pittosporum	x		1			
	Plantaginaceae							
*	<i>Plantago lanceolata</i>	Lamb's Tongues	x					
	Polygalaceae							
	<i>Comesperma ericinum</i>	Matchheads	x				1	
	<i>Comesperma volubile</i>	-	x					
	Proteaceae							
	<i>Banksia paludosa</i>	-	x					

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	<i>Banksia serrata</i>	Old-man Banksia	x				3	
	<i>Banksia spinulosa</i>	Hairpin Banksia	x	3	1		2	2
	<i>Conospermum longifolium subsp. longifolium</i>	-	x					
	<i>Hakea dactyloides</i>	Broad-leaved Hakea	x					1
	<i>Hakea salicifolia</i>	Willow-leaved Hakea	x					
	<i>Hakea sericea</i>	Needlebush	x	1			2	
	<i>Hakea teretifolia</i>	Dagger Hakea	x				2	
	<i>Isopogon anemonifolius</i>	Broad-leaf Drumsticks	x					
	<i>Isopogon anethifolius</i>	-	x					
	<i>Lambertia formosa</i>	Mountain Devil	x				1	
	<i>Lomatia ilicifolia</i>	Holly-leaved Lomatia	x					
	<i>Persoonia levis</i>	Broad-leaved Geebung	x				1	1
	<i>Persoonia linearis</i>	Narrow-leaved Geebung	x	2	2		3	2
	<i>Persoonia mollis</i>		x	2			2	
	<i>Petrophile pedunculata</i>	-	x					
	<i>Petrophile pulchella</i>	Conesticks	x				3	
	<i>Telopea speciosissima</i>	Waratah	x	2			2	
	Ranunculaceae							
	<i>Clematis aristata</i>	Old Man's Beard	x					
	Rhamnaceae							
	<i>Pomaderris discolor</i>	-	x					
	<i>Pomaderris intermedia</i>	-	x		1			
	Rubiaceae							
	<i>Morinda jasminoides</i>	Sweet Morinda	x			2		
	<i>Opercularia aspera</i>	Coarse Stinkweed	x					
	<i>Pomax umbellata</i>	Pomax	x	2	2		2	
	Rutaceae							
	<i>Correa reflexa var. reflexa</i>	Native Fuschia	x					
	<i>Crowea exalata</i>	-	x					
	<i>Philotheca scabra subsp. scabra</i>	A wax-flower	x					
	<i>Zieria laevigata var. laxiflora</i>	A zieria	x					
	<i>Zieria pilosa</i>	Hairy Zieria	x					
	<i>Zieria smithii</i>	Sandfly Zieria	x					
	Santalaceae							
	<i>Exocarpos strictus</i>	Dwarf Cherry	x					
	<i>Leptomeria acida</i>	Sour Currant Bush	x				2	1
	Sapindaceae							
	<i>Dodonaea triquetra</i>	Large-leaf Hop-bush	x	1				

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	Scrophulariaceae							
	<i>Veronica plebeia</i>	Trailing Speedwell	x		1		1	
	Selaginellaceae							
	<i>Selaginella uliginosa</i>	Swamp Selaginella	x			1		
	Solanaceae							
*	<i>Solanum nigrum</i>	Black-berry Nightshade	x					
	<i>Solanum pungetium</i>	Eastern Nightshade	x					
	Sterculiaceae							
	<i>Lasiopetalum ferrugineum</i> var. <i>ferrugineum</i>	Rusty Petals	x	1				
	Stylidiaceae							
	<i>Stylidium graminifolium</i>	Grass Triggerplant	x		1		1	
	<i>Stylidium laricifolium</i>	Giant Triggerplant	x				1	
	Thymelaeaceae							
	<i>Pimelea linifolia</i>	Slender Rice-flower	x	2	2			1
	Verbenaceae							
*	<i>Lantana camara</i>	Lantana	x			2		
*	<i>Verbena</i> sp.	A purpletop	x					
	Violaceae							
	<i>Viola hederacea</i>	Ivy-leaved Violet				2		
	MAGNOLIOPSIDA: MONOCOTYLEDONS							
	Anthericaceae							
	<i>Caesia parviflora</i> var. <i>parviflora</i>	-	x					
*	<i>Chlorophytum comosum</i>	Spider Plant	x					
	<i>Laxmannia gracilis</i>	Slender Wire Lily	x	1				
	<i>Thysanotus tuberosus</i>	Common Fringe-lily	x					
	Commelinaceae							
	<i>Commelina cyanea</i>	Native Wandering Jew	x		1	1		
	Cyperaceae							
	<i>Caustis flexuosa</i>	Curly Wig	x					
	<i>Cyperus polystachyos</i>	A Sedge	x					
	<i>Eleocharis</i> sp.	-	x					
	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	x					
	<i>Gahnia aspera</i>	Rough Saw-sedge	x		1			

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	<i>Gahnia clarkei</i>	Tall Saw-sedge	x			4		
	<i>Gahnia radula</i>	A Saw-sedge	x					
	<i>Lepidosperma concavum</i>	A sword-sedge	x					
	<i>Lepidosperma laterale</i>	Variable Sword-sedge	x	2	2		2	
	<i>Lepidosperma sp.</i>	-	x					
	<i>Ptilothrix deusta</i>	-	x		2			1
	<i>Schoenus apogon</i>	Fluke Bogrush			4	2		2
	<i>Schoenus imberbis</i>	Beardless Bog-rush	x					1
	Haemodoraceae							
	<i>Haemodorum corymbosum</i>	Blood Root	x					
	Hypoxidaceae							
	<i>Hypoxis hygrometrica</i>	Golden Weather-grass	x					
	Iridaceae							
	<i>Patersonia glabrata</i>	Leafy Purple-flag	x					
	<i>Patersonia sericea</i>	Silky Purple-Flag	x	2	1		2	
	Lomandraceae							
	<i>Lomandra confertifolia subsp. rubiginosa</i>	A mat-rush	x	2	2			
	<i>Lomandra glauca subsp. glauca</i>	Pale Mat-rush	x				2	2
	<i>Lomandra gracilis</i>	-					1	
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	x	3	3	1		
	<i>Lomandra multiflora</i>	Many-flowered Mat-rush	x	2			2	2
	<i>Lomandra obliqua</i>	Fish Bones	x				2	
	Luzuriagaceae							
	<i>Eustrephus latifolius</i>	Wombat Berry	x					
	Orchidaceae							
	<i>Caladenia alata</i>	-		1				
	<i>Cryptostylis</i> Sp. (Leaf only)	A Tongue Orchid			1			
	<i>Cryptostylis subulata</i>	Large Tongue Orchid	x					
	<i>Cymbidium suave</i>	Snake Orchid	x					
	<i>Dendrobium speciosum</i>	Rock Lily	x					
	<i>Diuris sulphurea</i>	Hornet Orchid		1	1			
	<i>Spiranthes australis</i>	Austral Ladies Tresses	x					
	Poaceae							
*	<i>Andropogon virginicus</i>	Whisky Grass					1	
	<i>Anisopogon avenaceus</i>	Oat Speargrass	x					1
	<i>Aristida sp.</i>	A Threeawn Speargrass	x					
	<i>Aristida vagans</i>	Threeawn Speargrass	x	2			2	2

Status	Scientific Name	Common Name	BES	Q1	Q2	Q3	Q4	Q5
	<i>Austrodanthonia tenuior</i>	-	x				1	
	<i>Austrostipa pubescens</i>	Tall Speargrass					2	
*	<i>Briza maxima</i>	Quaking Grass	x					
*	<i>Bromus cartharticus</i>	Prairie Grass	x					
*	<i>Cortaderia selloana</i>	Pampas Grass	x					
	<i>Cymbopogon refractus</i>	Barbed Wire Grass	x					
	<i>Cynodon dactylon</i>	Common Couch				3		
	<i>Deyeuxia quadrisetia</i>	Reed Bent Grass	x					
	<i>Digitaria parviflora</i>	Small-flowered Finger Grass		1		1	1	
	<i>Digitaria sp.</i>	A Fingergrass	x					
	<i>Echinopogon caespitosus var. caespitosus</i>	Tufted Hedgehog Grass	x	2				
*	<i>Ehrharta erecta</i>	Panic Veldtgrass	x					
	<i>Entolasia marginata</i>	Bordered Panic	x	1	2	2		
	<i>Entolasia stricta</i>	Wiry Panic	x	3	2	2	2	2
	<i>Eragrostis benthamii</i>	-					1	
	<i>Eragrostis brownii</i>	Brown's Lovegrass	x	1			2	2
	<i>Eragrostis leptostachya</i>	Paddock Lovegrass		2				
	<i>Imperata cylindrica var. major</i>	Blady Grass	x	2	2	2		
	<i>Microlaena stipoides var. stipoides</i>	-	x	2	2			
	<i>Oplismenus aemulus</i>	-	x			3		
	<i>Panicum simile</i>	Two-colour Panic		2	1		2	
	<i>Panicum sp.</i>	-	x					
*	<i>Paspalum dilatatum</i>	Paspalum	x					
*	<i>Paspalum urvillei</i>	Vasey Grass	x					
*	<i>Pennisetum clandestinum</i>	Kikuyu Grass	x					
*	<i>Setaria geniculata</i>	Slender Pigeon Grass	x					
	<i>Themeda australis</i>	Kangaroo Grass	x	2			1	
Restionaceae								
	<i>Leptocarpus tenax</i>	-	x					
	<i>Lepyrodia scariosa</i>	Scale Rush	x					3
Smilacaceae								
	<i>Smilax glycyphylla</i>	Sweet Sarsparilla	x					
Xanthorrhoeaceae								
	<i>Xanthorrhoea resinosa subsp. resinosa</i>	A Grasstree	x				2	



global environmental solutions

Lot 3 in DP 568613 and Lot 384 in DP 755952
George Evans Road, Mundamia

Proposed Residential Estate

Flora & Fauna Issues & Assessment Report

Appendix F
Fauna Species List

November 2012

Key:

Legal Status:

TSC Act = NSW *Threatened Species Conservation Act, 1995*

EPBC Act = Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*

V = Vulnerable; M = Migratory

Taxonomy:

Non-flying Mammals – Ronald Strahan (1995) "*Mammals of Australia*"

Bats – Sue Churchill (1998) "*Australian Bats*"

Amphibians – Martin Robinson (1998) "*A Field Guide to Frogs*"

Birds – Les Christidis and Walter Boles (2008) "*Systematics and Taxonomy of Australian Birds*"

Family	Scientific Name	Common Name	Legal Status			Survey	
			Introduced	TSC Act	EPBC Act	BES 2004	InSites 2008
Amphibians							
Hylidae	<i>Litoria dentata</i>	Bleating Tree Frog				x	
	<i>Litoria peronii</i>	Peron's Tree Frog				x	x
	<i>Litoria verreauxii</i>	Verreaux's Tree Frog				x	x
Myobatrachidae	<i>Crinia signifera</i>	Common Eastern Froglet				x	x
	<i>Paracrinia haswelli</i>	Haswell's Froglet				x	x
	<i>Limnodynastes peronii</i>	Striped Marsh Frog					x
	<i>Uperoleia tyleri</i>	Tyler's Toadlet				x	x
Reptiles							
Agamidae	<i>Amphibolurus muricatus</i>	Jacky Lizard				x	x
Elapidae	<i>Pseudonaja textilis</i>	Common Brown Snake					x
	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake				x	
Scincidae	<i>Ctenotus taeniolatus</i>	Copper-tailed Skink				x	
	<i>Lampropholis delicata</i>	Garden Skink				x	x
	<i>Lampropholis guichenoti</i>	Grass Skink				x	
Varanidae	<i>Varanus varius</i>	Lace Monitor				x	

Appendix F Fauna Species List

Family	Scientific Name	Common Name	Legal Status			Survey	
			Introduced	TSC Act	EPBC Act	BES 2004	InSites 2008
Avifauna							
Acanthizidae	<i>Gerygone mouki</i>	Brown Gerygone					x
	<i>Acanthiza pusilla</i>	Brown Thornbill				x	x
	<i>Origma solitaria</i>	Rock Warbler				x	x
	<i>Acanthiza lineata</i>	Striated Thornbill				x	x
	<i>Sericornis frontalis</i>	White-browed Scrubwren					x
	<i>Gerygone olivacea</i>	White-throated Gerygone					x
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite		V	M	x	
	<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle			M		x
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				x	x
Alcedinidae	<i>Alcedo azurea</i>	Azure Kingfisher					x
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck			M	x	x
Artamidae	<i>Gymnorhina tibicen</i>	Australian Magpie				x	x
	<i>Artamus cyanopterus</i>	Dusky Woodswallow				x	
	<i>Cracticus torquatus</i>	Grey Butcherbird				x	x
	<i>Strepera graculina</i>	Pied Currawong					x
Cacatuidae	<i>Cacatua roseicapilla</i>	Galah				x	x
	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		V		x	
	<i>Calyptorhynchus lathami</i>	Glossy Black Cockatoo		V		x	x
	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo				x	x
	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black Cockatoo				x	x
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				x	x
Caprimulgidae	<i>Eurostopodus mystacalis</i>	White-throated Nightjar				x	
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing			M	x	x
Cinclosomatidae	<i>Psophodes olivaceus</i>	Eastern Whipbird				x	x
Climacteridae	<i>Cormobates leucophaeus</i>	White-throated Tree-creeper				x	

Appendix F Fauna Species List

Family	Scientific Name	Common Name	Legal Status			Survey	
			Introduced	TSC Act	EPBC Act	BES 2004	InSites 2008
Columbidae	<i>Macropygia amboinensis</i>	Brown Cuckoo-Dove					x
	<i>Phaps chalcoptera</i>	Common Bronze-wing				x	x
	<i>Geopelia striata</i>	Peaceful Dove				x	
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird				x	
Corvidae	<i>Corvus coronoides</i>	Australian Raven				x	x
Cuculidae	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo					x
	<i>Eudynamys scolopacea</i>	Common Koel					x
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird					x
Dicruridae	<i>Rhipidura albiscapa</i>	Grey Fantail				x	x
	<i>Myiagra rubecula</i>	Leaden Flycatcher				x	
	<i>Grallina cyanoleuca</i>	Magpie-lark				x	x
	<i>Rhipidura rufifrons</i>	Rufous Fantail				x	
	<i>Rhipidura leucophrys</i>	Willie Wagtail				x	
Halcyonidae	<i>Dacelo novaeguineae</i>	Kookaburra				x	x
	<i>Todirhamphus sanctus</i>	Sacred Kingfisher				x	
Hirundinidae	<i>Hirundo nigricans</i>	Tree Martin				x	
	<i>Hirundo neoxena</i>	Welcome Swallow					x
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren				x	x
	<i>Malurus lamberti</i>	Variegated Fairy-wren				x	x
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill				x	x
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater				x	x
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater				x	
	<i>Philemon corniculatus</i>	Noisy Friarbird				x	x
	<i>Anthochaera carunculata</i>	Red Wattlebird				x	x
	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater				x	
	<i>Lichenostomus leucotis</i>	White-eared Honeyeater				x	

Appendix F Fauna Species List

Family	Scientific Name	Common Name	Legal Status			Survey	
			Introduced	TSC Act	EPBC Act	BES 2004	InSites 2008
Menuridae	<i>Melithreptus lunatus</i>	White-naped Honeyeater				x	
	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater				x	x
	<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater				x	x
	<i>Menura novaehollandiae</i>	Superb Lyrebird				x	
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole					x
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler					x
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush				x	x
	<i>Pachycephala rufiventris</i>	Rufous Whistler				x	x
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote				x	x
	<i>Pardalotus striatus</i>	Striated Pardalote				x	x
Passeridae	<i>Taeniopygia bichenovii</i>	Double-barred Finch				x	
	<i>Neochmia temporalis</i>	Red-browed Finch				x	
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin					x
	<i>Microeca fascinans</i>	Jacky Winter					x
Psittacidae	<i>Platycercus elegans</i>	Crimson Rosella				x	x
	<i>Platycercus eximius</i>	Eastern Rosella				x	x
	<i>Glossopsitta pusilla</i>	Little Lorikeet				x	
	<i>Glossopsitta concinna</i>	Musk Lorikeet				x	
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet				x	
Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird				x	x
Strigidae	<i>Ninox strenua</i>	Powerful Owl		V		x	
	<i>Ninox novaeseelandiae</i>	Southern Boobook				x	
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye					x
Mammals							
Bovidae	<i>Bos taurus</i>	European Cattle	Domestic			x	
	<i>Ovis aries</i>	Sheep	Domestic				x

Appendix F Fauna Species List

Family	Scientific Name	Common Name	Legal Status			Survey	
			Introduced	TSC Act	EPBC Act	BES 2004	InSites 2008
Canidae	<i>Canis familiaris</i>	Dog	Domestic			x	x
	<i>Vulpes vulpes</i>	Fox	X			x	x
Dasyuridae	<i>Antechinus agilis</i>	Agile Antechinus				x	
Equidae	<i>Equus caballus</i>	Horse	Domestic			x	
Felidae	<i>Felis catus</i>	Cat	Domestic			x	
Leporidae	<i>Lepus capensis</i>	Brown Hare	X			x	
	<i>Oryctolagus cuniculus</i>	Rabbit	X			x	x
Macropodidae	<i>Macropus giganteus giganteus</i>	Eastern Grey Kangaroo				x	x
	<i>Wallabia bicolor</i>	Swamp Wallaby				x	
Molossidae	<i>Mormopterus norfolkensis</i>	East-coast Free-tail Bat		V			x
	<i>Tadarida australis</i>	White-striped Free-tail Bat				x	x
Muridae	<i>Rattus lutreolus</i>	Swamp Rat				x	
Peramelidae	<i>Perameles nasuta nasuta</i>	Long-nosed Bandicoot				x	
Petauridae	<i>Petaurus breviceps breviceps</i>	Sugar Glider				x	x
	<i>Petaurus australis australis</i>	Yellow-bellied Glider		V		x	x
Phalangeridae	<i>Trichosurus vulpecula vulpecula</i>	Common Brushtail Possum				x	
Pseudocheiridae	<i>Pseudocheirus peregrinus peregrinus</i>	Common Ringtail Possum				x	x
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox		V	V	x	
Rhinolophidae	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat				x	x
Vespertilionidae	<i>Miniopterus schreibersii oceanensis</i>	Common Bent-wing Bat		V		x	x
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat				x	x
	<i>Scotorepens orion</i>	Eastern Broad-nosed Bat				x	
	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				x	x
	<i>Vespadelus darlingtoni</i>	Large Forest Bat				x	x
	<i>Vespadelus vulturnus</i>	Little Forest Bat				x	x
	<i>Vespadelus regulus</i>	Southern Forest Bat					x

Appendix F Fauna Species List

Family	Scientific Name	Common Name	Legal Status			Survey	
			Introduced	TSC Act	EPBC Act	BES 2004	InSites 2008
Vombatidae	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat					x
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat					x
	<i>Nyctophilus sp.</i>	Long-eared Bat				x	
	<i>Wombatus ursinus ursinus</i>	Common Wombat					x



global environmental solutions

Lot 3 in DP 568613 and Lot 384 in DP 755952
George Evans Road, Mundamia

Proposed Residential Estate

Flora & Fauna Issues & Assessment Report

Appendix G
Decision of the SEWPaC with respect to the EPBC Act

November 2012



Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Mr Francis Dominic Fanning
Technical Director – Ecology
SLR Consulting Australasia Pty Ltd
PO Box 176
LANE COVE NSW 1595

Date: 26 April 2012
EPBC Ref: 2012/6327
EPBC contact: Mark Jenkins
(02) 6274 1558
mark.jenkins@environment.gov.au

Dear Mr Fanning

Decision on referral

**Residential development - Lot 3 and Lot 384 George Evans Road
Mundamia, NSW**

This is to advise you of my decision, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), about the proposed action to develop a residential subdivision at Lot 3 and Lot 384 George Evans Road, Mundamia, New South Wales.

As a delegate of the Minister for Sustainability, Environment, Water, Population and Communities, I have decided that the proposed action is not a controlled action. This means that the proposed action does not require further assessment and approval under the EPBC Act before it can proceed.

A copy of the document recording this decision is enclosed. This document will be published on the department's website.

Please note that this decision relates only to the specific matters protected under Chapter 2 of the EPBC Act.


This decision does not affect any requirement for separate state or local government environment assessment and approvals of the proposed action.

The department has an active audit program for proposals that have been referred under the EPBC Act. The audit program aims to ensure that proposals are implemented as planned. You should be aware that the project may be selected for audit by the department at any time and all related records and documents may be subject to scrutiny. Information about the department's compliance monitoring and auditing program is enclosed.

I have also written to Mr Richard Ash, Project Manager, Twynam Mundamia Pty Ltd and Mr John Ross, Project Manager, NSW Department of Planning and Infrastructure advising them of this decision.

If you have any questions about the referral process or this decision, please contact the EPBC project manager and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely



Charmayne Murray
Assistant Secretary (acting)
Environment Assessment Branch



**Notification of
REFERRAL DECISION – not controlled action**

**Residential development - Lot 3 and Lot 384 George Evans Road Mundamia,
NSW (EPBC 2012/6327)**

This decision is made under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action

person named in the referral	Twynam Mundamia Pty Ltd (ABN 68 147 695 994)
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proposed action	The proposed action is the development of a residential subdivision at Lot 3 and Lot 384 George Evans Road, Mundamia, New South Wales, as described in the referral documentation received on 26 March 2012 (see EPBC Act referral 2012/6327).
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Referral decision: Not a controlled action

status of proposed action	The proposed action is not a controlled action.
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Person authorised to make decision

Name and position	Charmayne Murray Assistant Secretary (acting) Environment Assessment Branch
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signature

date of decision

24/4/2012



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Lot 3 in DP 568613 and Lot 384 in DP 755952
George Evans Road, Mundamia

Proposed Residential Estate

Flora & Fauna Issues & Assessment Report

Appendix H
Vegetation Management Principles Plan

November 2012

**LOT 3 in DP 568613 and LOT 384 in DP 755952
GEORGE EVANS ROAD, MUNDAMIA
PROPOSED RESIDENTIAL ESTATE**

VEGETATION MANAGEMENT PRINCIPLES PLAN

November 2012

1 INTRODUCTION

- The proposed residential development of the subject site at Mundamia involves the retention of 9.49 hectares of vegetation for conservation purposes running along the northern and eastern boundaries of the proposed sub-division (Figure 1).
- The *Conservation Area* is proposed to be zoned 2E – *Environmental Conservation* as part of the rezoning of the site.
- An variable width *Asset Protection Zone* (APZ), to be managed as an *Inner Protection Area* (IPA) is required along the western boundary of the *Conservation Area*.
- The remainder of the vegetation within the *Conservation Area* will be retained and managed for biodiversity conservation purposes.
- This *Vegetation Management Principles Plan* (VMPP) outlines the structure and general principles of the final *Vegetation Management Plan* (VMP) which will be produced following approval of the Part 3A *Project Application*.
- One threatened flora species Nowra Heath Myrtle *Triplarina nowraensis* is present within the proposed *Conservation Area* (Figure 2), some of which are located within the proposed *Asset Protection Zone* (APZ).
- All individuals of this species within the *Conservation Area* are to be retained and the VMP would provide detailed recommendations on the management of this species, the aim being to protect, conserve and expand the local population.
- Eight threatened fauna species have been recorded within and adjacent to the subject site, and the proposed *Conservation Area* provides the highest quality habitat for these species (the East Coast Free-tail Bat, Common Bent-wing Bat, Grey-headed Flying Fox, Yellow-bellied Glider, Square-tailed Kite, Powerful Owl, Gang Gang Cockatoo and Glossy Black Cockatoo).
- The area of vegetation to be retained within the *Conservation Area* will involve 3 different management regimes:
 - the active management of the APZ within the *Conservation Area*;
 - the active management of the water quality features at the interface between the development footprint and the *Conservation Area*; and
 - management of the remainder of vegetation within the *Conservation Area*.
- The aims of this VMPP are to provide the basic principles to guide the preparation of a detailed VMP with respect to:
 - the management and maintenance of the APZ;
 - management of the population of and habitat for the Nowra Heath Myrtle;
 - the management and maintenance of the water quality features;
 - the implementation of appropriate enhancement measures within areas of retained native vegetation;
 - the maintenance and enhancement of habitat for native fauna; and
 - the monitoring of the *Conservation Area*, APZs, constructed swales and detention areas.

2 GENERAL PROTECTION MEASURES

- Erection of appropriate protection barriers and signage, including temporary fencing and sediment fencing (pursuant to a *Fencing Protocol*).
- Identification by the Project Ecologist of all trees to be removed within the APZ for bushfire protection purposes, avoiding hollow-bearing trees (unless absolutely necessary).
- The identification of individuals of the Nowra Heath Myrtle to ensure their protection during any management activities.
- The provision of sediment fences around all earthworks to protect areas of retained vegetation and/or habitats downslope and downstream.
- The conduct of an environmental induction program for site workers, and the provision of relevant signage around the site.
- Monitoring of works and the provision of a mechanism for the remedy of any disturbance or damage.

3 VEGETATION WITHIN the CONSERVATION AREA

- The overwhelming majority of the *Conservation Area* will be managed to maintain the current biodiversity values.
- Specific activities to be undertaken in this area will include:
 - a dedicated and ongoing weed removal and monitoring program;
 - the removal of debris and rubbish;
 - the identification of areas requiring supplementary plantings, and the implementation of a planting regime if necessary;
 - the implementation of a monitoring program during and immediately post-construction to identify any problems which may arise and to monitor the ongoing condition of vegetation in this area; and,
 - monitoring of the Nowra Heath Myrtle population.
- Given the relatively good condition of most the vegetation communities in the *Conservation Area*, it is considered that any weed management will be minor.
- It is likely that supplementary plantings will not be required throughout the majority of the *Conservation Area*. The only areas where supplementary plantings may be required is potentially along roads and other areas of disturbance.

4 ASSET PROTECTION ZONES

- Management of the *Asset Protection Zones* (APZs) within the *Conservation Area* along the eastern side of the residential subdivision will be undertaken in an environmentally sensitive manner, designed to achieve the requirements of the RFS without compromising the integrity of the vegetation communities or threatened species habitats.
- Any removal of vegetation within the APZs will be the minimum required by the RFS to achieve acceptable bushfire protection outcomes.
- All removal or modification of vegetation within the APZs will be supervised by the Project Ecologist to ensure threatened species habitat is maintained.
- Hollow-bearing trees and Yellow-bellied Glider feed trees will be retained preferentially throughout the APZs under the supervision of the Project Ecologist.
- All removal or thinning of mid-storey and understorey vegetation will be conducted by hand and/or hand tools to limit potential impacts.
- Vegetation removed from APZs will be re-used in other parts of the site.
- The APZs will be monitored and managed to ensure that no weed infestations occur and that the threatened species are not being affected.
- Unless absolutely essential, subject to approval by the Project Ecologist, no hollow-bearing trees will be removed from within the APZ.

5 STORMWATER MANAGEMENT FEATURES

- The landscaping of the bioretention swales and detention basins will be undertaken in consultation with the Project Ecologist to ensure that these structures function both as water management features and as fauna habitat.
- Any changes to the planting schedule must be approved by the Project Ecologist.
- Monitoring of the bioretention swales and detention basins will include:
 - ongoing review of the extent, distribution and composition of weed and native plant species;
 - monitoring of native fauna species utilising the wetlands; and
 - identification of any issues, problems or additional opportunities, and implementation of approved improvements.

6 MAINTENANCE REGIME

- The *Conservation Area* will be subject to an ongoing regime of:
 - monitoring (see below); and
 - 3-monthly management of weeds during construction works.
- The *Asset Protection Zones* will be managed by:
 - the annual hand removal of excess forest debris (<6mm in diameter) and/or lower stratum vegetation to achieve the fuel loads required by the RFS;
 - monitoring (see below);
 - 3-monthly management of weeds during construction works; and
 - annual weed removal as deemed necessary by the monitoring program.

7 MONITORING PROGRAM

- Establishment of photo-monitoring points and fixed survey quadrats (where possible) in the *Conservation Area* and APZ.
- Monitoring of the Nowra Heath Myrtle population.
- Monitoring of construction activities and protection fencing.
- Monitoring of the *Conservation Area* in respect of:
 - native plant species diversity, percentage cover and abundance;
 - weed species diversity, percentage cover and abundance;
 - vertebrate fauna diversity and abundance; and
 - disturbance.
- Monitoring of APZs and stormwater management features (3-monthly during construction), annually thereafter for the life of development activities.
- *Monitoring Reports* to DoP/Council (annually).