

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 clifflines 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