Travers

bushfire & ecology

Ecological Assessment

Proposed
Residential Rezoning
Macquariedale Road
Appin

April 2014
(REF: A13114REP)

Ecological Assessment

Proposed Residential Rezoning
Macquariedale Road, Appin

APRIL 2014

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Date:	30th April 2014
File:	A13114REP

Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person including the client then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be interpreted without reference to the entire report.

The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

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Executive Summary

Travers bushfire & ecology has been engaged by *Walker Corporation* to undertake a flora and fauna assessment for the proposed rezoning of selected lots located off Macquariedale Road, Appin. The report also examines potential mitigation measures to minimise or offset the loss of habitat as a result of the proposed residential zone.

The total parcel of land affected by the proposed rezoning is located immediately west of the existing township. The specific Lot and DP numbers for the proposed rezoning include:

- Lot 201 DP 749272
- Lot 1 DP 209779
- Lot 2 DP 558807
- Lot 1 DP 1000355

Recorded threatened flora, fauna and endangered ecological communities (EECs)

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979 (EP&A Act)*, the *Threatened Species Conservation Act 1995 (TSC Act)*, the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* and the *Fisheries Management Act 1994, (FM Act)*.

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *TSA Act*, eleven (11) threatened fauna species, no threatened flora species, and two (2) endangered ecological communities (EECs) were recorded within the study area.

Threatened fauna species recorded include:

- Powerful Owl (*Ninox strenua*),
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*),
- Gang-gang Cockatoo (*Callocephalon fimbriatum*),
- Varied Sittella (*Daphoenositta chrysoptera*),
- Little Lorikeet (*Glossopsitta pusilla*),
- Grey-headed Flying-fox (*Pteropus poliocephalus*),
- Greater Broad-nosed Bat (*Scoteanax rueppellii*),
- East-coast Freetail Bat (*Micronomus norfolkensis*),
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*),
- Eastern Bentwing-bat (*Miniopterus orianae oceansis*) and
- Cumberland Plain Land Snail (*Meridolum corneovirens*).

Endangered ecological communities recorded include:

- Shale-Sandstone Transition Forest (SSTF)
- Cumberland Plain Woodland (CPW)

In accordance with Section 5A of the *Environmental Planning and Assessment Act 1979*, the 7 part test of significance concluded that the proposed rezoning will likely have a significant impact on CPW and Cumberland Plain Land Snail. This is given that the proposal seeks to

remove all CPW present within the site boundary, and adjoining remnants outside of the site boundary are of low quality and largely persisting as canopy only vegetation. It is concluded that there will be no likely significant impact on any remaining state listed threatened species, populations or the EEC's (including SSTF).

Removal of EEC's will also include removal of all 'preferred' habitats for the Cumberland Plain Land Snail causing a significant impact on Cumberland Plain Land Snail. This assessment conclusion is concurred by snail expert Michael Shea (see Appendix 6).

However, *Travers bushfire & ecology* believes that the existing populations will persist at a reduced size within the proposed conservation areas provided that mitigation measures are implemented and future restoration of CPW in the proposed offsets are likely to see the affected population recover over an extended period of time.

Walker Corporation have commenced the preparation of biodiversity certification assessment documentation for the purposes of seeking biodiversity certification of the planning proposal. In the event that Biodiversity Certification is approved the impact on EEC's and threatened species will be taken as 'not significant'. A maintain and improve outcome has been demonstrated by the proposed offsets in the Preliminary Biodiversity Certification Assessment (*Ecological Australia* 2014) and Cumberland Plain Land Snail is also currently treated as an ecosystem credit.

Therefore it is expected that the proposed offsets and mitigation measures will provide a net biodiversity gain. The proposed offsets at Macquariedale Road and Elladale Road , Appin, will also offset Cumberland Plain Land Snail habitat and the Elladale site has been investigated as a recipient area for translocation. Walker Corporation have committed to support the preparation of a Cumberland Plain Land Snail Translocation Protocol on the basis of preliminary advice given by Michael Shea and as recommended within this report. The commitment also supports undertaking appropriate monitoring and reporting requirements as part of the Translocation Protocol, to assist in understanding the impacts of such projects and mitigation measures on the existing CPLS population and its recovery.

The Preliminary Biodiversity Certification Assessment (*EcoLogical Australia 2014)* identifies that the proposed planning scheme can be offset to achieve a maintain or improve outcome using the proposed Macquariedale Road conservation area and the Elladale Road offset site. *EcoLogical Australia* separately advises that based on the number of required credits a total biodiversity offset of 45-50ha consisting of the CPW (10ha) and SSTF (35-40ha) would sufficiently offset the planning proposal in accordance with the Biodiversity Certification Assessment Methodology (BCAM) subject to the mechanism of securing the offset sites.

For the purposes of this assessment a total 54.7ha biodiversity offset area has been chosen to ensure the planning proposal meets the biodiversity certification requirements based on a 90% credit benefit under the BCAM. This is assuming that the site can be secured through a conservation agreement.

In respect of matters required to be considered under the *EPBC Act*, one (1) threatened fauna species, one (1) protected migratory bird species, no threatened flora species, and two (2) EECs, listed under this Act were recorded within the site boundary. These include:

- Grey-headed Flying-fox (*Pteropus poliocephalus*) – threatened species, and
- White-throated Needletail (*Hirundapus caudacutus*) – migratory species.

The endangered ecological communities recorded include:

- Shale-Sandstone Transition Forest, and

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

The proposed subdivision development was considered to have a significant impact on matters of national environmental significance, that being Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. As such a referral to Department of Environment (formerly SEWPAC) is required. It is concluded that there will be no likely significant impact on any remaining nationally listed threatened species, populations or the EEC's.

In respect of matters relative to the *FM Act*, the study area is not considered to provide suitable habitat for threatened marine or aquatic species and, as such, there are no matters requiring further consideration under this Act.

Targeted fauna survey

Following an initial flora and fauna survey program in November 2012 which recorded a number of threatened fauna species, targeted surveys were undertaken in February 2013 by *Travers bushfire & ecology* as well as birding expert Mr John Young. This survey was undertaken to determine the significance and extent of use of the site for Cumberland Plain Land Snail and threatened hollow dependent birds, and to identify any conservation or mitigation measures required to minimise the potential ecological impacts.

The targeted survey and subsequent expert advice on large forest owls and other recorded hollow dependent threatened bird species was undertaken and prepared by birding expert Mr John Young. Mr Young recorded the following additional survey findings:

- A Gang-gang Cockatoo nesting hollow is located along the riparian corridor outside of the study area to the west.
- A Little Lorikeet nesting hollow is located within the proposed R2 Residential Zone.
- The study area is not a current breeding site or the main feeding site for Glossy Black-Cockatoo.
- An egg shell fragment which was found below a large hollow (previously identified as potentially being a Masked Owl based on photographic evidence) was confirmed as the non-threatened Australian Wood Duck based on visual identification of further shell fragments.

The report prepared by Mr John Young (Appendix 5) concludes that no large forest owls inhabit the site and the Powerful Owl previously recorded would have been called in from a distant territory. It is Mr Young's opinion that Powerful Owl, Masked Owl, Glossy Black Cockatoo and Gang-gang Cockatoo will not be likely to be adversely affected by the proposed R2 Residential Zone based on the lack of any suitable breeding locations within the R2 residential Zone. With regard to the threatened species Little Lorikeet, Mr Young recommended that the nest tree found within the proposed R2 Residential Zone, be retained in a small pocket park area with a minimum 15m buffer, to ensure that the current nesting behaviour at this site is maintained. Mr Young also advised that if this was to fail for any reason, that there were other nesting opportunities for Little Lorikeet within the proposed conservation areas such that this species would not be significantly affected by the proposed R2 Residential Zone.

Target snail surveys and habitat assessment at the same time in February 2013 identified Cumberland Plain Land Snail extending westward up to 350m into Shale - Sandstone Transition Forest in the northern and central patches. In both of these patches, living specimens were located at the western extents of their range and were mostly likely not dependent on the remnant CPW patches.

Snail expert Michael Shea from the Australian Museum was then later engaged to undertake a site review and assessment for the species. Searches were undertaken on site with Mr Shea on the 25th October 2013 as well as on the proposed offset site along Elladale Road on the 31st January 2014. The report by Mr Shea with comments on site significance and relocation options is provided in Appendix 6.

Ecological impacts of proposed rezoning

Impacts on EEC's

The rezoning proposal will potentially result in the following impacts on the recorded EECs (Figures 1 and 2):

- Shale-Sandstone Transition Forest (SSTF) - A total of 46.20 ha within the site. 34.06 ha will be conserved (73.4%), and 12.14 ha will be removed or modified (26.6%).

- Cumberland Plain Woodland (CPW) – 3.78 ha will be removed or modified (100%). For the purpose of the calculations, the regrowth vegetation areas are subject to a vegetation clearance that is permissible under the NVA Act and reduces the effective impact to on CPW to 2.96 ha.

In accordance with the biodiversity certification process the insitu vegetation is assessed for the determination of suitable offsets. For the purposes of the 7 part test assessment, recently cleared or managed regrowth areas are not considered to be in a condition to warrant protection.

A referral to the Department of Environment will be required as the loss of all CPW vegetation is a matter of national significance. In terms of offsetting however, the EPBC offset calculator has been utilised to identify whether the proposed offsets are likely to pass the EPBC Offset maintain test. Further information on the offset outcomes is provided in the Biodiversity Offset Report (*Travers bushfire & ecology,* 2014).

The loss of SSTF due to the future RMS bypass route is not the responsibility of *Walker Corporation*. However the proponent also recognises that the proposed rezoning results in a limitation on the future bypass route and the impacts of the rezoning and proposed residential zone have a cumulative effect. Where APZs impact within the bypass, this has been taken into consideration.

The conserved area of SSTF is in addition to conserved remnant native vegetation within Council lands. SSTF occurs around the sports oval, on rural lots to the immediate west and into remnant bushland immediately north and south. The majority of existing SSTF remnants are in good condition with limited weed presence and good resilience.

All other recorded threatened species are not expected to be significantly affected in association with the proposed mitigation measures and the retention of the higher quality habitat associated with the main riparian corridor.

Given the occurrence of Cumberland Plain Land Snail in the SSTF, the proponent has offered to restore Forest Red Gum habitat within conserved lands, to relocate the existing snail populations within the site to adjoining or nearby habitat areas and to provide an appropriate offsite offset for the loss of EEC and threatened species habitat.

The vegetation within the site including the proposed onsite biodiversity offset lands are within an area mapped as priority conservation lands (PCL) within the Cumberland Plain Recovery

Plan (2010) and functions as part of a discontinuous corridor. Consequently this planning proposal is impacting on a corridor and the conservation value of the existing vegetation patch would be reduced. However, a significant corridor of a minimum of 150m to a maximum of 400m in total width will be retained along Ousedale Creek which will continue to function as a major environmental corridor. Should the future bypass not proceed, the width of the corridor will potentially be increased to 200m to a maximum of 425m respectively. In either case, the remnant bushland corridor will continue to function as a major environmental corridor.

The proposed rezoning will maintain a viable area of SSTF. Both communities can effectively be expanded in the region by implementing a suitable biodiversity offset in a location that supports other riparian corridors or existing reserves. Whilst the RMS bypass has not been approved, it is logical to provide a significant conservation area in the form of a biodiversity offset in another locality of high conservation value. The proponents have access to significant lands in the region and can offer conservation outcomes that could significantly benefit the ecology of the region (Biodiversity offset strategy *Travers bushfire & ecology* 2014).

The loss of CPW and SSTF is a significant ecological issue, however, not such that they cannot be offset in an area of similar conservation value to create a valuable conservation outcome.

The proponents have offered to enrich existing habitat where possible within conserved lands, to relocate the existing snail populations into retained vegetation areas within the site and or the proposed Elladale offset site and to secure the offset sites in perpetuity under a conservation agreement or equivalent mechanism. The removal of SSTF and CPW vegetation is a 'red flag' issue under the NSW Biodiversity Certification process including, which will require Ministerial approval of a red flag variation report. A biodiversity offset strategy (*Travers bushfire & ecology* 2014) has been prepared which offers significant off site biodiversity offsets for both communities.

Impacts on threatened species

The proposal does not cause any significant impact on potential threated flora species within the study area, as no threatened flora species have been recorded within the site.

The threatened fauna species of note impacted as a result of the proposed R2 Residential Zone include:-

- Cumberland Plain Land Snail
- Glossy Black-Cockatoo
- Little Lorikeet

Hollow dependent threatened fauna

The presence of hollow bearing resources will be reduced and large stands of *Allocasuarinas* will be removed, thereby impacting on foraging habitat for the Glossy Black-Cockatoo as well as suitable roosting/breeding hollows for hollow dependent threatened species.

The proposed rezoning is also expected to remove a breeding hollow of the Little Lorikeet and will potentially remove habitat of several threatened bird species. An expert statement from Mr John Young, has been provided which provides advice as to the significance of impacts on the recorded threatened bird species. Mr Young considers that all recorded threatened bird species will not be adversely affected as a result of the proposed R2 Residential Zone, with the exception of Little Lorikeet. Mr Young has supported the proposed R2 Residential Zone on the basis of protecting the breeding location of the Little Lorikeet in a pocket park.

The vegetation on site forms an important corridor for fauna, as evidenced by the presence of several threatened fauna species and Priority Conservation Land mapping that maps a large portion of the vegetation and associated habitat or Priority Conservation Lands (PCL).

Cumberland Plain Land Snail

As a result of vegetation removal and/or modification, 13.72 ha of Cumberland Plain Land Snail habitat will be affected. This represents 43.0% of known habitat for this species including the remaining and 'preferred' CPW portions, whilst disturbed and fragmented. The impact assessment of CPLS includes areas removed or modified for the proposed residential area and APZs. It does not include the bypass but does include APZs that occur within the bypass. Based on the distribution and density of observed Cumberland Plain Land Snails within the site, the proposal is removing an equivalent proportion of the population through direct habitat removal.

The loss of Cumberland Plain Land Snail habitat within the site as a result of the rezoning is significant. Advice provided by snail expert Michael Shea (Appendix 6) indicates that it is also unclear whether the species is capable in persisting indefinitely in SSTF, considered as 'marginal habitat'. However, the CPLS habitat being removed consists of degraded CPW and SSTF which currently supports fringing habitat adjacent to long since removed CPW for the Appin township. The existing population is surviving on poorer quality substrates sparsely distributed across the site particularly where the canopy is dominated by Forest Red Gum but based on floristic characteristics is more closely aligned to SSTF. Therefore CPLS habitat within the site is not solely contained to CPW and may be supported within SSTF dominated by Forest Red Gum and or on appropriate soil substrates and fringing CPW areas.

Given the distant recorded locations of CPLS (including living specimens) within the SSTF and the impact area of the proposed R2 zones, the snail population within the site is expected to persist to the west of the proposed bypass but over a smaller area and a likely reduced population size. The retained CPLS habitat consists of the less preferred SSTF in which snails were recorded at lower densities, as evident on site. However the known CPLS habitat area to the west of the bypass road for the northern and central patches is likely to be sufficient in size to maintain a viable population even with the future bypass in place.

Current limited knowledge of snail habitat preference suggests that snail occurrences are primarily associated with the Cumberland Plain and Castlereagh Woodland vegetation types (Clark 2009). However, our conclusion above is supported from recordings by *Travers bushfire & ecology* of live specimens persisting in small highly fragmented patches of SSTF (and isolated from CPW for decades) at other locations including a nearby site at Brooks Point Road, Appin as well as locations at Airds Bradbury and Picton. The species may be showing non-typical habitat preferences at the outer extent of distribution area (*pers comm* M Shea). The above examples are at the southern extent of the species known distribution.

Figure 6 shows snail recorded locations extending into SSTF to the west in each portion of the site and the small CPW portions present. It should be noted that whilst dead shells may indicate that living specimens are to be expected to still be present, no living snails were recorded in each of the three CPW portions present and no shells were found at all in the northern CPW portion. Of the 59 shells found (15 living and 44 dead specimens), 54 (91.5%) were recorded in SSTF mapped areas of the site, and only 3 of these were relatively close to CPW mapped areas.

Further to the proposed relocation or translocation of living snails into selected areas as a mitigation measure, a 0.7 ha restoration Forest Red Gum revegetation area for the loss of CPW is proposed for the southern portion of the conservation area at Macquariedale Road. It is recognised that such restoration will not provide suitable habitat in the short-term and

therefore snails would be relocated into the surrounding SSTF. In summary it is considered that the areas to the west of the bypass road, whilst being SSTF, is considered sufficient in size to maintain the two or three existing populations even with the future bypass in place.

In respect to living snails present within the proposed development areas, snail expert Michael Shea has indicated a preference to translocate individuals into CPW instead of relocating into adjacent SSTF habitat known to be utilised from the same population. There are risks associated with translocating snails into other 'separate' populations and the referred translocation approach should be considered in more thoroughly as part of a translocation protocol before the method of translocation and recipient areas are decided.

Mitigation Measures

SSTF, degraded CPW and Cumberland Plain Land Snail habitat will be directly impacted by the proposed rezoning. The foraging habitat of the other recorded threatened fauna species will also be impacted, but not such that they will be put at any likely risk of extinction in the locality.

The proposed R2 zone has been significantly reduced in size to reduce the impact on the recorded EECs, threatened species and associated habitat. The preferred residential zone area has also been placed in a location that strategically provides a major environmental corridor and associated threated species habitat.

Given the high conservation value of the landscape, the proponent recognises that a significant biodiversity outcome is needed to demonstrate an overall maintain and improve outcome. The proposed zoning of E2 Environmental Conservation for all areas to be retained is appropriate given the conservation significance of the vegetation present, its role as an environmental corridor and recognition as a PCL under the Cumberland Plain Recovery Plan.

A key principle of offsetting in NSW is one of avoidance or protection of threatened species habitat, EECs and endangered populations is to be implemented before considering offsetting. The reduced residential zone and proposed mitigation measures aim to satisfy this principle.

The removal of CPW and SSTF is a matter of National Environmental Significance (NES) and a referral to the Commonwealth Department of Environment is required. The proposal will also be subject to the Department's Environmental Offsets Policy which guides the use of offsets under the EPBC Act.

The following onsite mitigation measures are recommended:

- Retain the recorded Little Lorikeet nesting hollow surrounded by a minimum 15m non-development buffer such as within a pocket park. This buffer will retain the nearest trees in all directions as a screen. These trees are all maturing and are of notable good heath for retention within a pocket park scenario. The nesting tree itself is in poor health and will potentially require management of dead limbs for safety. This buffer distance should be increased to allow for protection of root zones and allow for practical long term maintenance of the pocket park.
- Prepare and implement a Cumberland Plain Land Snail translocation protocol and habitat restoration procedure consistent with advice from Michael Shea (Appendix 6) to recover snails from proposed development areas and ensure suitable recipient habitat areas are provided. This is to be refined based on further habitat assessment and the advice of a panel of current experts in this field. This should also consider the use of the southern Forest Redgum/Ironbark vegetation community and revegetation area as a recipient area for snail relocation from the southern population. Walker Corporation

have committed to support further site investigations in order to obtain more detailed information on the habitat preferences for Cumberland Plain Land Snails. Such investigations would be advised by leading snail experts and would likely include soil structure and organic mineral content sampling which is expected to guide the identification of appropriate CPLS recipient areas for restoration.

- Hollow bearing trees that potentially contain roosting and breeding habitat for threatened microbats should be identified and conserved where possible (subject to condition of the tree and other development factors). Hollows should be removed under the supervision of a fauna ecologist to ensure animal welfare (particularly for threatened species) and hollows removed should be relocated or replaced within conservation areas.
- Restore Forest Red Gum dominated vegetation in the 0.7 ha southern portion alongside the proposed bypass to support Cumberland Plain Land Snail in the long term. This will provide a long term refuge for an isolated snail population which will be placed initially in surrounding Shale-Sandstone Transition Forest areas.
- Prepare bushland management plans for proposed conservation areas including the biodiversity offset sites.
- Zone all conservation areas as E2 Environmental Conservation and secure as biodiversity offset areas such as through a conservation agreement or transfer public land as a bushland reserve.

Biodiversity offsets are recommended to offset the loss of:

- Cumberland Plain Woodland,
- Shale-Sandstone Transition Forest, and
- Threatened species habitat.

EcoLogical Australia (2014) were engaged to undertake a preliminary maintain or improve test based upon the Biodiversity Certification Assessment Methodology utilising the Macquariedale Road site, and potential offset lands on Elladale Road a few kilometres to the west (still in Appin). *EcoLogical Australia* has identified that there is an excess in credits generated from the available offset lands. There is an excess of suitable lands present at the Elladale Road site that could be utilised for offsetting requirements. Further discussion is afforded in the Biodiversity Offset Strategy (*Travers bushfire & ecology,* 2014). Any offset requirements to satisfy the EPBC Act Environmental Offsets Policy also need to be considered.

The following additional documentation will be required for biodiversity offsetting purposes:

- Prepare and submit a biodiversity certification reporting and red flag variation report to enable approval of the proposed offset strategy under the *TSC Act.*
- Prepare and submit a referral to Department of Environment for assessment under the *EPBC Act*. This will need to include a biodiversity offset assessment using the *EPBC Act* Biodiversity Offsets Calculator.
- Prepare bushland management plans for the proposed on site conservation areas and off site biodiversity offset which is to address the above on site mitigation measures and habitat enrichment to support the Cumberland Plain Land Snail.

Appropriateness of the proposed zonings

Based on the observed threatened species and vegetation and the size of the proposed biodiversity offset areas, the conservation areas are suitable for zoning as:

- E2 Environmental Conservation

E2 Environmental Conservation is reserved for the most significant conservation landscape in a locality. The proposed conservation lands are mapped as Priority Conservation lands and function as major environmental corridors. A high level of protection is warranted given the long term viability of the remnant patch and the need to provide a secure conservation outcome.

The proposed R2 Low Density Residential Zone is located in a landscape of development potential but also, in part, moderate to high conservation value. In the context of the proposed offsets, the R2 zone is appropriate. The outcome achieved as part of this rezoning appears to be a balanced development versus conservation outcome that yields both a viable development area but also a viable conservation area.

The future Appin bypass has been given the proposed rezoning of SP2 Special Uses based on its possible use as a future road corridor. Infrastructure corridors are a vital part of a functioning community but there is no indication as yet whether the future Appin bypass will be built in its current location. The rezoning of the future bypass land as SP2 Special Uses allows the final use to be determined as part of broader feasibility studies or to be used as an offset for other infrastructure works.

List of abbreviations

APZ	asset protection zone
BPA	bushfire protection assessment
CLUMP	conservation land use management plan
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from 4/07)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from 10/09)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from 4/11)
DOE	Commonwealth Department of Environment
EEC	endangered ecological community
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act*
EPBC Act	*Environment Protection and Biodiversity Conservation Act*
ESMP	ecological site management plan
FF	flora and fauna assessment
FM Act	*Fisheries Management Act*
FMP	fuel management plan
HTA	habitat tree assessment
IPA	inner protection area
LEP	Local Environment Plan
LGA	local government area
NES	national environmental significance
NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (Part of the NSW Department of Premier and Cabinet)
OPA	outer protection area
PBP	*Planning for bushfire protection 2006*
POM	plan of management
RF Act	*Rural Fires Act*
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*
SIS	species impact statement
SULE	safe useful life expectancy
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
TSC Act	*Threatened Species Conservation Act*
VMP	vegetation management plan

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Introduction 1

Travers bushfire & ecology has been engaged by *Walker Corporation* to undertake a flora and fauna constraints assessment for a rezoning proposal off Macquariedale Road at Appin, immediately west of the existing township. The specific Lot and DP numbers for the proposed rezoning are:

- Lot 201 DP 749272
- Lot 1 209779
- Lot 1 DP 558807
- Lot 1 DP 1000355

Previous studies have been undertaken by *Clements and Associates* in respect to flora surveys in 2007 and subsequent supplementary information. OEH determined that the flora assessment was inadequate and that there were deficiencies within the report. They also determined that the interpretation of the quadrat and soil data was incorrect and insisted that Shale-Sandstone Transition Forest (SSTF) and Cumberland Plain Woodland (CPW) were present within the site. The data from *Clements* did not show CPW as occurring at all.

Fauna survey was not previously conducted on site although *Ambrose Ecological* were engaged to undertake survey on adjoining lands to the immediate north east in 2011.

Travers bushfire & ecology initially undertook six (6) full days of flora survey and five (5) days of fauna survey, including some nocturnal works across the entire site. Survey was undertaken in November 2012 during mild to hot conditions on both wet and dry days. Further targeted survey was undertaken in February 2013 incorporating one (1) day for vegetation quadrats and condition, four (4) days of targeted snail searches and four (4) days of threatened bird survey by specialist John Young. One (1) additional day of snail searches and checks was undertaken to confirm habitat mapping with snail expert Michael Shea. The survey methodology is described in detail within Section 2 as well as in Appendix 1.

1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions and to make comparative notes to Biometric vegetation types
- Carry out a fauna survey for the detection and assessment of fauna and their habitats
- Complete target surveys for threatened species, populations and ecological communities
- Prepare a flora and fauna impact assessment in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act),* the *Threatened Species Conservation Act 1995 (TSC Act),* the *Fisheries Management Act 1994 (FM Act)* and *Threatened species assessment guidelines, the assessment of significance* (DECC 2007).

1.2 Statutory requirements

1.2.1 Threatened Species Conservation Act 1995

The specific requirements of the *TSC Act* must be addressed in the assessment of impacts on threatened flora and fauna, populations and ecological communities. The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *Environmental Planning and Assessment Act 1979 (EPA Act)* and are based on a 7 part test of significance. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

1.2.2 Fisheries Management Act 1994

The *FM Act* provides a list of threatened aquatic species that require consideration when addressing the potential impacts of a proposed development. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a SIS is required to be prepared.

1.2.3 Environment Protection and Biodiversity Conservation Act 1999

The *EPBC Act* requires that Commonwealth approval be obtained for certain actions. It provides an assessment and approvals system for actions that have a significant impact on matters of *national environmental significance* (NES). These may include:

- World Heritage Properties and National Heritage Places
- Wetlands of International Importance protected by international treaty
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species
- Commonwealth marine environment

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides whether the action would have a significant effect on a matter of NES.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) for assessment. In the case where no listed federal species are located on site, then no referral is required. The onus is on the proponent to make the application and not on the Council to make any referral.

A threshold criterion applies to specific NES matters which may determine whether a referral is or is not required, such as for the *EPBC Act* listed ecological communities CPW and Shale-Gravel Transition Forest. Consultation with SEWPAC may be required to determine whether a referral is or is not required. If there is any doubt as to the significance of impact, or whether a referral is required, a referral is generally recommended to provide a definite decision under the *EPBC Act,* thereby removing any further obligations in the case of *not controlled* actions.

A significant impact is regarded as being:

> *important, notable, or of consequence, having regard to its context or intensity and depends upon the sensitivity, value, and quality of the environment which is impacted and upon the duration, magnitude, and geographical extent of the impacts. A significant impact is likely when it is a real or not a remote chance or possibility.*
>
> *Source: EPBC Policy Statement*

Guidelines on the correct interpretation of the actions and assessment of significance are located on the department's web site http://www.environment.gov.au/epbc/publications.

1.3 Proposed works

The planning proposal seeks to:

- Rezone land at Appin from RU2 Rural Landscape, R3 Medium Density Residential and RE1 Public Recreation to R3 Low Density Residential, SP2 Special Uses and E2 Environmental Conservation,
- Vary the minimum lot size from part 40 ha and part 975m^2 to part 100 ha and part 450m^2,
- Vary the maximum building height to apply a 9m maximum building height to the R2 Low Density Residential zoned land, and
- Amend the land reservation map to show the land proposed to be zoned SP2 to facilitate acquisition by the RMS.

1.4 Site description

Table 1.1 provides a summary of the planning, cadastral, topographical and disturbance details of the subject site.

Table 1.1 - Planning, cadastral and general site features

Location	Macquariedale Road, Appin
Local government area	Wollondilly
Grid reference	295500E 6213500N
Elevation	195-245m AMSL
Topography	Situated on a flat to low graded landscape with Ousedale Creek along the western boundary where slopes are moderate along the riparian zone. There are also some moderate slopes at the narrowest point of the site where there is a small drainage line which comes off Ousedale Creek.
Geology and soils	Geology; Hawkesbury Sandstone (west and central) and Wianamatta Group Shale (east). Soils; Hawkesbury Soil Landscape along Ousedale Creek – shallow soils with rock outcropping present. The remainder of the site is Blacktown Soil Landscape – moderately deep yellow podzols and soloths.
Catchment & drainage	Sydney Metro CMA; Nepean River. The site borders Ousedale Creek to the immediate west
Vegetation	Shale-Sandstone Transition Forest and Cumberland Plain Woodland
Existing land use	Residential (rural) and grazing
Clearing	Approximately 13-14ha of the site has been cleared or underscrubbed in recent years within paddocks south of Macquariedale Road, the vegetation around the existing dwelling, vegetation immediately west of Lewis Street and vegetation to the north east of the existing sporting oval.

Survey Methodology 2

2.1 Information collation, technical resources, desktop assessments, specialist identification and licences

A review of the relevant information pertinent to the subject site was undertaken.

Client documents reviewed include:

- *Anne Clements & Associates* (2007) Preliminary Assessment of Significance of proposed Rezoning: Lot 201 DP 749272, Lot 1 DP 209779 and Lot 1 DP 558807, Macquariedale Road, Appin,
- *Ambrose Ecological Services* (2011) Fauna Survey and Assessment – Approved Residential Rezoning and Subdivision of Rural Land, Corner of Rixon & Appin Roads, North Appin,
- OEH correspondence dated 16.12.11, and
- Determinations under the gateway process signed by the Minister, Hon. Brad Hazzard, dated 25.10.11.

Standard Technical Resources utilised:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- Aerial photographs (*Google Earth Pro / Spatial Information Exchange / Nearmap*)
- Topographical maps (scale 1:25,000)
- *Threatened Species Conservation Act 1995* (*TSC Act*)
- *Fisheries Management Act 1994* (*FM Act*)
- *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*)
- Rare or Threatened Australian Plants (ROTAP)
- *Vegetation mapping of the Cumberland Plain* (NPWS 2002) and *Tozer* (2003)
- Cumberland Plain Recovery Plain (2010)

Desktop Assessment:

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site, desktop assessments were undertaken including:

- ***A literature review*** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.

- ***A data search*** – A search of the *Atlas of NSW Wildlife* database (OEH 2012) was undertaken to identify records of threatened flora and fauna species located within a 10km radius of the site. Searches were also undertaken on the SEWPAC *protected matters search tool* website to generate a report to assist to determine whether matters of *national environmental significance* (*NES*), or other matters protected by the *EPBC Act* are likely to occur in the area of interest. The search was broadened to a 10km radius as per the *Atlas of NSW Wildlife* database search. These two searches combined, enabled the preparation of a list of threatened flora and fauna species that

could potentially occur within the habitats found on the site (Tables A2.1, A2.2 and A2.3).

Accuracy of identification:

Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation were made according to *Specht et al* (1995).

***Licences*:**

Individual staff members of *Travers bushfire & ecology* are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Sections 120 & 131 of the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: S10359.

Travers bushfire & ecology staff are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows *Travers bushfire & ecology* to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

2.2 Flora survey methodology

A review of the *Atlas of NSW Wildlife* database (OEH 2012) was undertaken prior to the botanical survey to identify threatened species previously recorded within 10km of the subject site to determine whether target searches were required to be undertaken.

A total of forty eight (48) floristic biometric style quadrats were assessed within vegetated portions of the site or recently cleared parts. Five (5) vegetation transects were also undertaken. Vegetation condition data points were undertaken to assist in defining the quality of the remnant CPW and cleared areas surrounding it. Target searches for threatened species were undertaken for particular species, where applicable, during the random meander and stratified surveys. A breakdown of the survey methods by date is listed below.

5/11/12 - Determine access points and brief random meander to familiarise self with the site boundaries. Undertake biometric style flora quadrats in the central portion of the site gathering details on species richness, height and projected foliage cover, vegetation condition, presence of hollow bearing trees and fallen logs. Target threatened flora searches were done in between undertaking quadrat surveys.

6/11/12 - Undertake biometric style flora quadrats in the central and north western portion of the site, gathering details on species richness, height and projected foliage cover, vegetation condition, presence of hollow bearing trees and fallen logs. Undertake target survey for *Pterostylis saxicola* along the periphery of Ousedale Creek as well as Transect 1.

7/11/12 - Undertake target threatened species survey in the northern portion of the site. Undertake biometric style flora quadrats in the north eastern portion of the site, gathering details on species richness, height and projected foliage cover, vegetation condition, presence of hollow-bearing trees and fallen logs.

8/11/12 - Undertake biometric style flora quadrats in the south western portion of the site gathering details on species richness, height and projected foliage cover, vegetation condition, presence of hollow bearing trees and fallen logs. Target threatened flora searches were undertaken in the same area. Transects 2, 3 and 4 were also undertaken.

9/11/12 - Undertake biometric style flora quadrats 36-40 gathering details on species richness, height and projected foliage cover, vegetation condition, presence of hollow bearing trees and fallen logs. Transect 5 undertaken along the southern boundary. Target threatened flora searches undertaken in the southern portion of the site.

28/02/13 - Undertake additional biometric style flora quadrats 41-47 within adjoining vegetation and in areas with survey gaps. Vegetation condition survey points were also conducted (thirty three (33) in total) within poorer condition or regrowth vegetation to determine the condition of vegetation, coverage by exotic species, age class of Eucalypts and Acacias, and to assist in mapping more accurately the cleared or heavily degraded areas surrounding the remnant CPW vegetation type.

14/11/13 - Undertake one (1) additional quadrat for the purposes of offsetting calculations under the Biodiversity Certification Assessment Methodology for Ecological Australia (quadrat 48).

Note that all quadrats were randomly placed across the site but with an approximate interval of 100-150m between each. Additional transects were undertaken to the quadrats to ensure there was a mixture of survey techniques applied. Transects were deemed a more suitable technique within linear patches of vegetation that were 20m wide or less (Transects 2 and 5).

Determining the edges of vegetation communities was done by a combination of aerial photographic interpretation, ground-truthing and quadrat analysis.

Table 2.1 - Minimum number of plots required per stratification unit for undertaking a flora assessment to determine biometric vegetation type

Area of stratification unit (hectares)	Minimum number of plots
0-4	1 plot per 2ha (or part thereof)
5-20	3 plots
21-50	4 plots
51-100	5 plots
101-250	6 plots
251-1000	7 plots
> 1000	8 plots

Table 2.2 – Compliance of survey data for determining a Biometric vegetation type

Community	Biometric stratification unit	Area	Minimum no. quadrats required	No. quadrats undertaken
Aquatic Herbfield	Nil	~11ha	-	1
Cleared or Scattered Trees	Nil			
Young Regrowth Vegetation	Nil			
Forest Red Gum Forest / Woodland	HN528 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin (CPW)	~4ha	2	4
Disturbed Forest Red Gum Forest / Woodland				
Forest Red Gum / Ironbark Forest	HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (SSTF)	~46ha	4	39
Grey Gum / Blackbutt / Rough-barked Apple Forest				
Grey Gum / Blackbutt Forest				
Grey Gum Forest				

Note: Four (4) additional quadrats were undertaken outside of the subject site on adjoining lands.

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.3 and are depicted on Figure 2.

Current fauna survey techniques employed by *Travers bushfire & ecology* in line with relevant survey guidelines as well as current survey knowledge are provided in Appendix 1. Fauna survey techniques that have been tailored to the site are provided in Section 2.6.

2.4 Field survey effort

Tables 2.3 and 2.4 below detail the flora and fauna survey effort undertaken for the subject site.

Table 2.3 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Diurnal birds	5/11/12	0-7/8 cloud, none-light SE wind, no rain, temp 27-30°C	Diurnal opportunistic	7hrs 35min 1125 - 1900
	6/11/12	7-0/8 cloud, no wind, no rain, temp 22-34°C	Diurnal opportunistic	5hrs 25min 0800 - 1325
		0/8 cloud, no wind, no rain, temp 30°C	Diurnal opportunistic	1hr 1355 - 1455
		0-8/8 cloud, no wind, no rain, temp 25-22°C	Diurnal opportunistic	2hrs 10min 1535 - 1745
			Surveillance camera	1 camera day
	7/11/12	8/8 cloud, no wind, light rain, temp 22°C	Diurnal opportunistic	6hrs 20min 0910 - 1530
			Surveillance camera	1 camera day
	8/11/12	2-8/8 cloud, none-light SE wind, late storm, temp 21-27°C	Diurnal opportunistic	7hrs 45min 0900 - 1645
			Surveillance camera	1 camera day
	9/11/12	8/8 cloud, no wind, light rain, temp 18-22°C	Diurnal opportunistic	3hrs 30min 0730 - 1100
	25/2/13	2/8 cloud, no wind, no rain, temp 29°C	Diurnal opportunistic	3hrs 35mins 1225 – 1600
	26/2/13	2-5/8 cloud, no wind, no rain, temp 25 - 27°C	Diurnal opportunistic	5hrs 50mins 1010 – 1600
	27/2/13	4/8 cloud, light SW wind, no rain, temp 25 - 28°C	Diurnal opportunistic	11hrs 0915 – 2015
	28/2/13	8/8 cloud, no wind, no rain, temp 23 - 25°C	Diurnal opportunistic	2hrs 20mins 0900 – 1120
		8/8 cloud, no wind, no rain, temp 23 - 25°C	Diurnal opportunistic	2hrs 10mins 1220 – 1430
Nocturnal birds	5/11/12	5/8 cloud, no wind, no rain, temp 23-20°C	Spotlighting	2hrs 55min 1940 - 2235
			Call playback (Section 2.6 species)	Commenced @ 2000
	6/11/12	7/8 cloud, no wind, no rain (distant storm), temp 22-21°C	Spotlighting	2hrs 5min 1940 - 2145
			Call playback (Section 2.6 species)	Commenced @ 2015
	25/2/13	7/8 cloud, no wind, no rain, temp 24 - 26°C	Stag-watching / spotlighting	2hrs 1700 – 1900
	26/2/13	2-5/8 cloud, no wind, no rain, temp 25 - 27°C	Stag-watching / spotlighting	45mins 1815 – 1900

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Arboreal mammals	5/11/12 6/11/12 7/11/12 8/11/12	5/8 cloud, no wind, no rain, temp 23-20^{o}C no wind, no rain, temp >17^{o}C 7/8 cloud, no wind, no rain (distant storm), temp 22-21^{o}C no wind, no rain, temp >18^{o}C no wind, overnight rain, temp >16^{o}C no wind, no rain, temp >16^{o}C	Spotlighting Call playback (Section 2.6 species) *Elliott* trapping Spotlighting Call playback (Section 2.6 species) *Elliott* trapping Surveillance camera *Elliott* trapping Surveillance camera *Elliott* trapping Surveillance camera	2hrs 55min 1940 - 2235 Commenced @ 2020 25 trap nights 2hrs 5min 1940 - 2145 Commenced @ 2015 25 trap nights 1 camera night 25 trap nights 1 camera night 25 trap nights 1 camera night
Terrestrial mammals	5/11/12 6/11/12 7/11/12 8/11/12	5/8 cloud, no wind, no rain, temp 23-20^{o}C no wind, no rain, temp >17^{o}C 7/8 cloud, no wind, no rain (distant storm), temp 22-21^{o}C no wind, no rain, temp >18^{o}C no wind, overnight rain, temp >16^{o}C no wind, no rain, temp >16^{o}C	Spotlighting Call playback (Section 2.6 species) *Elliott* trapping Spotlighting Call playback (Section 2.6 species) *Elliott* trapping Cage trapping Surveillance camera *Elliott* trapping Cage trapping Surveillance camera *Elliott* trapping Cage trapping Surveillance camera	2hrs 55min 1940 - 2235 Commenced @ 2020 25 trap nights 2hrs 5min 1940 - 2145 Commenced @ 2015 25 trap nights 5 trap nights 2 camera nights 25 trap nights 5 trap nights 2 camera nights 25 trap nights 5 trap nights 2 camera nights
Bats	5/11/12 6/11/12	5/8 cloud, no wind, no rain, temp 23-20^{o}C 7/8 cloud, no wind, no rain (distant storm), temp 22-21^{o}C	Spotlighting *Anabat* x2 (Passive monitoring) Spotlighting *Anabat* x1 (Passive monitoring) *Anabat* x1 (Passive monitoring)	2hrs 55min 1940 - 2235 o'night from 1930 2hrs 5min 1940 - 2145 o'night from 1950 1hr 25min 1940 - 2115

Reptiles	5/11/12	0-7/8 cloud, none-light SE wind, no rain, temp 27-30^{o}C	Diurnal opportunistic	7hrs 35min 1125 - 1900
	6/11/12	7-0/8 cloud, no wind, no rain, temp 22-34^{o}C	Diurnal opportunistic	5hrs 25min 0800 - 1325
		0/8 cloud, no wind, no rain, temp 30^{o}C	Habitat search / diurnal opportunistic	1hr 1355 - 1455
		0-8/8 cloud, no wind, no rain, temp 25-22^{o}C	Diurnal opportunistic	2hrs 10min 1535 - 1745
			Surveillance camera	1 camera day
	7/11/12	8/8 cloud, no wind, light rain, temp 22^{o}C	Habitat search / diurnal opportunistic	6hrs 20min 0910 - 1530
			Surveillance camera	1 camera day
	8/11/12	2-8/8 cloud, none-light SE wind, late storm, temp 21-27^{o}C	Habitat search / diurnal opportunistic	7hrs 45min 0900 - 1645
			Surveillance camera	1 camera day
	9/11/12	8/8 cloud, no wind, light rain, temp 18-22^{o}C	Diurnal opportunistic	3hrs 30min 0730 - 1100
	25/2/13	2/8 cloud, no wind, no rain, temp 29^{o}C	Diurnal opportunistic	3hrs 35mins 1225 – 1600
	26/2/13	2-5/8 cloud, no wind, no rain, temp 25 - 27^{o}C	Diurnal opportunistic	5hrs 50mins 1010 – 1600
	27/2/13	4/8 cloud, light SW wind, no rain, temp 25 - 28^{o}C	Diurnal opportunistic	11hrs 0915 – 2015
	28/2/13	8/8 cloud, no wind, no rain, temp 23 - 25^{o}C	Diurnal opportunistic	2hrs 20mins 0900 – 1120
		8/8 cloud, no wind, no rain, temp 23 - 25^{o}C	Diurnal opportunistic	2hrs 10mins 1220 – 1430
Amphibians	5/11/12	5/8 cloud, no wind, no rain, temp 23-20^{o}C	Spotlighting & call identification	2hrs 55min 1940 - 2235
	6/11/12	7/8 cloud, no wind, no rain (distant storm), temp 22-21^{o}C	Spotlighting & call identification	2hrs 5min 1940 - 2145
Molluscs	7/11/12	8/8 cloud, no wind, light rain, temp 22^{o}C	Habitat searches	1hr 20min 1230 - 1330
	8/11/12	2-8/8 cloud, none-light SE wind, late storm, temp 21-27^{o}C	Habitat searches	4hrs 15min 1115 - 1530
	25/2/13	2/8 cloud, no wind, no rain, temp 29^{o}C	Targeted searches, habitat assessment	3hrs 35mins 1225 – 1600
	26/2/13	2-5/8 cloud, no wind, no rain, temp 25 - 27^{o}C	Targeted searches, habitat assessment	5hrs 50mins 1010 – 1600
	27/2/13	4/8 cloud, light SW wind, no rain, temp 25 - 28^{o}C	Targeted searches, habitat assessment	11hrs 0915 – 2015
	28/2/13	8/8 cloud, no wind, no rain, temp 23 - 25^{o}C	Targeted searches, habitat assessment	2hrs 20mins 0900 – 1120
		8/8 cloud, no wind, no rain, temp 23 - 25^{o}C	Targeted searches, habitat assessment	2hrs 10mins 1220 – 1430
	25/10/13	0/8 cloud, no wind, no rain, temp 17 - 24^{o}C	Targeted searches / specialist advice	5hrs 1000 – 1500

Table 2.4 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Survey of the boundaries of all communities – field verification, aerial photographic interpretation and quadrat analysis	5/11/12, 6/11/12, 7/11/12, 8/11/12, 9/11/12, 28/02/13
Stratified sampling	Biometric quadrats in all existing bushland or remnant areas. Transects.	5/11/12, 6/11/12, 7/11/12, 8/11/12, 9/11/12, 28/02/13, 14/11/13
Target searches	Target searches in known habitats	5/11/12, 6/11/12, 7/11/12, 8/11/12, 9/11/12, 28/02/13

2.5 Site specific survey techniques

2.5.1 Diurnal birds

At central points along *Elliott* trap lines, call-playback of Varied Sittella (*Daphoenositta chrysoptera*) from a mobile phone was used to evoke a response.

Given the early observation of Glossy Black-Cockatoo (*Calyptorhynchus lathami*) foraging near a suitable nesting tree early in the survey period, the tree was targeted by surveillance camera.

2.5.2 Nocturnal birds

Given the suitability of habitat present, Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*) and Bush Stone-curlew (*Burhinus grallarius*) were targeted by call-playback techniques. Call-playback locations are indicated on Figure 2.

Large hollows suitable for nesting were located during survey. The nearby surrounds to these trees were searched for signs of owl activity as indicated by whitewash or pellets.

2.5.3 Arboreal and terrestrial mammals

Elliott type A and B traps were used for trapping arboreal and terrestrial mammals during surveys. Trapping consisted of one hundred (100) arboreal trap nights and one hundred (100) terrestrial trap nights.

Terrestrial trap-lines of alternating type A and B *Elliott* traps using 50-100m separations were placed along the same line as the arboreal traps in the most suitable terrestrial habitats.

Five (5) trap-lines were set on the nights of 5, 6, 7 & 8 November 2012. The location of the trap-lines is shown on Figure 2. Each trap-line consisted of five (5) type A traps and five (5) type B traps.

Cage trapping was also undertaken during surveys to target the threatened Spotted-tailed Quoll (*Dasyurus maculatus*). Cage trapping consisted of a total of fifteen (15) trap nights. Cage traps were placed in suitable areas of dense shrub and ground cover at the end of each of the *Elliott* trap lines to provide adequate separation throughout the study area. The cage traps were baited with sardines and laced with truffle oil. Jelly meat cat food was smeared over nearby trees as a lure.

Given the suitability of habitat present, Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted by call-playback techniques. Koala was targeted from additional call-playback locations as indicated on Figure 2.

2.5.4 Invertebrates

Given the proximity to previous *Atlas of NSW Wildlife* database records of Cumberland Plain Land Snail (*Meridolum corneovirens*), and the recorded presence of its typical host community CPW, target surveys were undertaken during initial survey in November 2012. Habitat searches were undertaken along search transects which spanned the length of CPW or neighbouring patches of SSTF patches of low sandstone influence. These remnants were located at the eastern vegetated extent of the study area. Search transect locations are shown on Figure 2.

Following the recorded presence of Cumberland Plain Land Snail, further target surveys were undertaken in February 2013. This survey aimed to determine the extent of habitat use and where living snails exist. Within search areas, the most appropriate areas of observed habitat were targeted. Dense areas of leaf litter with likely moisture retaining properties were scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks were also turned over.

Searches were later undertaken on site with snail expert Michael Shea on the 25th October 2013 as well as on the proposed offset site along Elladale Road, Appin on the 31st January 2014.

2.5.5 Habitat trees

A search for large hollows suitable for nesting by cockatoos and / or owls was undertaken during surveys. Locations were recorded on a *Trimble* handheld GPS unit and are shown on Figure 2.

2.6 Survey limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the subject site for that occasion. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may be observed within the subject site outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to minimise the implications of this survey limitation.

As some flora species are difficult to identify unless flowering, the presence of some species on site may have been overlooked. Care has been taken to target any area where native vegetation was present, traversing in a zig zag pattern.

2.6.1 Flora survey limitations

Due to the dense nature of understorey vegetation in parts of the southern portion of the site, (e.g. in the vicinity of Quadrats 31, 32, 36 and 37), target survey for threatened species was limited to the quadrats and a narrow meander in between them.

The survey was conducted in late spring over one potential period of flowering. The report by *Clements* does not state when field surveys were undertaken. One (1) additional day of survey was undertaken in the final week of summer in 2013 but was limited to the periphery of vegetation within the site and to those areas of adjacent vegetation between the site and the existing urban fringe of Appin.

Given that there has not likely been a repeat survey in the same season, it may be considered to be a limitation upon the survey results as not all plants will flower each year.

November is a very good time of the year to undertake target surveys for threatened flora species with potential to occur. *Persoonia bargoensis* is best targeted in summer to early autumn, however, it is not essential to survey during the flowering period as there are other characteristics of the plant which make it discernible, although survey during that period is preferred. *Persoonia bargoensis* prefers sandstone or laterite soils and given that there are few records nearby, (although there is one (1) record approximately 1km from the site), the potential for occurrence was low. Survey was undertaken during the flowering period for *Acacia*

bynoeana, Epacris purpurascens var. *purpurascens, Grevillea parviflora* subsp. *parviflora, Persoonia hirsuta, Pterostylis saxicola* and *Pultenaea pendunculata.*

It should be noted that the *Clements* report stated that no threatened flora species were observed.

2.6.2 Fauna survey limitations

Trapping to detect reptile activity was not undertaken during surveys. Habitat for the Broad-headed Snake is considered sub-optimal along Ousedale Creek with a low potential to occur. Only this species would justify this effort.

Targeted Koala survey has not included any detailed scat searches. Presence is not expected to occur as explained in Section 4.3.3.

Only opportunistic frog call identification has been undertaken along the northern edges of Ousedale Creek. Tadpole searches and spotlighting along the creek itself was not undertaken. Littlejohn's Tree Frog is considered to have a low potential to occur and Giant Burrowing Frog and Red-crowned Toadlet are considered unlikely to occur, based on soil, associated habitat and local records.

Survey Results 3

3.1 Flora results

3.1.1 Flora species

The plants observed within the vegetation communities of the subject site are listed in Table 3.1 below.

During the November 2012 flora survey, a total of two hundred and eight (208) species were observed. This includes one hundred and fifty one (151) native species and fifty seven (57) exotic species. The majority of exotic species were recorded within cleared or grazed portions of the site, along Macquariedale Road, along the edge of the sporting ovals or within the riparian corridor of Ousedale Creek. Within the quadrats, the level of exotic vegetation within the understorey rarely exceeded 5% projected foliage cover.

Table 3.1 – Flora observations for the subject site

Family	Scientific name	Common name
Trees		
Mimosaceae	*Acacia baileyana*	Cootamundra Wattle
Mimosaceae	*Acacia binervata*	Two-veined Hickory
Mimosaceae	*Acacia decurrens*	Black Wattle
Mimosaceae	*Acacia parramattensis*	Parramatta Wattle
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Myrtaceae	*Corymbia gummifera*	Red Bloodwood
Myrtaceae	*Corymbia maculata*	Spotted Gum
Eleocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark
Myrtaceae	*Eucalyptus fibrosa*	Broad Leaved Ironbark
Myrtaceae	*Eucalyptus longifolia*	Woollybutt
Myrtaceae	*Eucalyptus pilularis*	Blackbutt
Myrtaceae	*Eucalyptus punctata*	Grey Gum
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Santalaceae	*Exocarpos cupressiformis*	Native Cherry
Euphorbiaceae	*Glochidion ferdinandi*	Cheese Tree
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree
Meliaceae	*Melia azedarach* var. *australasica*	White Cedar
Oleaceae	*Notelaea longifolia*	Mock Olive
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum

Family	Scientific name	Common name
Shrubs		
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia floribunda*	Sally Wattle
Mimosaceae	*Acacia implexa*	Hickory
Mimosaceae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle
Mimosaceae	*Acacia terminalis*	Sunshine Wattle
Mimosaceae	*Acacia ulicifolia*	Prickly Moses
Agavaceae	*Agave americana**	Century Plant
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Native Blackthorn
Asteraceae	*Cassinia aculeata*	Dolly Bush
Rutaceae	*Correa reflexa*	Native Fuschia
Sapindaceae	*Dodonaea triquetra*	Hop Bush
Santalaceae	*Exocarpos strictus*	Pale Ballart
Proteaceae	*Hakea sericea*	Needlebush
Asteraceae	*Helichrysum elatum*	Tall Everlasting
Myrtaceae	*Kunzea ambigua*	Tick Bush
Verbenaceae	*Lantana camara**	Lantana
Sterculiaceae	*Lasiopetalum parvifolium*	Small Rusty-petals
Santalaceae	*Leptomeria acida*	Native Currant
Myrtaceae	*Leptospermum trinervium*	Flaky-barked Tea-tree
Epacridaceae	*Leucopogon juniperinus*	Prickly Beard-heath
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet
Oleaceae	*Ligustrum sinense**	Small-leaved Privet
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant
Rubiaceae	*Opercularia diphylla*	-
Asteraceae	*Osteospermum fruticosum**	Shrubby Daisy-bush
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge
Pittosporaceae	*Pittosporum revolutum*	Yellow Pittosporum
Fabaceae	*Podolobium ilicifolium*	Prickly Shaggy Pea
Rhamnaceae	*Pomaderris ferruginea*	-
Fabaceae	*Pultenaea retusa*	-
Rosaceae	*Rubus fruticosus* sp. agg.*	Blackberry Complex
Fabaceae	*Senna pendula* var. *glabrata**	-
Solanaceae	*Solanum mauritianum**	Wild Tobacco
Ulmaceae	*Trema tomentosa* var. *aspera*	Native Peach
Rutaceae	*Zieria smithii*	Sandfly Zieria
Groundcovers		
Orchidaceae	*Acianthus fornicatus*	Pixie Caps
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Asteraceae	*Ageratina adenophora**	Crofton Weed
Poaceae	*Aira cupaniana**	Silvery Hairgrass
Aloeaceae	*Aloe* sp.*	-
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel
Poaceae	*Andropogon virginicus**	Whisky Grass
Poaceae	*Anisopogon avenaceus*	Oat Speargrass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla Lily
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern

Family	Scientific name	Common name
Asparagaceae	*Asparagus scandens**	Asparagus Fern
Rubiaceae	*Asperula conferta*	Common Woodruff
Poaceae	*Austrodanthonia racemosa*	Wallaby Grass
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass
Poaceae	*Austrostipa pubescens*	Tall Speargrass
Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass
Poaceae	*Avena fatua**	Wild Oats
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
Poaceae	*Bromus cartharticus**	Prairie Grass
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern
Asteraceae	*Calotis dentex*	Boganflea
Cyperaceae	*Carex longebrachiata*	Bergalia Tussock
Gentianaceae	*Centaurium erythraea**	Pink Stars
Gentianaceae	*Centaurium tenuiflorum**	Branched Century
Apiaceae	*Centella asiatica*	Indian Pennywort
Sinopteridaceae	*Cheilanthes sieberi*	Rock Fern
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza sumatrensis**	Fleabane
Apiaceae	*Cyclospermum leptophyllum**	Slender Celery
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Phormiaceae	*Dianella caerulea* var. *caerulea*	Flax Lily
Phormiaceae	*Dianella revoluta* var. *revoluta*	Spreading Flax Lily
Orchidaceae	*Dendrobium speciosum*	Rock Orchid
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass
Convolvulaceae	*Dichondra repens*	Kidney Weed
Poaceae	*Digitaria ramularis*	-
Blechnaceae	*Doodia aspera*	Rasp Fern
Poaceae	*Echinopogon caespitosus* var. *caespitosus*	Tufted Hedgehog Grass
Boraginaceae	*Echium plantagineum**	Patterson's Curse
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia polygonoides*	-
Cyperaceae	*Eleocharis sphacelata*	Tall Spike-rush
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Eragrostis brownii*	Brown’s Lovegrass
Poaceae	*Eragrostis curvula**	African Lovegrass
Cyperaceae	*Gahnia aspera*	Saw Sedge
Rubiaceae	*Galium proquinquum*	Bedstraw
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Haloragaceae	*Gonocarpus teucroides*	Raspwort
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower
Dilleniaceae	*Hibbertia diffusa*	-
Apiaceae	*Hydrocotyle peduncularis*	Pennywort
Clusiaceae	*Hypericum perforatum**	St Johns Wort

Family	Scientific name	Common name
Asteraceae	*Hypochaeris radicata**	Flatweed
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Juncaceae	*Juncus continuus*	-
Juncaceae	*Juncus subsecundus*	Finger Rush
Juncaceae	*Juncus usitatus*	Common Rush
Poaceae	*Lachnagrostis filiformis*	Blown Grass
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily
Cyperaceae	*Lepidosperma filiforme*	-
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Poaceae	*Lolium perenne**	Perennial Ryegrass
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra multiflora* var. *multiflora*	Many-flowered Mat-rush
Lomandraceae	*Lomandra obliqua*	Twisted Mat-rush
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Haloragaceae	*Myriophyllum aquaticum**	Brazilian Water Milfoil
Poaceae	*Oplismenus aemulus*	Basket Grass
Cactaceae	*Opuntia stricta**	Common Prickly Pear
Hydrocharitaceae	*Ottelia ovalifolia*	Swamp Lily
Oxalidaceae	*Oxalis perennans*	-
Poaceae	*Panicum simile*	Two Colour Panic
Poaceae	*Paspalum dilatatum**	Paspalum
Iridaceae	*Patersonia sericea*	Wild Iris
Poaceae	*Pennisetum clandestinum**	Kikuyu
Polygonaceae	*Persicaria decipiens*	Slender Knotweed
Poaceae	*Phalaris aquatica**	Phalaris
Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower
Plantaginaceae	*Plantago debilis*	Slender Plantain
Plantaginaceae	*Plantago lanceolata**	Ribwort
Plantaginaceae	*Plantago varia*	
Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower
Poaceae	*Poa annua**	Winter Grass
Poaceae	*Poa labillardieri* var. *labillardieri*	Tussock Grass
Rubiaceae	*Pomax umbellata*	Pomax
Euphorbiaceae	*Poranthera microphylla*	
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Polygonaceae	*Rumex crispus**	Curled Dock
Goodeniaceae	*Scaevola albida*	Pale Fan-flower
Cyperaceae	*Schoenus melanostachys*	Black Bog Rush
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	-
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Solanaceae	*Solanum nigrum**	Black Nightshade
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Solanaceae	*Solanum pseudocapsicum**	-
Asteraceae	*Soliva sessilis**	Jojo
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass

Family	Scientific name	Common name
Phormiaceae	*Stypandra glauca*	Nodding Blue Lily
Asteraceae	*Taraxacum officinale**	Dandelion
Orchidaceae	*Thelymitra ixioides* var. *ixioides*	Spotted Sun Orchid
Poaceae	*Themeda australis*	Kangaroo Grass
Anthericaceae	*Thysanotus tuberosus*	Fringed Lily
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Fabaceae	*Trifolium pratense**	Red Clover
Fabaceae	*Trifolium repens**	White Clover
Verbenaceae	*Verbena bonariensis**	Purpletop
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell
Asteraceae	*Vittadinia cuneata var. cuneata*	Fuzzweed
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell
Araeceae	*Zantedeschia aethiopica**	White Arum Lily
Vines		
Apocnyaceae	*Araujia sericifera**	Mothvine
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper
Pittosporaceae	*Billardiera scandens* var. *scandens*	Apple Dumplings
Lauraceae	*Cassytha pubescens*	Common Devil's Twine
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Fabaceae	*Desmodium varians*	-
Chenopodiaceae	*Einadia nutans* subsp. *linifolia*	Climbing Saltbush
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Glycine tabacina*	Variable Glycine
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
Fabaceae	*Kennedia prostrata*	Running Postman
Fabaceae	*Kennedia rubicunda*	Dusky Coral Pea
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle
Apocynaceae	*Marsdenia rostrata*	Common Milk Vine
Rubiaceae	*Morinda jasminoides*	-
Bignoniaceae	*Pandorea pandorana*	Wonga Vine
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Passifloraceae	*Passiflora edulis**	Common Passionfruit
Passifloraceae	*Passiflora herbertiana*	Native Passionfruit
Apocynaceae	*Tylophora barbata*	Bearded Tylophora
*** denotes exotic species**		

3.1.2 Vegetation communities

Nine (9) vegetation communities were observed within the site boundary through extensive ground truthing. They were:

- Vegetation Community 1 – Aquatic Herbfield
- Vegetation Community 2 – Cleared or Scattered Trees
- Vegetation Community 3 – Young Regrowth Vegetation
- Vegetation Community 4 – Forest Red Gum Forest / Woodland
- Vegetation Community 5 – Disturbed Forest Red Gum Forest / Woodland
- Vegetation Community 6 – Forest Red Gum / Ironbark Forest
- Vegetation Community 7 – Grey Gum / Blackbutt / Rough-barked Apple Forest
- Vegetation Community 8 – Grey Gum / Blackbutt Forest
- Vegetation Community 9 – Grey Gum Forest

Aquatic Herbfield

One small dam is located on the southern side of Macquariedale Road, approximately 120m west of the existing residence and 15m from the road. The size of the dam is around 0.03ha.

Vegetation within the dam is sparse to moderate with only a few species present, including *Eleocharis sphacelata* and *Otellia ovalifolia.* There are some fringing *Juncus* species on the rim of the dam. The invasive exotic species *Myriophyllum aquaticum* was noted in the eastern edge of the dam.

Photo 1 – Aquatic Herbfield on the south side of Macquariedale Road

Cleared or Scattered Trees

The majority of cleared vegetation was observed on the southern side of Macquariedale Road. A few remnant eucalypt trees may remain to the south of the Aquatic Herbfield, the only trees elsewhere are Acacia species.

The ground layer is predominately exotic south of Macquariedale Road due to previous grazing activities and maintenance as a grassed paddock. The number of native species increases amongst the few remnant trees to the south of the Aquatic Herbfield. North of Macquariedale Road, the understorey is fairly evenly mixed between natives and exotics with *Microlaena stipoides* being the dominant native grass species.

Some of this vegetation type exists adjacent to the eastern boundary amongst the remnant CPW vegetation.

Young Regrowth Vegetation

This vegetation community occurs in the southern-most paddock over an area of 0.82 ha and comprises of young regrowth (less than five (5) years old) of *Acacia decurrens* and *Kunzea ambigua* with a mixture of native and exotic grasses, herbs and annuals. The vegetation appears to be managed and is currently treeless. With limited native species diversity, it is difficult to determine if the past vegetation was CPW or SSTF, although it is likely to be mostly CPW.

Photo 2 – Young regrowth vegetation within the southern-most paddock

Note: the vegetation described as regrowth has been permitted to be cleared by the Hawkesbury Nepean Catchment Management Authority in July 2008 as it met the definition of regrowth under the CMA's guidelines.

Forest Red Gum Forest / Woodland

This vegetation community occurs in the eastern extremities of the remnant vegetation to the north east of the sporting oval, immediately west of Lewis Street, and as two (2) linear patches along Macquariedale Road and the southern site boundary. In total, this vegetation community occupies approximately 2.66 ha.

Forest Red Gum Forest / Woodland is equivalent to the biometric vegetation type HN528 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin (CPW).

Canopy – Predominately comprised of *Eucalyptus tereticornis.* North of Macquariedale Road, the projected foliage cover was generally less than 10%. South of Macquariedale Road in the two (2) linear patches, the canopy cover was around the benchmark figure of between 20-30%. The average height of the canopy is approximately 22-30m.

Mid-storey – Occasional *Acacia decurrens, Bursaria spinosa, Kunzea ambigua, Acacia parramattensis* and *Allocasuarina littoralis* with a projected foliage cover of 5-25%.

Ground layer – Common native species include *Einadia hastata, Leucopogon juniperinus, Dichondra repens, Centella asiatica, Pratia purpurascens, Oxalis perennans, Entolasia marginate, Microlaena stipoides* and *Echinopogon caespitosus.*

Disturbances – Moderate to high incursions of ground layer weeds in most areas however very low around Quadrat 7.

Photo 3 – Forest Red Gum dominated vegetation, Quadrat 24

Disturbed Forest Red Gum Forest / Woodland

As for the previous description however the mid-storey is much reduced to absent and the ground layer is regularly mown. This vegetation community occurs within a 100m radius of the existing residence on the south side of Macquariedale Road.

Forest Red Gum / Ironbark Forest

This vegetation community occurs on low sandstone influenced soils and adjoins CPW vegetation. The vegetation relates to the Catchment Management Authority's biometric equivalent of HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (SSTF).

Forest Red Gum / Ironbark Forest occupies approximately 4.92 ha of the site, occurring to the immediate west and north west of the residence, just south of Macquariedale Road, and as a larger patch of over 3ha near the southern boundary.

Canopy – Comprised of *Eucalyptus tereticornis* and *Eucalyptus fibrosa.* To a lesser extent, there are *Eucalyptus resinifera, Eucalyptus eugenioides* and rarely *Eucalyptus punctata.* The height of the canopy is mostly above 20m and up to 33m.

Mid-storey – Within the southern patch (3.1ha), the mid-storey vegetation is moderate through to very dense with the projected foliage cover reaching up to 80%. On the eastern edge of this patch it is reduced back to around 15%. The patches to the west and north west of the residence vary between 15-35%. Common species include *Bursaria spinosa, Kunzea ambigua, Acacia decurrens, Exocarpos cupressiformis, Allocasuarina littoralis* and the vine *Parsonsia straminea.*

Ground layer – Variable in make-up between the presence of grasses, herbs, ferns and small shrubs. Common species include *Microlaena stipoides, Entolasia* spp., *Echinopogon caespitosus, Dichelachne micrantha, Austrostipa pubescens, Aristida vagans, Leucopogon juniperinus, Solanum prinophyllum, Desmodium varians, Calotis dentex, Dichondra repens, Glycine clandestina, Lomandra filiformis, Lomandra multiflora* and *Pratia purpurascens.*

Disturbances – There are some existing pathways in the southern patch. The other patches to the west and north west of the existing residence have had some understorey clearing in the past and there is a low to moderate incidence of weeds present.

Photo 4 – Forest Red Gum / Ironbark vegetation, Quadrat 35

Grey Gum / Blackbutt / Rough-barked Apple Forest

This vegetation community occurs on high sandstone influenced soils and adjoins Ousedale Creek. It has moderate levels of rock-outcropping and some riparian influences. The vegetation relates to the Catchment Management Authority's biometric equivalent of HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (SSTF).

Canopy – Dominated by the presence of *Eucalyptus punctata, Eucalyptus pilularis* and *Angophora floribunda. Angophora floribunda* occurs almost exclusively within this vegetation community and was mostly found within 50m of Ousedale Creek. The height of the canopy varies between 25-35m with an average projected foliage cover of 30-35%.

Mid-storey – Common species include *Pomaderris ferruginea, Acacia floribunda, Acacia parramattensis, Dodonaea triquetra, Notelaea longifolia, Allocasuarina littoralis, Kunzea ambigua, Acacia binervata, Persoonia linearis* and *Exocarpos cupressiformis.* The height of the mid-storey is largely between 1-4m with emergent *Acacia* spp. up to 12m and a projected foliage cover of 50%.

Ground layer – The ground layer is diverse with small shrubs, herbs, ferns and grasses. Common species include *Stypandra glauca, Morinda jasminoides, Lomandra longifolia, Doodia aspera, Dianella caerulea, Billardiera scandens, Leucopogon juniperinus, Lepidosperma laterale, Glycine clandestina, Microlaena stipoides, Imperata cylindrica* var. *major, Entolasia stricta, Cheilanthes sieberi, Dichondra repens* and the vine *Clematis aristata.*

Disturbances – There are minimal disturbances to this community. There is one walking track adjacent to the creek line in the north western portion of the site.

Photo 5 – Vegetation along Ousedale Creek, Transect 1

Grey Gum / Blackbutt Forest

This vegetation community occurs approximately 50-125m from Ousedale Creek in high sandstone influenced soils and limited rock outcropping (less than 5%). The vegetation relates to the Catchment Management Authority's biometric equivalent of HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (SSTF). This vegetation community occurs over 6.28 ha.

Canopy – Predominately comprised of *Eucalyptus punctata* and *Eucalyptus pilularis. Corymbia gummifera* was noted within the north western corner of the site and not noted elsewhere (from Quadrat 14 and north). Less dominant, but common canopy species, also include *Eucalyptus fibrosa* and *Eucalyptus sparsifolia.* Canopy height occasionally exceeded 30m but mostly 20-28m. The projected foliage cover of the canopy varied between 15-40%.

Mid-storey – Common species include *Acacia binervata, Acacia decurrens, Pomaderris ferruginea, Kunzea ambigua, Acacia implexa, Allocasuarina littoralis, Persoonia linearis, Acacia floribunda, Dodonaea triquetra, Bursaria spinosa, Exocarpus cupressiformis* and the vine *Parsonsia straminea.* There is a common layer to a height of approximately 4m then the *Acacia* spp. and *Allocasuarina littoralis* reach between 8-12m.

Ground layer – Moderately grassy with a mixture of herbs, small shrubs and ferns. Common species include *Stypandra glauca, Billardiera scandens, Leucopogon juniperinus, Lepidosperma laterale, Pimelea linifolia, Pomax umbellata, Hibbertia aspera, Poranthera microphylla,Glycine clandestina, Microlaena stipoides, Aristida vagans, Anisopogon avenaceus, Echinopogon caespitosus, Entolasia stricta, Dichondra repens* and the vine *Clematis aristata.*

Disturbances – Very limited; in good condition.

Photo 6 – Grey Gum / Blackbutt vegetation, Quadrat 14

Grey Gum Forest

This vegetation community comprises around 60% of all vegetation within the site, or approximately 31.99 ha. The vegetation relates to the Catchment Management Authority's biometric equivalent of HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (SSTF).

Canopy – Heavily dominated by *Eucalyptus punctata.* Many other species exist as part of the canopy but vary in dominance. Examples include *Eucalyptus resinifera, Eucalyptus fibrosa, Eucalyptus pilularis, Eucalyptus longifolia* and *Eucalyptus tereticornis.* The average height of the canopy is around 25-30m with an average projected foliage cover of 25% (averaged over more than twenty (20) quadrats).

Mid-storey – Common species include *Acacia decurrens, Kunzea ambigua, Allocasuarina littoralis, Persoonia linearis, Acacia floribunda, Dodonaea triquetra, Bursaria spinosa, Exocarpus cupressiformis* and the vine *Parsonsia straminea.* In the northern portion of the site (north from Quadrat 13 and east of Quadrat 18) the mid-storey is dominated by *Melaleuca styphelioides.* There is a moderate clay influence in the area and limited topographical change. This area may be a short term sink where excess water drains from the adjoining sports oval. The *Acacia* spp., *Melaleuca stypelioides* and *Allocasuarina littoralis* reach between 8-12m.

Ground layer - Moderately grassy with a mixture of herbs, small shrubs and ferns. Common species include *Stypandra glauca, Billardiera scandens, Leucopogon juniperinus, Lepidosperma laterale, Pimelea linifolia, Pomax umbellata, Hibbertia aspera, Poranthera microphylla, Glycine clandestina, Microlaena stipoides, Aristida vagans, Echinopogon caespitosus, Entolasia stricta, Dichelache micrantha, Austrostipa pubescens, Dichondra repens* and *Gahnia aspera.*

Photo 7 – Grey Gum dominated vegetation with Melaleuca mid-storey, Quadrat 21

Photo 8 – Grey Gum dominated vegetation, Quadrat 33

3.1.3 Comparison to biometric vegetation types

The equivalent biometric vegetation types were thus sourced from the OEH database for the Hunter-Nepean catchment area.

Vegetation Communities 4 and 5 relate most closely to HN528 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin (CPW).

Vegetation Communities 6, 7, 8 and 9 relate most closely to HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (SSTF).

Biometric Benchmarks

The OEH has published benchmark figures for all biometric vegetation types across NSW. The following table highlights the appropriate benchmark figures for the two (2) biometric vegetation types within the site boundary.

The biometric benchmarks are in Table 3.2.

Table 3.2 – Biometric benchmark data

Veg. comm.	Native species richness	Native overstorey cover		Native mid-storey cover		Native ground cover (grasses)		Native ground cover (shrubs)		Native ground cover (other)		No. of trees with hollows	Total length of fallen logs
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper		
HN526	29	20.5	25.5	25.5	30.5	26.8	30.8	0	5	14.8	18.8	0	0
HN556	36	18.5	23.5	13	23	15	21	0	10	15	21	0	0

Quadrat Analysis Part 1

Table 3.3 – Quadrat data in biometric format

Quadrat	Native species richness	Native overstorey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	No. of trees with hollows	Total length of fallen logs	Biometric vegetation type
1	29	13.5	51.5	30	30	20	0	22	HN556
2	30	25	38	15	12	25	2	17	HN556
3	35	20	43.5	50	15	20	1	33	HN556
4	31	11.5	32	12	10	8	1	6	HN556
5	47	23	33	70	10	15	1	14	HN556
6	28	31	29	70	12	12	0	13	HN556
7	15	2	26.5	93	2	1	0	0	HN526
8	20	11.5	33	80	3	7	1	7	HN556
9	26	27	19	65	10	10	0	9	HN556
10	26	28	31	50	15	30	0	2	HN556
11	45	29	27	45	20	20	0	40	HN556
12	37	38	32	50	20	29	2	36	HN556
13	28	33	25.5	35	12	8	1	43	HN556
14	34	23.5	33.5	20	25	20	2	31	HN556
15	35	14	28	35	20	30	3	28	HN556
16	36	22	39	30	15	30	1	17	HN556
17	18	26.5	38	15	5	35	1	9	HN556
18	27	12	38	35	7	25	1	7	HN556
19	32	16	21.5	30	25	25	3	25	HN556
20	20	8	69	15	8	12	2	8	HN556
21	27	31	50	40	8	40	1	16	HN556
22	28	32	36.5	35	8	35	0	27	HN556
23	38	17	22	50	15	20	0	6	HN556
24	18	8	11.5	65	5	15	1	3	HN526
25	15	8	22	35	3	7	0	8	HN526
26	25	17.5	31.5	60	12	25	0	33	HN556
27	25	21	37	80	8	5	0	30	HN556
28	35	28	26	50	12	25	0	37	HN556
29	41	26	27	20	17	60	4	26	HN556
30	39	23.5	15.5	40	15	35	2	36	HN556
31	26	22	71.5	55	10	10	2	20	HN556
32	23	21.5	72	25	8	15	1	5	HN556
33	34	13	28.5	50	20	20	0	25	HN556
34	28	25	50	70	12	10	0	9	HN556

Quadrat	Native species richness	Native overstorey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	No. of trees with hollows	Total length of fallen logs	Biometric vegetation type
35	23	15	30	80	5	5	0	16	HN556
36	27	20.5	44	25	20	5	1	4	HN556
37	25	8.5	58	65	15	15	0	8	HN556
38	25	31	15.5	55	15	5	0	4	HN556
39	32	26	31	55	7	25	1	15	HN556
40	27	21	29.5	70	15	15	0	12	HN556
41	48	38	36	35	15	20	n/a	n/a	HN556
42	44	29	27	30	15	25	n/a	n/a	HN556
43	41	18	12	30	8	30	n/a	n/a	HN556
44	40	17	21	20	15	30	n/a	n/a	HN556
45	32	34	26	40	10	15	n/a	n/a	HN556
46	15	0	0	75	3	3	n/a	n/a	cleared
47	14	40	10	65	5	5	n/a	n/a	HN526
48									

Low condition vegetation is described as (*BioBanking Assessment Methodology* and *Credit Calculator Operation Manual*, DECCW):

Woody native vegetation with;

- native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and

    - less than 50% of groundcover vegetation is indigenous species, or
    - greater than 90% of groundcover vegetation is cleared.

For quadrats that are equivalent to ME020, an over-storey coverage of 5% or less may be regarded as low condition vegetation if less than 50% of groundcover vegetation is indigenous species. For quadrats that are equivalent to ME021, an over-storey coverage of less than 5% may be regarded as low condition vegetation if less than 50% of groundcover vegetation is indigenous species.

With respect to all quadrats, only Quadrat 7 fell below the benchmark figure for over-storey coverage. Whilst native species diversity was considered low and the placement of the quadrat was near a clearing, edge effects were low and presence of exotic species in the understorey was only about 1% of the foliage cover. As such, Quadrat 7 could not be regarded as low condition vegetation.

Quadrat Analysis Part 2 – *Tozer (2003)*

For the map units, the minimum number of native species required to carry out the tests and the number of positive diagnostic species required for seven (7) locally occurring map units are (Table 3.4):

Table 3.4 – Diagnostic test for vegetation type (Tozer 2003)
(Source: *Anne Clements & Associates* (2007)

Map Unit	Abbreviation	Minimum no. of native species	Minimum no. of positive diagnostic species
1 – Shale-Sandstone Transition Forest (Low Sandstone Influence)	SSTF (LSI)	≥ 33	≥ 12
2 – Shale-Sandstone Transition Forest (High Sandstone Influence)	SSTF (HSI)	≥ 40	≥ 20
9 – Shale Hills Woodland	SHW	≥ 28	≥ 15
10 – Shale Plains Woodland	SPW	≥ 30	≥ 22
12 – Riparian Forest	RF	≥ 17	≥ 6
32 – Upper Georges River Sandstone Woodland	UGRSW	≥ 42	≥ 27
33 – Western Sandstone Gully Forest	WSGF	≥ 39	≥ 27

Utilising *Tozer,* a comparative test was performed on each quadrat to test a 'best fit' of the vegetation type against that of *Tozer* (2003) and *NPWS* (2002) (Table 3.5). Under the heading of Map Units 1, 2, 10 and 32 are the number of corresponding positive diagnostic species observed within the quadrat.

Table 3.5 – Determination of vegetation community (Tozer (2003) & NPWS (2002))

Quadrat	Native species richness	Map Unit 1	Map Unit 2	Map Unit 10	Map Unit 32	Result
1	29	6	13		8	Map Unit 2
2	30	7	19		10	Map Unit 2
3	35	7	19		13	Map Unit 2
4	31	6	24		11	Map Unit 2
5	47	13	26		10	Map Unit 2
6	28	8	15		7	Map Unit 2
7	15	7	8	7	4	Map Unit 10 **** see note 1**
8	20	6	10	3	6	Map Unit 2
9	26	10	16		7	Map Unit 2
10	26	7	17		8	Map Unit 2
11	45	11	28		14	Map Unit 2
12	37	12	15		7	Map Unit 1
13	28	8	18		7	Map Unit 2
14	34	5	18		17	Map Unit 2
15	35	7	20		13	Map Unit 2
16	36	9	19		12	Map Unit 2
17	18	5	13		5	Map Unit 2
18	27	6	14		7	Map Unit 2
19	32	6	16		13	Map Unit 2
20	20	6	15		7	Map Unit 2
21	27	7	18		8	Map Unit 2
22	28	11	17		7	Map Unit 2
23	38	14	20	10	7	Map Unit 1
24	18	6	7	5	3	Map Unit 10 **** see note 1**
25	15	8	7	7	2	Map Unit 10 **** see note 1**
26	25	8	11	5	6	Map Unit 1
27	25	11	13		7	Map Unit 1
28	35	11	20		7	Map Unit 2
29	41	8	22		13	Map Unit 2
30	39	11	23		10	Map Unit 2

Quadrat	Native species richness	Map Unit 1	Map Unit 2	Map Unit 10	Map Unit 32	Result
31	26	8	12		6	Map Unit 2
32	23	8	10		4	Map Unit 2
33	34	6	21		8	Map Unit 2
34	28	10	15		4	Map Unit 2
35	23	11	13	8	3	Map Unit 1
36	27	10	12	9	3	Map Unit 1
37	25	12	12	6	3	Map Unit 1
38	25	9	14	10	4	Map Unit 1
39	32	8	17		7	Map Unit 2
40	27	12	13	9	3	Map Unit 1

Note 1 – Borderline between SSTF and CPW. The dominant species within the quadrats were more aligned to the CPW community.

Note 2 – Quadrats 41-47 were not tested but briefly compared to Tozer. It was obvious which EEC or otherwise they resembled.

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed in Table 3.6 below.

Table 3.6 – Fauna observations for the study area

Common name	Scientific name	Method observed
Birds		**Nov 2012**
Australian King Parrot	*Alisterus scapularis*	O C
Australian Magpie	*Gymnorhina tibicen*	O C
Australian Pelican	*Pelecanus conspicillatus*	O
Australian Raven	*Corvus coronoides*	O C
Australian Wood Duck	*Chenonetta jubata*	O
Bar-shouldered Dove	*Geopelia humeralis*	O C
Bell Miner	*Manorina melanophrys*	O C
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O C
Black-shouldered Kite	*Elanus axillaris*	O
Brown Cuckoo-Dove	*Macropygia amboinensis*	O C
Brown Goshawk	*Accipiter fasciatus*	O C
Brown Thornbill	*Acanthiza pulsilla*	O C
Channel-billed Cuckoo	*Scythrops novaehollandiae*	O C
Common Blackbird *	*Turdus merula*	O C
Common Bronzewing	*Phaps chalcoptera*	O
Common Koel	*Eudynamys scolopacea*	O C
Common Myna *	*Acridotheres tristis*	O C
Crested Pigeon	*Ocyphaps lophotes*	C
Crimson Rosella	*Platycerus elegans*	C [PR]
Dollarbird	*Eurystomus orientalis*	C
Dusky Moorhen	*Gallinula tenebrosa*	O
Dusky Woodswallow	*Artamus cyanopterus*	O C
Eastern Rosella	*Platycercus eximius*	O C
Eastern Spinebill	*Acanthorhynchus tenuirostris*	O C
Eastern Whipbird	*Psophodes olivaceus*	O C
Eastern Yellow Robin	*Eopsaltria australis*	O C
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	C
Galah	*Cacatua roseicapilla*	O C
Gang-gang Cockatoo [TS]	*Callocephalon fimbriatum*	O C
Glossy Black-Cockatoo [TS]	*Calyptorhynchus lathami*	O C
Golden Whistler	*Pachycephala pectoralis*	C [PR]
Grey Butcherbird	*Cracticus torquatus*	O C
Grey Fantail	*Rhipidura fuliginosa*	O C
Grey Shrike-thrush	*Colluricincla harmonica*	O C
Jacky Winter	*Microeca fascinans*	C [PR]
Laughing Kookaburra	*Dacelo novaeguineae*	O
Leaden Flycatcher	*Myiagra rubecula*	O C
Little Black Cormorant	*Phalacrocorax sulcirostris*	O C
Little Lorikeet [TS]	*Glossopsitta pusilla*	C [PO]
Little Wattlebird	*Anthochaera chrysoptera*	C
Long-billed Corella	*Cacatua tenuirostris*	C [PR]
Magpie-lark	*Grallina cyanoleuca*	C
Masked Lapwing	*Vanellus miles*	O C
Musk Lorikeet	*Glossopsitta concinna*	O C

Common name	Scientific name	Method observed
Nankeen Kestrel	*Falco cenchroides*	O
Noisy Friarbird	*Philemon corniculatus*	O C
Noisy Miner	*Manorina melanocephala*	O C
Olive-backed Oriole	*Oriolus sagittatus*	O C
Pacific Black Duck	*Anas superciliosa*	O
Pacific Baza	*Aviceda subcristata*	O C
Pallid Cuckoo	*Cululus pallidus*	C
Pied Currawong	*Strepera graculina*	O C
Powerful Owl [TS]	*Ninox strenua*	S P
Purple Swamphen	*Porphyrio porphyrio*	O
Rainbow Lorikeet	*Trichoglossus haematodus*	O C
Red Junglefowl *	*Gallus gallus*	I C
Rock Dove *	*Columba livia*	O
Rufous Whistler	*Pachycephala rufiventris*	O C
Sacred Kingfisher	*Todiramphus sanctus*	C
Satin Bowerbird	*Ptilonorhynchus violaceus*	O C
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	C
Silvereye	*Zosterops lateralis*	C
Spotted Pardalote	*Pardalotus punctatus*	C
Striated Thornbill	*Acanthiza lineata*	O C
Sulphur Crested Cockatoo	*Cacatua galerita*	O C
Superb Fairy-wren	*Malurus cyaneus*	O C
Varied Sittella [TS]	*Daphoenositta chrysoptera*	O C
Variegated Fairy-wren	*Malurus lamberti*	O C
Welcome Swallow	*Hirundo neoxena*	O
White-bellied Cuckoo-shrike	*Coracina papuensis*	C
White-browed Scrubwren	*Sericornis frontalis*	O C
White-faced Heron	*Egretta novaehollandiae*	O
White-throated Gerygone	*Gerygone olivacea*	C
White-throated Needletail	*Hirundapus caudacutus*	O
Willie Wagtail	*Rhipidura leucophrys*	O C
Yellow-tufted Honeyeater	*Licherostomus melanops*	O C
Yellow-faced Honeyeater	*Lichenostomus chrysops*	O C
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	O C
Mammals		
Black Rat *	*Rattus rattus*	T
Brown Antechinus	*Antechinus stuartii*	T
Chocolate Wattled Bat	*Chalinolobus morio*	A[PR]
Common Brushtail Possum	*Trichosurus vulpecula*	S
Common Ringtail Possum	*Pseudocheirus peregrinus*	S
Common Wombat	*Vombatus ursinus*	I
Domesticated Dog *	*Canis familiaris*	C
Domesticated Goat *	*Capra hircus*	O
East-coast Freetail Bat [TS]	*Micronomus norfolkensis*	A
Eastern Bentwing-bat [TS]	*Miniopterus orianae oceansis*	A[PR]
Eastern Freetail-bat	*Mormopterus ridei*	A[PO]
European Red Fox *	*Vulpes vulpes*	S
Gould's Wattled Bat	*Chalinolobus gouldii*	A
Greater Broad-nosed Bat [TS]	*Scoteanax rueppelli*	A
Grey-headed Flying-fox [TS]	*Pteropus poliocephalus*	S
Horse *	*Equus caballus*	O
Large Forest Bat	*Vespadelus darlingtoni*	A

Common name	Scientific name	Method observed
Long-eared Bat	*Nyctophilus sp*	A
Little Forest Bat	*Vespadelus vulturnus*	A
Rabbit *	*Oryctolagus cuniculus*	I
Short-beaked Echidna	*Tachyglossus aculeatus*	O
Sugar Glider	*Petaurus breviceps*	T S
Swamp Wallaby	*Wallabia bicolor*	S O
White-striped Mastiff-bat	*Austronomus australis*	A
Yellow-bellied Sheathtail-bat [TS]	*Saccolaimus flaviventris*	A [PR]
Reptiles		
Bar-sided Skink	*Eulamprus tenius*	H
Eastern Bearded Dragon	*Pogona barbata*	O
Eastern Water Dragon	*Physignathus lesueurii*	O
Eastern Water Skink	*Eulamprus quoyii*	O
Grass Skink	*Lampropholis guichenoti*	O
Jacky Lizard	*Amphibolurus muricatus*	O
Lace Monitor	*Varanus varius*	O I
Red-Bellied Black Snake	*Pseudechis porphyriacus*	O H
Amphibians		
Broad-palmed Frog	*Litoria latopalmata*	C
Common Eastern Froglet	*Crinia signifera*	C
Dwarf Tree Frog	*Litoria fallax*	C
Laughing Tree Frog	*Litoria tyleri*	C
Peron's Tree Frog	*Litoria peronii*	C
Smooth Toadlet	*Uperoleia laevigata*	C
Striped Marsh Frog	*Limnodynastes peronii*	C O
Whistling Tree Frog	*Litoria verreauxii*	C
Mollusc		
Cumberland Land Snail [TS]	*Meridolum corneovirens*	H
Common Garden Snail *	*Helix aspersa*	H
A carnivorous snail *	*Austrorhytida capillacea*	H

Note: * indicates introduced species
[TS] indicates threatened species

All species listed are identified to a high level of certainty unless otherwise noted as:
[PR] indicates species identified to a 'probable' level of certainty
[PO] indicates species identified to a 'possible' level of certainty

A	-	Anabat II/SD-1	C	-	Call Identification
O	-	Observation	P	-	Call-playback Response
T	-	Trap (*Elliott*, cage, etc)	H	-	Habitat Search
S	-	Spotlight	I	-	Scat, Track or Sign Identification

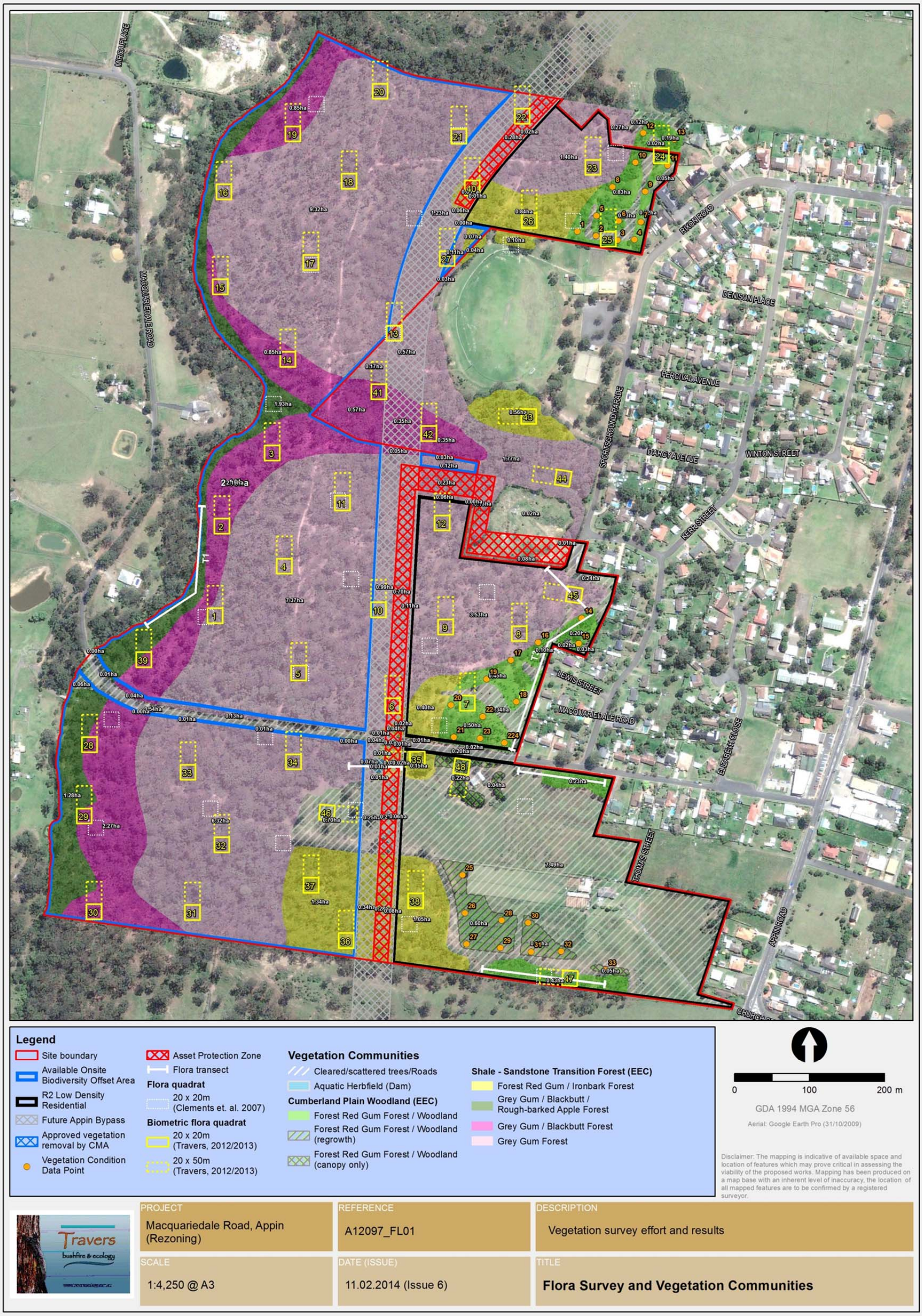

Figure 1 – Flora Survey and Vegetation Communities

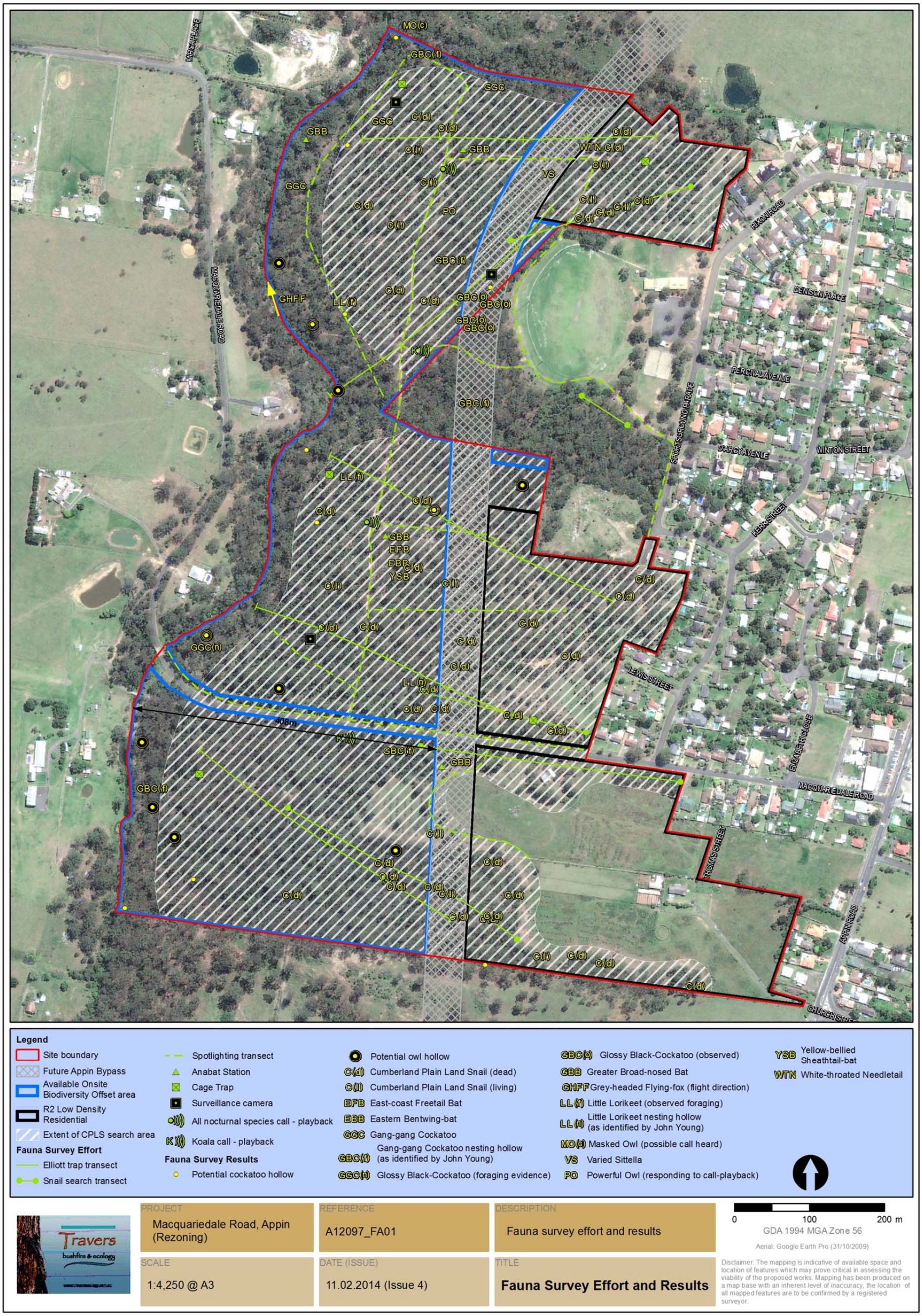

Figure 2 – Fauna Survey Effort and Results

Ecological Assessment 4

4.1 Previous surveys reviewed

The NPWS – *Vegetation Mapping of the Cumberland Plain, 2002* was examined to identify the potential vegetation communities on site. An extract of that mapping is provided (Figure 3).

1 – Shale-Sandstone Transition Forest (Low Sandstone Influence)
2 – Shale-Sandstone Transition Forest (High Sandstone Influence)
32 – Upper Georges River Sandstone Woodland
33 – Western Sandstone Gully Forest

Based upon the NPWS mapping, only SSTF occurs within the site.

More recent vegetation mapping of the Sydney area by *Tozer* maps the site as containing Cumberland Shale Sandstone Transition Forest. Refer to Figure 4.

Clements (2007) vegetation mapping is shown in Figure 5.

Original vegetation as mapped by *Clements* denotes vegetation within the western portion of the site is attributed to a sandstone vegetation community, not deemed to qualify for the EEC SSTF, based upon soil analysis. The central vegetated portion was mapped as SSTF, whilst the remainder of lands in the east was mapped as cleared / disturbed.

Later vegetation analysis by *Clements* extended the SSTF further towards Ousedale Creek.

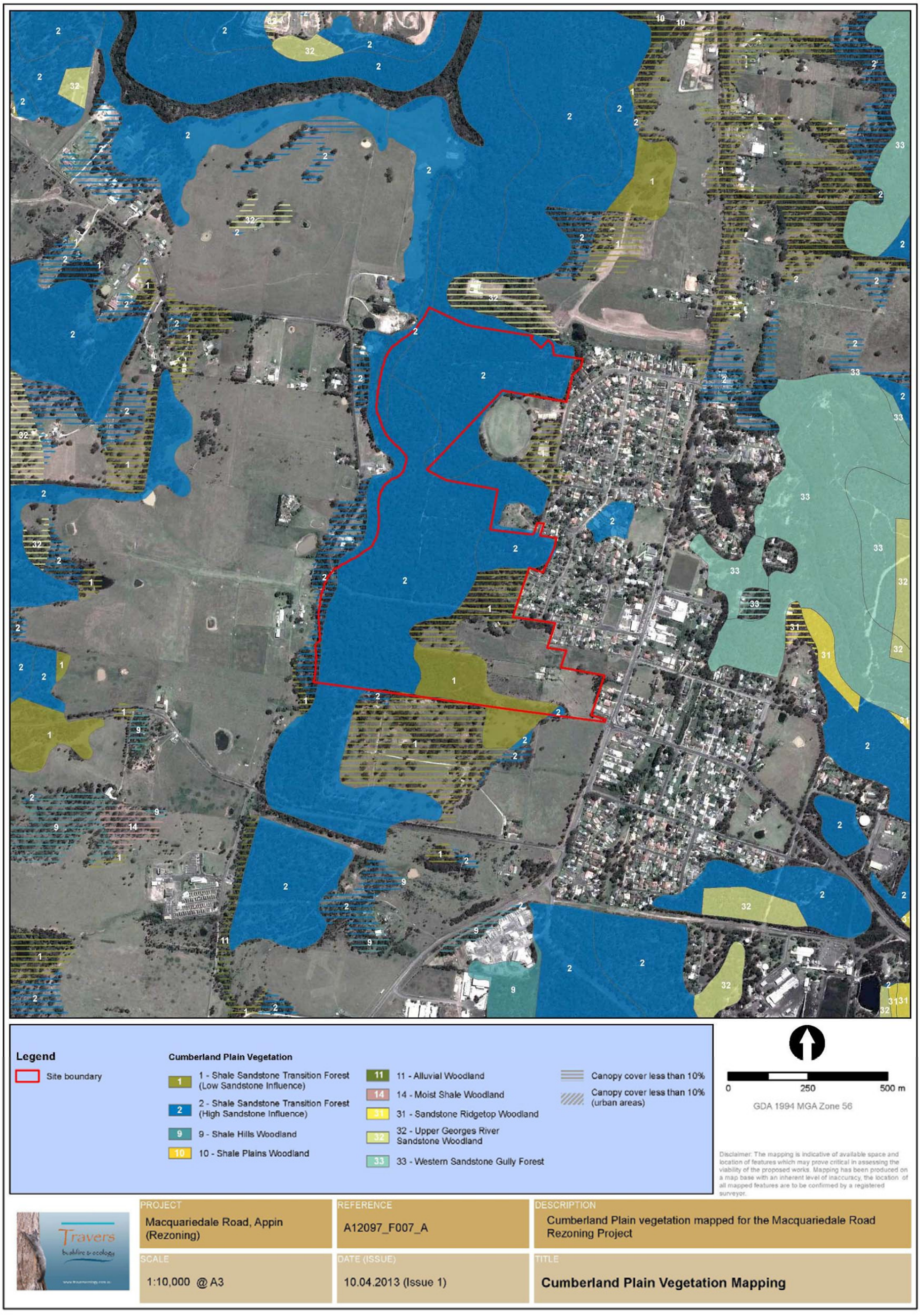

Figure 3 – NPWS (2002) vegetation mapping

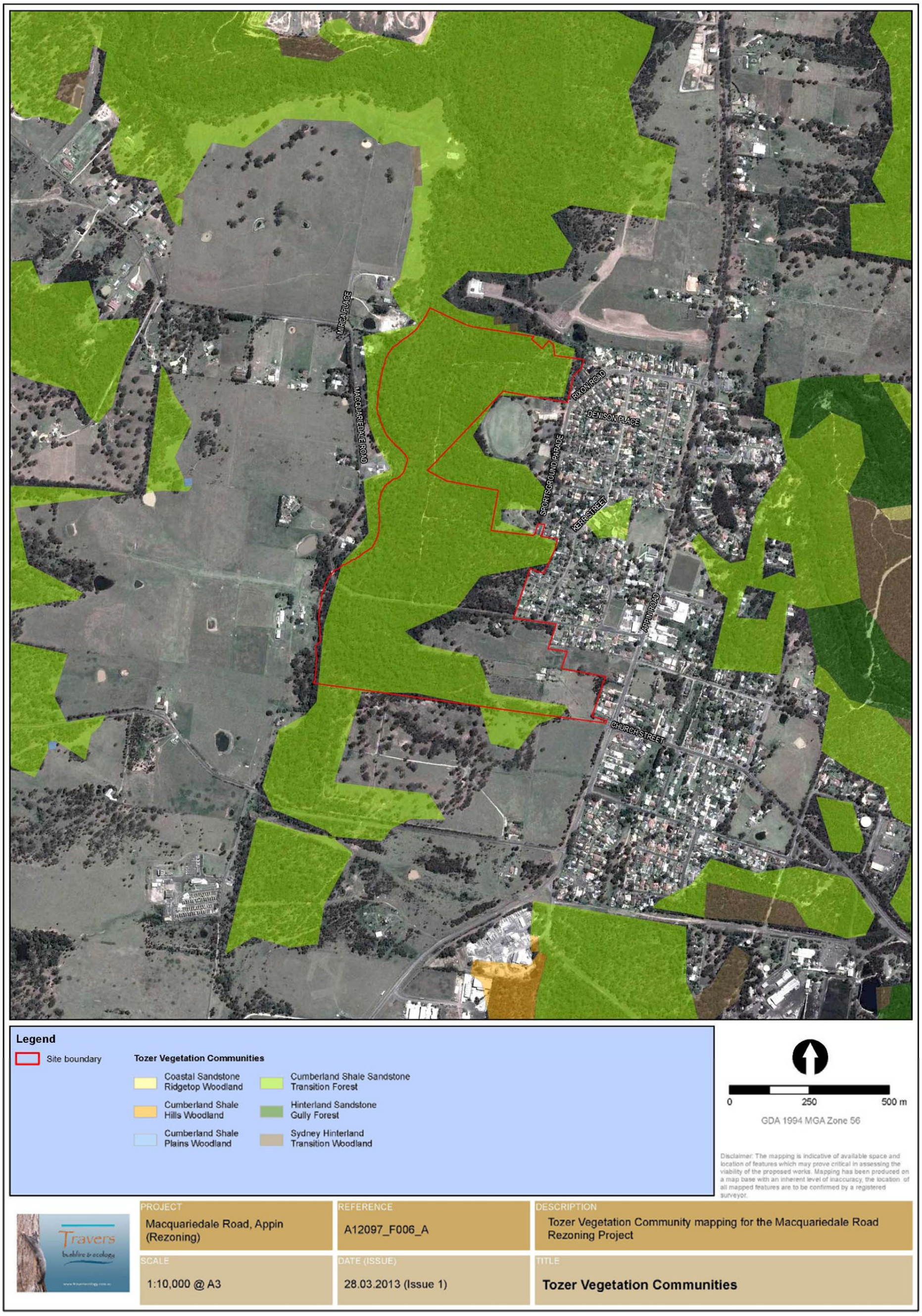

Figure 4 – Tozer vegetation communities

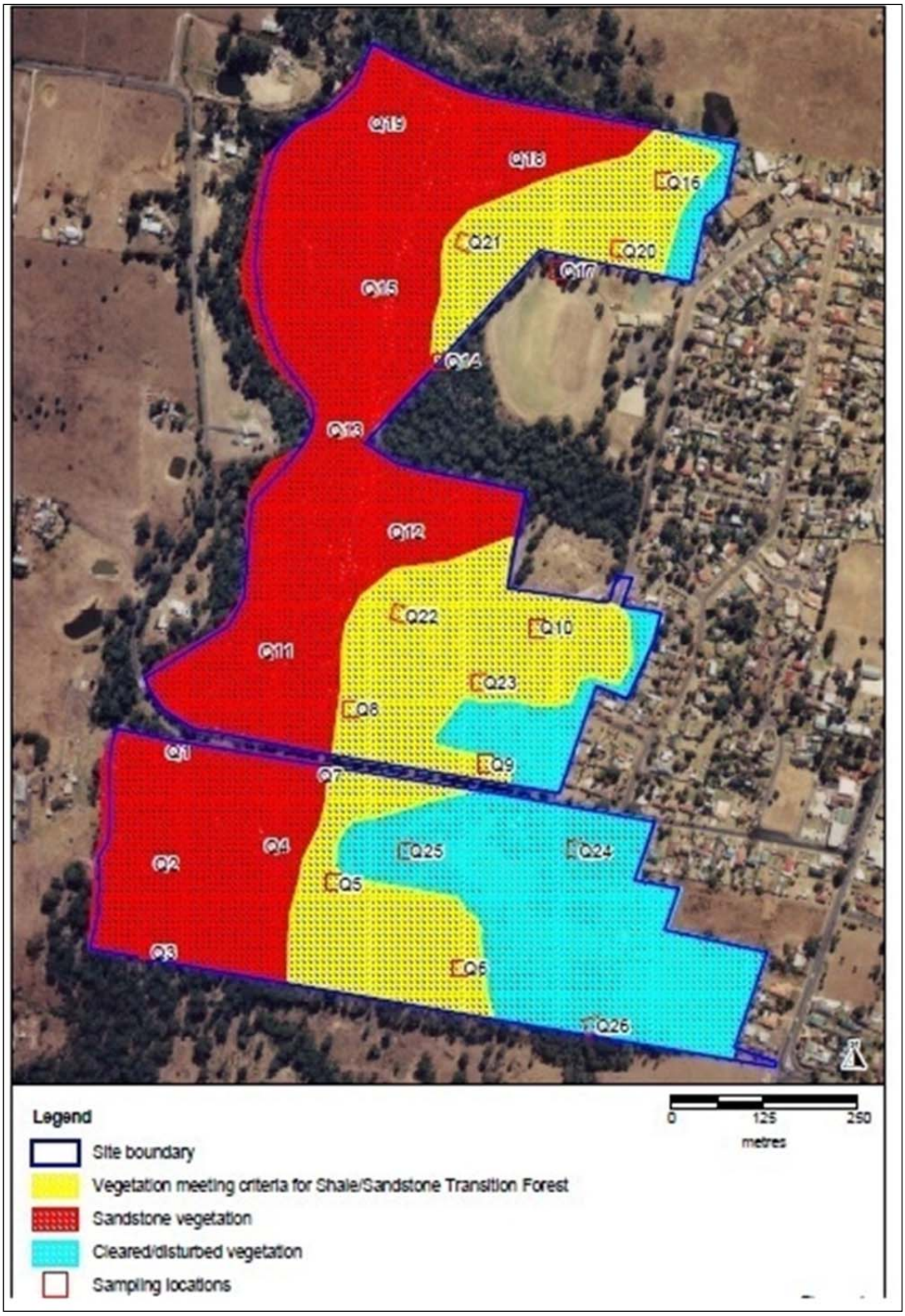

Figure 5 – Vegetation mapping
(Source: Anne Clements (2007))

4.2 Flora

The condition of vegetation within the site was generally very good. Weeds were limited to the periphery of vegetation patches, in particular, around the sporting oval and north along the back edge of the housing, along the edge of Macquariedale Road, within the cleared paddocks and a small amount within Ousedale Creek. Outside of these aforementioned areas, there were very few weeds present. With respect to noxious weeds, the following species were observed;

- *Asparagus asparagoides**
- *Echium plantagineum**
- *Hypericum perforatum**
- *Lantana camara**
- *Opuntia stricta**
- *Rubus fruticosus* sp. agg.*

All species are Class 4 noxious weeds.

Characteristics
Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.

Control objective
Minimise the negative impact of those plants on the economy, community or environment of NSW.

Control action
The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority, and the plant may not be sold, propagated or knowingly distributed.

Whilst there is potential habitat for a variety of threatened flora species, no species have been observed by *Clements* or by *Travers bushfire & ecology.*

All species are listed in Table 3.1 and vegetation communities are described in Section 3.

4.2.1 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* database (OEH 2012) indicated a list of species that have been recorded within a 10km radius of the study area. Those species are considered for suitable habitat and potential to occur in Table A2.1 (Appendix 2).

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened flora species:

Table 4.1 – State listed threatened flora species with suitable habitat present

COMMON NAME	TSC Act	POTENTIAL TO OCCUR
Acacia bynoeana	E1	✓
Epacris purpurascens var. *purpurascens*	V	✓
Grevillea parviflora subsp. *parviflora*	V	✓
Persoonia bargoensis	E1	low
Persoonia hirsuta	E1	low
Pimelea curviflora var. *curviflora*	V	very low
Pimelea spicata	E1	very low
Pterostylis saxicola	E1	low
Pultenaea pedunculata	E1	very low

Note: Full habitat descriptions for these species are provided in Appendix 2.

Acacia bynoeana

An *Atlas of NSW Wildlife* database record from 2006 shows an *Acacia bynoeana* specimen located along the eastern boundary of the site, just to the north of Lewis Street. The record says that the sighting has a 5km degree of accuracy. As such, this record may actually come from a site a few kilometres away. The habitat attributes (vegetative) on site are not ideal for the species, although potential habitat does exist. Survey was undertaken during the species flowering period and Transect 3 was undertaken within a few metres of the 2006 record. The specimen was not located during the November 2012 survey.

Epacris purpurascens* var. *purpurascens

This species has a peak flowering period in spring and thus survey for the species was undertaken at the most appropriate time of the year. The species is found in areas usually with a strong shale influence. Within the north eastern portion of the Wollondilly Shire, the prominent locations of these species are near the headwalls of creek lines. Target survey was undertaken primarily around the smaller tributaries or drainage ditches off Ousedale Creek which appeared to have more clay-like soils. No specimens were observed.

Grevillea parviflora* var. *parviflora

The eastern portion of the site is believed to contain some potential habitat for this species of *Grevillea.* It is however unlikely that the previously grazed and managed portions of the site would currently support the species. Target survey was undertaken primarily within the low sandstone influenced areas of vegetation, primarily the CPW vegetation, and Forest Red Gum / Ironbark Forest (where access was available). No specimens were observed.

Persoonia bargoensis

The potential habitat for this species was considered to be low given that lack of local records, although there was one (1) record approximately 1km away. The preferred habitat is sandstone or laterite soils. This soil's habitat attributes limit the potential areas where the species can occur. Target searches for the species were primarily focussed on the far western portion of the site, west of the existing vehicular track (e.g. west of Quadrats 5 and 18).

Persoonia hirsuta

The potential habitat is limited to the higher sandstone influenced areas of the site, similar to that as described for *Persoonia bargoensis.* The nearest record is 4km away and all local records are to the west in heavily sandstone influenced communities. Target searches for the species were primarily focussed on the far western portion of the site, west of the existing vehicular track (e.g. west of Quadrats 5 and 18).

Pimelea curviflora* var. *curviflora

As per both aforementioned *Persoonia* species, the potential habitat is within higher sandstone influenced soils. Target survey for the species was primarily undertaken west of Quadrats 5 and 18. The species has a very low likelihood of presence on site, given that there are no records within a 10km radius.

Pimelea spicata

Potential habitat is present within the CPW community north west of the sporting oval, immediately west of Lewis Street, in the linear patch east of the existing residence and in the linear patch along the southern boundary. Target searches were undertaken at the time of quadrat and transect surveys. No specimens were located. The species has a very low likelihood of presence on site, given that there are no records within a 10km radius.

Pterostylis saxicola

Potential habitat for this species is within areas where there are more significant sandstone outcrops within skeletal or very shallow soils. Target survey was conducted primarily within the Grey Gum / Blackbutt / Rough-barked Apple Forest along Ousedale Creek. No specimens were located. The species has a low likelihood of presence on site given that there has only been one (1) recorded sighting within a 10km radius (8km away) and this record is more than fifty (50) years old.

Pultenaea pedunculata

Potential habitat is present within the CPW community north-west of the sporting oval, immediately west of Lewis Street, in the linear patch east of the existing residence and in the linear patch along the southern boundary. Target searches were undertaken at the time of quadrat and transect surveys. No specimens were located. The species has a very low likelihood to be present on site given that there are no records within a 5km radius and all records are recorded to the north.

(b) Endangered flora populations (NSW)

There are no known endangered flora populations within the Wollondilly LGA.

(c) Endangered ecological communities (NSW)

Two (2) state listed EECs were located on site, namely;

- Shale-Sandstone Transition Forest
- Cumberland Plain Woodland

The rezoning proposal and Appin bypass will bisect the site into two (2) main portions the larger being on the western side. The western portion will be rezoned to E2 conservation, thereby protecting a large portion of the insitu SSTF. Remaining SSTF to the east of the

proposed bypass is likely to be removed or significantly modified for future residential subdivision. A total of 7.63 ha will be removed for the R2 zone and 1.49 ha as APZ in the bypass.

The loss of SSTF due to the future RMA bypass route is not the responsibility of *Walker Corporation*. However, the proponent recognises that the proposed rezoning results in a limitation on the future bypass route and the impacts of the rezoning and proposed residential zone have a cumulative effect. A further 3.02 ha of SSTF is expected to be removed for the future Appin bypass (cumulative loss 12.14 ha or 26.3% loss). CPW is not affected by the future bypass. Note: minor errors of adjustments to polygons may create an error of 1-2% for calculation of areas.

The conserved area of SSTF is in addition to conserved remnant native vegetation within Council lands. SSTF occurs around the sports oval, on rural lots to the immediate west, and into remnant bushland immediately north and south. The majority of existing SSTF remnants are in good condition with limited weed presence and / or good resilience.

Given the occurrence of Cumberland Plain Land Snail in the SSTF, the proponent has offered to restore the available CPW habitat within conserved lands, to relocate the existing snail populations within the site to adjoining habitat areas and to provide an appropriate offsite offset for the loss of EEC and threatened species habitat.

The current RMS preferred bypass route has not been given approval by NSW Office of Environment and Heritage, nor are there any intentions by the RMS to implement the bypass route in the short term. If the bypass route does not proceed, or is relocated the lands can be returned to the larger conservation area as indicated by the proposed R2 residential zone boundary.

The vegetation within the site and the proposed onsite biodiversity offset lands are within an area mapped as PCL within the Cumberland Plain Recovery Plan (2010) and functions as part of a discontinuous corridor. Consequently, this planning proposal is impacting on a corridor and the conservation value of the existing vegetation patch would be partially reduced. However, a significant corridor of a minimum of 100m to a maximum of 270m in total width will be retained along Ousedale Creek which will continue to function as a major environmental corridor. Should the future bypass not proceed, the width of the corridor will potentially be increased to 150m to a maximum of 320m respectively. In either case the remnant bushland corridor will continue to function as a major environmental corridor.

The proposed rezoning will maintain a viable area of SSTF and consolidate and restore existing degraded CPW remnants. Both communities can effectively be expanded in the region by implementing a suitable biodiversity offset in a location that supports other riparian corridors or existing reserves.

Future development of the bypass will potentially compromise the existing vegetation which is likely to isolate the existing vegetation to the east of the site. Whilst the RMA bypass has not been approved it is logical to provide a significant conservation area in the form of a biodiversity offset in another locality of high conservation value. The proponent has access to significant lands in the region and has offered biodiversity offsets that could significantly benefit the ecology of the region (Biodiversity Offset Strategy (*Travers bushfire & ecology* 2014)).

It is expected that all CPW vegetation will be removed or modified. Compensation through offsetting has been offered to limit local extinction of the EEC and to provide a more solid local ecological outcome. All CPW on site is typically degraded and it appears that it has

regrown since the early 1960s. The CPW offered at the offset site is of a higher quality a part of a larger remnant which also contains CPLS habitat and known locations of individuals.

The loss of CPW and SSTF is an issue, however, not such that they cannot be offset in an area of similar conservation value to create a valuable conservation outcome. The key impact of the proposed R2 Residential Zone is the loss of two Cumberland Plain Land Snail habitat areas. The removal of habitat will cause the loss of the recorded snail populations in the R2 residential zone. These areas are remnants of former habitat areas that once existed in now cleared lands in which the Appin township is located.

The proponent has offered to enrich existing habitat within conserved lands, to relocate the existing snail populations into retained vegetation areas within the site, and to provide threatened species biodiversity offsets on other lands in the region. This 'red flag' under the NSW Biodiversity Certification process including the removal of SSTF and CPW vegetation and will require Ministerial approval of a red flag variation report. A biodiversity offset strategy (*Travers bushfire & ecology* 2014) has been prepared which offers significant off site biodiversity offsets for both communities. The offset put forward retains approximately 34 ha of SSTF on site and will conserve a further 21 ha offsite. A minimum of 10 ha of CPW will be conserved also. The calculations are based upon a solid foundation of utilising the Biocertifcation calculator as well as the EPBC calculators as both EECs are listed under that act.

4.2.2 Matters of national environmental significance - flora

(a) Threatened flora species (national)

A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10km radius of the site. These species have been considered for habitat presence and potential to occur within Appendix 2.1.

Based on the habitat assessment within Appendix 2.1, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened flora species:

Table 4.2 – Nationally listed threatened flora species with suitable habitat present

COMMON NAME	EPBC Act	POTENTIAL TO OCCUR
Acacia bynoeana	V	✓
Grevillea parviflora subsp. *parviflora*	V	✓
Persoonia bargoensis	V	low
Persoonia hirsuta	E	low
Pimelea curviflora var. *curviflora*	V	very low
Pimelea spicata	E	very low
Pterostylis saxicola	E	low

No nationally listed threatened flora species were observed within the study area.

(b) Endangered ecological communities (national)

Two (2) nationally listed EECs were located on site, namely;

- Shale-Sandstone Transition Forest
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

All vegetation conforming to an EEC was classed as moderate-good condition in the biometric assessment. As both types of EEC are greater than 5ha and are of sufficient condition, removal of vegetation would require a referral to SEWPAC.

As described under 4.2.1, both EECs are listed under the EPBC Act. The EPBC offset calculator has been applied to calculate the minimum area of offset required for each EEC such that the affiliated Offset Strategy can be undertaken at the satisfaction of all involved authorities. Please refer to the Offset Strategy (*Travers bushfire & ecology,* 2014).

4.2.3 Flora and EEC assessment conclusions

All CPW vegetation will be removed or modified (2.96 ha) (noting that the regrowth area is not included as it is approved for removal), and approximately 12.14 ha of SSTF will be removed. Approximately 34.06 ha of SSTF vegetation on the western side of the proposed bypass will be conserved as part of the proposal. Further offsite offsets will be provided which incorporate a minimum of 10 ha of CPW and 21 ha of SSTF off Elladale Road, Appin. The details of which are provided in the Offset Strategy report.

Both communities are listed at the state and national level and would require a referral to the SEWPAC.

In accordance with *Principles for Use of Biodiversity Offsets in NSW*, an offset proposal such as through bio-certification or a biobanking arrangement is a valid mechanism by which the vegetation and habitat losses can be mitigated. The minimisation of impacts on threatened species and EECs would form a part of the proposal and offsets can be approved if the impacts have been minimised and the offsets offer real biodiversity conservation gains.

No endangered populations are listed for Wollondilly LGA.

No threatened flora species have been observed.

4.3 Fauna

All fauna species recorded during survey are listed in Table 3.6.

4.3.1 Fauna habitat

The fauna habitats present within the site are identified within Table 4.3.

Table 4.3 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate ✓	Steep	Drop-offs ✓
Vegetation structure				
Closed Forest	Open Forest ✓	Woodland ✓	Heath	Grassland ✓
Disturbance History				
Fire	Under-scrubbing ✓	Cut & fill works ✓ (dam)		
Tree clearing ✓	Grazing ✓			
Soil Landscape				
DEPTH:	Deep	Moderate ✓	Shallow ✓	Skeletal ✓
TYPE:	Clay ✓	Loam	Sand ✓	Organic
VALUE:	Foraging ✓	Denning	Roosting	Digging ✓
WATER RETENTION:	Well Drained ✓	Damp / Moist	Water logged	Swamp / Soak
Rock Habitat				
CAVES:	Large	Small ✓	Deep	Shallow ✓
CREVICES:	Large ✓	Small ✓	Deep ✓	Shallow ✓
ESCARPMENTS:	Winter / late sunny aspects ✓		Shaded winter / late aspects ✓	
OUTCROPS:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides ✓	
SCATTERED/ISOLATED:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides ✓	
Feed Resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias ✓	Melaleucas ✓	
	Banksias	Acacias ✓		
SEEDING TREES:	Allocasuarinas ✓	Conifers		
WINTER FLOWERING EUCALYPTS:	C. maculata	E. crebra ✓	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta	E. tereticornis ✓	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn ✓	Winter ✓	Spring ✓	Summer ✓
OTHER:	Mistletoe	Figs / Fruit	Sap / Manna ✓	Termites ✓
Foliage Protection				
UPPER STRATA:	Dense	Moderate ✓	Sparse ✓	
MID STRATA:	Dense	Moderate	Sparse ✓	
PLANT / SHRUB LAYER:	Dense ✓	Moderate ✓	Sparse ✓	
GROUNDCOVERS:	Dense ✓	Moderate ✓	Sparse ✓	
Hollows / Logs				
TREE HOLLOWS:	Large ✓	Medium ✓	Small ✓	
GROUND HOLLOWS:	Large ✓	Medium ✓	Small ✓	
Vegetation Debris				
FALLEN TREES:	Large ✓	Medium ✓	Small ✓	
FALLEN BRANCHES:	Large ✓	Medium ✓	Small ✓	
LITTER:	Deep ✓	Moderate ✓	Shallow ✓	
HUMUS:	Deep	Moderate ✓	Shallow ✓	

Drainage Catchment					
WATER BODIES	Soak(s)	Dam(s) ✓	Drainage line(s) ✓	Creek(s) ✓	River(s)
RATE OF FLOW:	Still ✓	Slow ✓	Rapid		
CONSISTENCY:	Permanent ✓	Perennial	Ephemeral ✓		
RUNOFF SOURCE:	Urban / Industrial	Parkland	Grazing ✓	Natural ✓	
RIPARIAN HABITAT:	High quality ✓	Moderate quality ✓	Low quality ✓	Poor quality	
Artificial Habitat					
STRUCTURES:	Sheds	Infrastructure	Equipment		
SUB-SURFACE	Pipe / Culvert(s)	Tunnel(s)	Shaft(s)		
FOREIGN MATERIALS:	Sheet ✓	Pile / Refuse ✓			

4.3.2 Habitat trees

A complete assessment of the location of habitat trees and the size of hollows within was not conducted as part of surveys undertaken. The available size range and quality of hollows were noted during site visits and, if appropriate, were investigated to determine suitability for hollow dependent threatened species.

During survey, the locations of trees providing large hollows considered suitable for threatened owls and cockatoos were identified and point referenced with a GPS. The locations of these trees are provided in Figures 2 & 11. Where these suitable large hollows were located, a further search of the surrounding area for evidence of owl activity was undertaken.

4.3.3 State legislative fauna matters

(a) Threatened species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* database (OEH, 2012) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Table A2.2 (Appendix 2) and are considered for potential habitat within the subject site.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened fauna species:

Table 4.4 – State listed threatened fauna species with suitable habitat present

COMMON NAME	TSC Act	POTENTIAL TO OCCUR
Gang-gang Cockatoo	V	recorded
Glossy Black-Cockatoo	V	recorded
Little Lorikeet	V	recorded
Powerful Owl	V	recorded
Varied Sittella	V	recorded
Grey-headed Flying-fox	V	recorded
Yellow-bellied Sheathtail-bat	V	recorded
East-coast Freetail Bat	V	recorded
Eastern Bentwing-bat	V	recorded
Greater Broad-nosed Bat	V	recorded
Cumberland Plain Land Snail	E	recorded
Swift Parrot	E	potential
Flame Robin	V	potential
Large-footed Myotis	V	potential

COMMON NAME	TSC Act	POTENTIAL TO OCCUR
Masked Owl	V	low
Littlejohn's Tree Frog	V	low
Broad-headed Snake	E	low
Barking Owl	V	low
Brown Treecreeper	V	low
Speckled Warbler	V	low
Black-chinned Honeyeater	V	low
Scarlet Robin	V	low
Diamond Firetail	V	low
Spotted-tailed Quoll	V	low
Koala	V	low
Eastern Falsistrelle	V	low
Giant Burrowing Frog	V	unlikely
Red-crowned Toadlet	V	unlikely
Black-necked Stork	E	unlikely
Little Eagle	V	unlikely
Square-tailed Kite	V	unlikely
Bush Stone-curlew	E	unlikely
Turquoise Parrot	V	unlikely
Painted Honeyeater	V	unlikely
Hooded Robin	V	unlikely
Eastern Pygmy Possum	V	unlikely
Yellow-bellied Glider	V	unlikely
Squirrel Glider	V	unlikely
Long-nosed Potoroo	V	unlikely
Large-eared Pied Bat	V	unlikely
Little Bentwing-bat	V	unlikely

Note: Full habitat descriptions for these species are provided in Appendix 2

As indicated, Powerful Owl (*Ninox strenua*), Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Varied Sittella (*Daphoenositta chrysoptera*), Little Lorikeet (*Glossopsitta pusilla*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), East-coast Freetail Bat (*Micronomus norfolkensis*), Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Eastern Bentwing-bat (*Miniopterus orianae oceansis*) and Cumberland Plain Land Snail (*Meridolum corneovirens*) were recorded present during survey. The Eastern Bentwing-bat and Yellow-bellied Sheathtail-bat were each recorded to a 'probable' level of certainty.

Threatened fauna species recorded and with potential to occur have been assessed in detail within Appendix 3. The impact assessment has concluded a significant impact on the Cumberland Plain Land Snail based on the loss of over a half of the available habitat area for this species which includes the 'preferred' habitat of CPW. The impact assessment has concluded a not significant impact in respect to remaining state listed threatened fauna species considered.

FM Act – No habitats suitable for threatened aquatic species were considered to be present within the study area and, as such, the provisions of this Act do not require any further consideration.

(b) Endangered populations (NSW)

There are no endangered fauna populations within the Wollondilly LGA.

(c) SEPP 44 Koala Habitat Protection

SEPP 44 Koala Habitat Protection applies to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. In addition, Part 2 of the Policy outlines a three (3) step process to assess the likelihood of the land in question being potential Koala habitat (PKH) or core Koala habitat (CKH). Part 2 applies to land which has an area of greater than 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

The subject site is required to be considered under SEPP 44 as it falls within the Wollondilly LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the subject site is greater than 1ha, hence Part 2 – Development Control of Koala Habitats, of the Policy applies.

PKH is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the Policy.

CKH is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population.

Step 1 – Is the land PKH?

Two (2) Koala food tree species, Grey Gum (*Eucalyptus punctata*) and Forest Red Gum (*Eucalyptus tereticornis*), as listed on Schedule 2 of SEPP 44 – were found within the study area. These trees comprised greater than 15% of the total number of trees within the vegetation communities are therefore classified under SEPP 44 as PKH.

Step 2 – Is the land CKH?

No Koalas were directly observed or recorded by call at the time of fauna survey, which included diurnal searches of trees, spotlighting and call-playback. In addition, there was no conclusive secondary evidence of Koala habitation in the area. Searches for secondary indications of Koalas included observations for scratchings on trees and scats beneath trees.

Some scratches observed on trees during survey, particularly high use sides on the old bark of Grey Gums were considered consistent with Koala. Further investigations found that these few trees were generally large trees containing hollows and a Lace Monitor was observed at one of these locations. The Common Brush-tailed Possum was also recorded during survey. Scat searches below large trees with scratches found no Koala pellets.

A search of the *Atlas of NSW Wildlife* database (OEH 2012) found numerous records of Koala habitation within 10km. The closest of these were located to the nearby east and north east associated with the connective open forests and woodlands of the Georges River on the other side of Appin Road. Despite the proximity of these records to the study area, there are no Koala records within the connective remnants along Ousedale Creek that run north and then north west in the other direction on the other (western) side of the Appin township.

Although the study area does provide PKH that would be considered suitable to contribute to a functioning Koala population, the absence of records along these connective remnants suggest that they do not support CKH.

4.3.4 Matters of national environmental significance - fauna

(a) Threatened species (National)

EPBC Act – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10km radius of the subject site. These species have been listed in Table A2.2 (Appendix 2).

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened fauna species:

Table 4.5 – Nationally listed threatened fauna species with suitable habitat present

COMMON NAME	EPBC Act	POTENTIAL TO OCCUR
Grey-headed Flying-fox	V	recorded
Swift Parrot	E	potential
Littlejohn's Tree Frog	V	low
Broad-headed Snake	V	low
Spotted-tailed Quoll	E	low
Koala	V	low
Giant Burrowing Frog	V	unlikely
Long-nosed Potoroo	V	unlikely
Large-eared Pied Bat	V	unlikely
New Holland Mouse	V	unlikely

Threatened fauna species recorded and with potential to occur have been assessed in detail within Appendix 3. The impact assessment has concluded a not significant impact in respect to state listed threatened fauna species.

The Significant Impact Criteria for threatened species listed under the EPBC Act 1999 (Appendix 4) was reviewed to assess the impacts as a result of the rezoning proposal. In respect to Grey-headed Flying-fox in particular the site does not contain any likely roosting or subsequent breeding habitat and foraging habitat will remain well represented in the locality. It is therefore concluded that there will not be any significant impact on this species or other nationally listed threatened fauna species with potential to occur as a result of the subdivision proposal.

(b) Protected migratory species (national)

The EPBC Act Protected Matters Report provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10km radius of the subject site. These migratory species are considered in Table A2.3 (Appendix 2). Threatened migratory species are assessed in Table A2.2 (Appendix 2).

4.4 Cumberland Plain Recovery Plan

The Cumberland Plain in western Sydney is Australia's fastest growing and most populous region. Many of its unique natural attributes need special effort to maintain their values and ensure their protection. Just 13% of western Sydney's native vegetation remains in highly fragmented patches of varying size and condition. The Cumberland Plain Recovery Plan (DECCW 2010) has been designed to provide for the long term survival and protection of the threatened biodiversity of the Cumberland Plain as the area develops.

The overall objective of the recovery plan is to provide for the long term survival of the threatened biodiversity of the Cumberland Plain. It is comprised of four (4) main objectives:

- Recovery Objective 1: To build a protected area network, comprising public and private lands, focused on the priority conservation lands.

- Recovery Objective 2: To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation.

- Recovery Objective 3: To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program.

- Recovery Objective 4: To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner.

The recovery plan describes the necessary actions to halt further losses of vegetation and to achieve a net gain. This approach should be balanced with the growing needs to deliver sustainable land for future housing developments and thus vegetation offsets are therefore a way of having both economic development and environmental protection.

DECCW has completed an assessment of the remaining bushland based on these principles and other factors, including the distribution and zoning of remnant vegetation, which has resulted in the identification of the priority conservation lands (PCLs). The PCLs have been identified as the lands that represent the best remaining opportunities in the region to secure long term biodiversity benefits for the lowest possible cost. The proposed rezoning at Macquariedale Road, Appin, is mapped as priority conservation lands (Figure 9 - DECCW 2010 - *Cumberland Plain Recovery Plan*).

The priority conservation lands typically contain habitat for a broader suite of threatened and regionally significant species and ecological communities than those addressed in the *Cumberland Plain Recovery Plan* (DECCW 2010). Conservation activities within priority conservation lands is recognised as having greater biodiversity benefits than just for the threatened biodiversity addressed in the recovery plan. The priority conservation lands have been identified as regional priorities for the implementation of recovery actions. The mapping does not, in itself, imply or guarantee conservation outcomes (DECCW 2010 - *Cumberland Plain Recovery Plan*).

Vegetation remnants within the proposed Macquariedale Road, Appin rezoning area have significant conservation benefit as an environmental corridor and provide direct benefit to resident threatened fauna species, contain SSTF and to a much lesser extent CPW. No threatened flora species have been observed to date.

The proposed residential zone area will enable retention of a minimum 150m wide environmental corridor to a maximum of 400m in total width along Ousedale Creek which will continue to function as a major environmental corridor. Should the proposed bypass not proceed, the width of the corridor will potentially be increased to 200m to a maximum of 425m respectively. In either case, the remnant bushland corridor will continue to function as a major environmental corridor.

The proposed E2 Environmental Conservation Zone conserves significant areas of habitat for threatened fauna species and the conservation of a significant portion of this remnant will result in a securely conserved Cumberland Plain reserve in association with Council lands. Best practice management of the reserve will form future management of the site in accordance with the *Cumberland Plain Recovery Plan* (2010).

The proposed on and off site biodiversity offset areas (Biodiversity Offset Strategy - *Travers Bushfire & Ecology* 2013) will be securely conserved and actively managed for conservation purposes. The sizes of the remnants to be retained are viable and sustainable into the future.

As freehold land, the preferred methods of securing the lands for conservation include:

- Voluntary acquisition (reservation)
- BioBanking agreements
- Conservation covenants

Other less desirable options include:

- Voluntary acquisition (open space)
- Environmental protection zoning
- Property vegetation plan under the *Native Vegetation Act 2003* (Wollondilly LGA only)

As the proposal is a planning proposal to rezone the lands to a combination of residential, special uses and environmental protection, the application of environmental protection zoning is considered appropriate at this stage. In future subdivision applications, conservation on private lands can be further secured through entering a Voluntary Conservation Agreement.

The *Cumberland Plain Recovery Plan* also supports the use of offsets where impacts on threatened species, populations and ecological communities cannot be avoided. Offsets at a predetermined ratio increase the extent and condition of vegetation on the Cumberland Plain using assisted natural regeneration and revegetation techniques.

Active management to best practice standards is needed to prevent the degradation of the remaining bushland in such a fragmented landscape. Without active management, weed invasion, frequent fire, stormwater flooding, grazing, mowing and recreational impacts such as illegal rubbish dumping will continue. Consequently, this offset strategy requires the preparation of a bushland management plan to define the active management requirements of the identified protection and restoration offsets.

4.5 Vegetation connectivity and wildlife corridors

The study area is located along the southern diminishing extent of a creekline corridor that extends to the north west before returning to extensive natural vegetation areas to the east, via the Nepean and Cataract Rivers. The township of Appin divides the study area from a more extensive habitat beyond the Georges River to the east. Whilst the natural vegetation patches diminish further south, the study area itself currently has a vegetated width of between 300-500m. The majority of this natural habitat area is located on the eastern side of the Ousedale Creek and is sufficient in size to support high fauna biodiversity. Fauna survey found a high number of recorded threatened fauna species utilising the available habitat area.

A corridor is used to ensure wildlife can move between vegetation parcels that contain habitat characteristics suitable for each taxa and foraging opportunities for those taxa. In other words, they need protection and food. They also need mating opportunity and for some wildlife movement opportunity is quite small as they are territorial whilst others are more opportunistic and migrate over larger areas.

For some wildlife, the dispersal (home) range is quite small whilst others migrate over larger areas. Where wildlife numbers, particularly some populations, and diversity are in large quantities and require movement to and from large areas (ecosystems) then a suitable large corridor linkage should be provided. Likewise, if a small quantity of wildlife is known to be present then a smaller corridor may accommodate these species / populations adequately.

The proposed Appin bypass through the study area will cause a barrier effect between the habitat along Ousedale Creek in the west and the woodland habitat in the east. In the case that the eastern portions are rezoned for development, the resulting corridor width would be reduced from 300-500m to approximately 150-400m.

Corridors that are 200m or more in width tend to facilitate the movement of all fauna by providing at least some core interior habitat that is not affected by edge environments (*Lindenmayer 1994*). Corridors between 80m and 200m in width tend to be effective at moving many fauna, including some fauna that do not tolerate urban disturbance and fragmentation (such as Sugar Gliders and some forest dependent birds) (*Bennett 1990, Saunders & de Rebeira 1991, Catterall et al 1991, Bentley & Catterall 1997*). Corridors less than 30m in width tend to be effective only for servicing the most tolerant of urban fauna (e.g. Brushtail Possums, Bush Rats, common urban birds, and fauna habitat generalists) (*Bentley 1990, Lindenmayer 1994, Catterall et al 1991, Bentley & Catterall 1997*).

4.6 Barrier effects

Roads and other linear infrastructure have potential to cause direct and indirect barrier effects to wildlife. Barrier effects are those that disrupt movement of wildlife due to the creation of direct or indirect barriers including (*van der Ree et al 2007*):

- physical obstructions
- loss of habitat
- removal of foraging and nesting resources
- canopy separation
- incursion of weeds
- increased presence of feral animals
- vehicle collisions
- altered microclimatic conditions

- changes to acoustics

The barrier effects of road construction can potentially limit the behaviour of select fauna species such as small terrestrial species or those that have had their habitat areas removed / divided, whilst others, such as microbats, may alternatively prosper with better foraging conditions and a more open vegetative landscape.

The potential for barrier effects on arboreal and terrestrial fauna movement across the proposed bypass road have been considered. Ground dwelling animals are generally reported to be inhibited by cleared road corridors of greater than 12m (i.e. single carriageway roads). The loss of direct canopy connectivity above the road is also reported as inhibiting the movement of non-gliding arboreal mammals and canopy gaps of greater than 30m for gliding mammals. Birds and more mobile species have been reported as being affected by loss of vegetative connectivity of between 30-200m subject to the species' ability to move, endurance, shyness, susceptibility to predation, presence of trees that act as stepping stones, the presence of key foraging plants or areas and the availability of nest or roosting resources.

As development is proposed within almost all areas within the site to the east of the bypass road and no habitat exists further east (Appin township) the barrier effects that will result from both the bypass and rezoning development are non-relevant. Only flying species will continue to traverse to habitats further east beyond the Appin township.

4.7 Flora and fauna conservation significance

Figures 10 and 11 provide an indication of the conservation significance of the landscape based on the observed vegetation types, vegetation condition and threatened species. Both figures indicate that the proposed rezoning will remove habitat of moderate to high conservation value.

However the proposed rezoning is in an area that is experiencing significant urban development growth and there is a need to provide a balanced conservation and development outcome. The proposed rezoning provides an opportunity to consolidate existing vegetation remnants, maintain a viable conservation area and provide a significant conservation outcome in the form of a protection and restoration offset (Biodiversity Offset Strategy – *Travers bushfire & ecology* 2014).

The Biodiversity Offset Strategy (*Travers bushfire & ecology* 2014) has located suitable offset land at Ellendale Road, Appin, which contains both existing CPW and SSTF based on existing vegetation surveys. A restored landscape in the currently cleared lands of this site, in conjunction with the existing vegetation areas, will provide a significant conservation outcome for the loss of habitat within the proposed rezoning area. The proposed offset lands are also within lands mapped as PCL, are significantly constrained by high conservation value habitat and are less viable for development.

The southern portions of the land are adjoining landscape that has been heavily impacted by land clearing and ongoing agricultural use. Further habitat has been cleared on lands to the south in recent years as evidenced by recent aerial photography (Figure 9). Lands to the south of the site are also potential development lands and there is limited connectivity based on the current vegetated widths. Whilst the loss of this habitat is significant, the impacts can be mitigated and a major conservation outcome can be achieved with both the proposed onsite and offsite biodiversity offsets.

Whilst all hollow resources have not been mapped within the site, all large hollows considered suitable for use by threatened cockatoos and owls were mapped and will be retained within the landscape. This is particularly given that all but one of these is located to the west of the proposed bypass road.

Recorded threatened fauna species and habitat features of value have been discussed in the 7 part test (Appendix 3). Cumberland Plain Land Snail habitat may become more suitable on the eastward transition within SSTF towards CPW. Much of the previous surrounding CPW habitat has been cleared for the Appin township and only small fragments remain within the site. Snails have been recorded onsite extending considerable distances into SSTF. Despite removal of the entire remnant CPW and the nearby adjacent SSTF containing similar soils or Forest Red Gums, will retain 57% of the CPLS habitat area.

Given the recorded locations of CPLS (including living specimens) within the SSTF and the impact of the proposed zonings, the snail population within the site is expected to persist to the west of the proposed bypass but over a smaller area and a likely reduced population size. The retained CPLS habitat consists of the less preferred SSTF and snails within this community are recorded at lower densities, as evident on site. Despite this, the recorded area to the west of the bypass road for the northern and central patches may be sufficient in size to maintain a viable population even with the future bypass in place.

The currently limited knowledge of snail habitat preference suggests that snail occurrences are primarily associated with the Cumberland Plain and Castlereagh Woodland vegetation types (Clark 2009). However, our conclusion above is supported from recordings by *Travers bushfire & ecology* of live specimens persisting in small highly fragmented patches of Shale - Sandstone Transition Forest which have also been isolated from CPW for decades at other locations including a nearby site at Brooks Point Road, Appin as well as locations at Airds Bradbury and Picton. The species may be showing non-typical habitat preferences at the outer extent of distribution area (*pers. comm.* Michael Shea). The above examples are at the southern extent of the species known distribution.

Figure 6 shows snail recorded locations extending into SSTF to the west in each portion of the site and the small CPW portions present. It should be noted that whilst dead shells may indicate that living specimens are to be expected to still be present, no living snails were recorded in each of the three CPW portions present and no shells were found at all in the northern CPW portion. Of the 59 shells found (15 living and 44 dead specimens), 54 (91.5%) were recorded in SSTF mapped areas of the site, and only 3 of these were relatively close to CPW mapped areas.

Further to the proposed relocation or translocation of living snails into selected areas as a mitigation measure, a 0.7 ha Forest Red Gum restoration area is proposed for the southern portion of the Macquariedale Road, conservation area. It is recognised that such restoration will not provide suitable habitat in the short-term and therefore snails would be relocated into the surrounding SSTF. In summary it is considered that the areas to the west of the bypass road, whilst being SSTF, are sufficient in size to maintain the two or three existing populations as viable even with the future bypass in place.

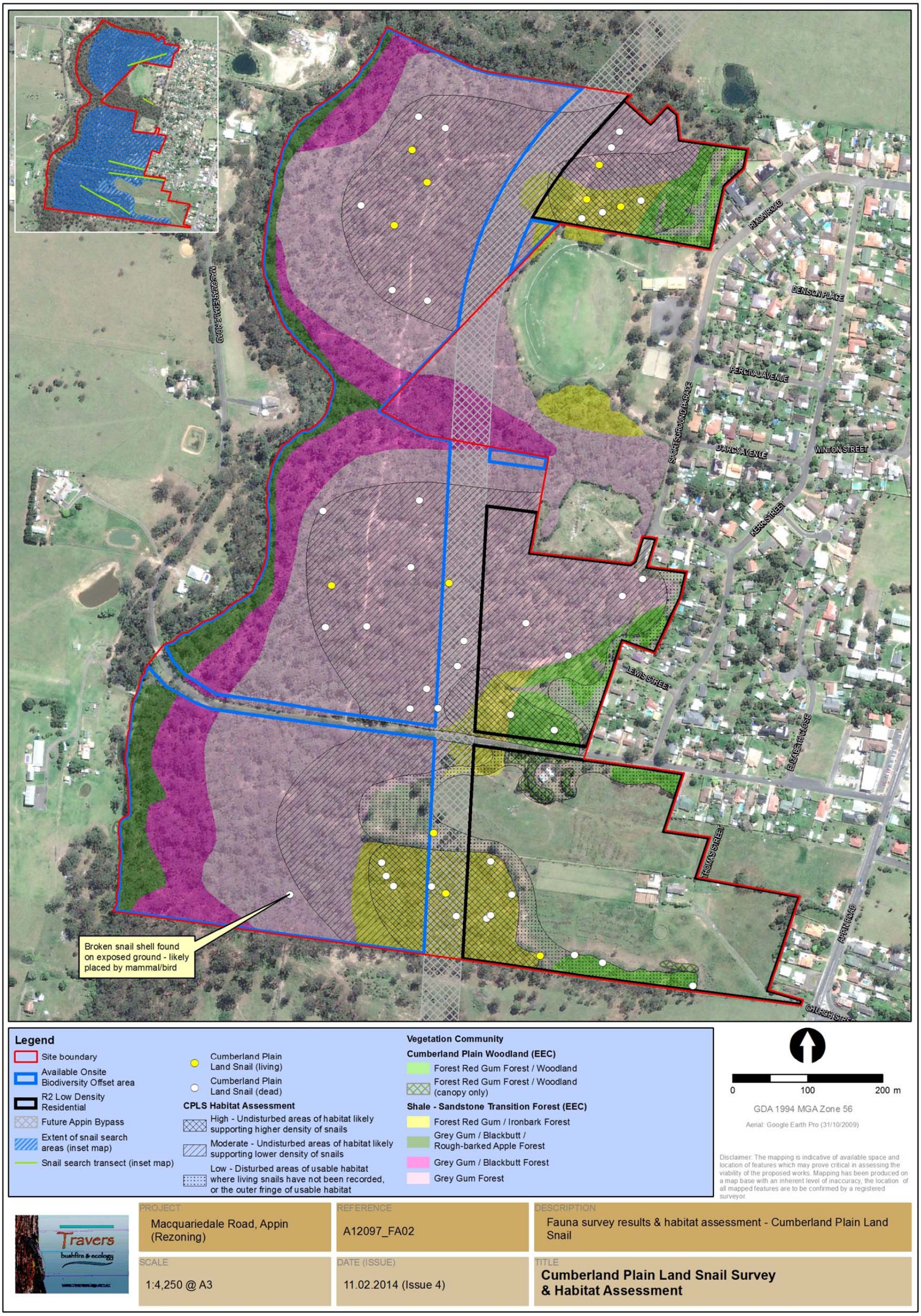

Figure 6 – Cumberland Plain Land Snail Survey & Habitat Assessment

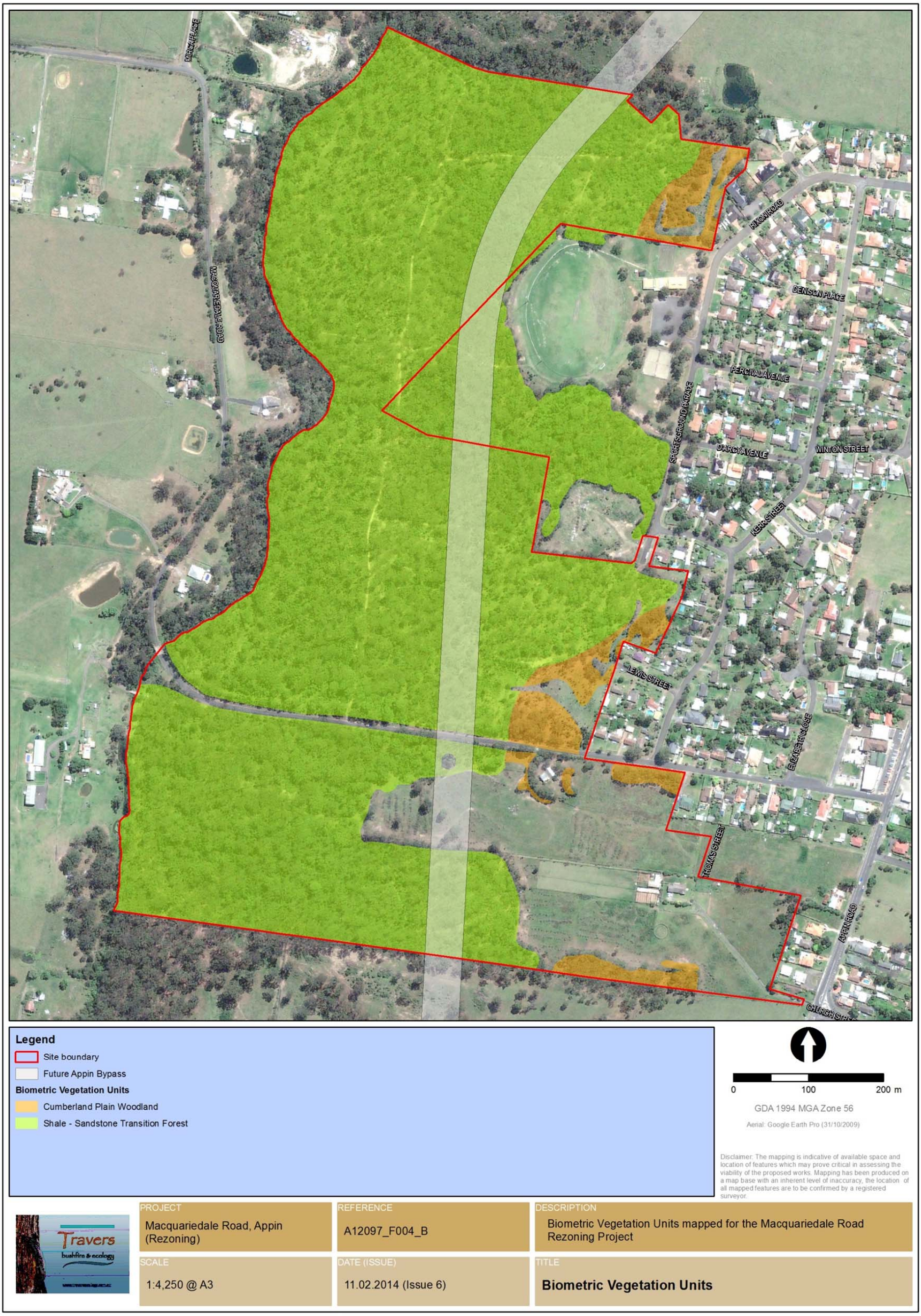

Figure 7 – Biometric vegetation units

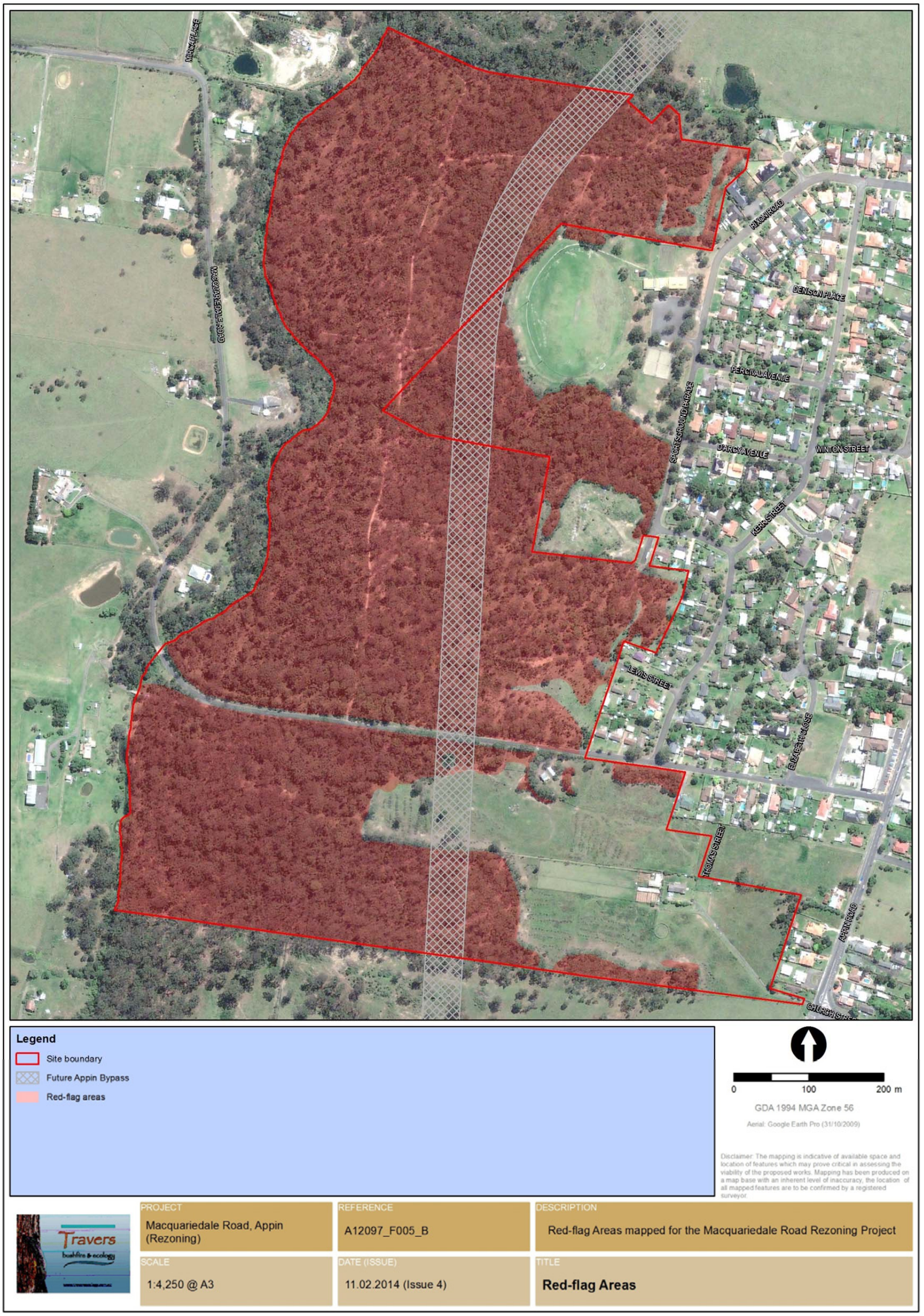

Figure 8 – Red flag areas

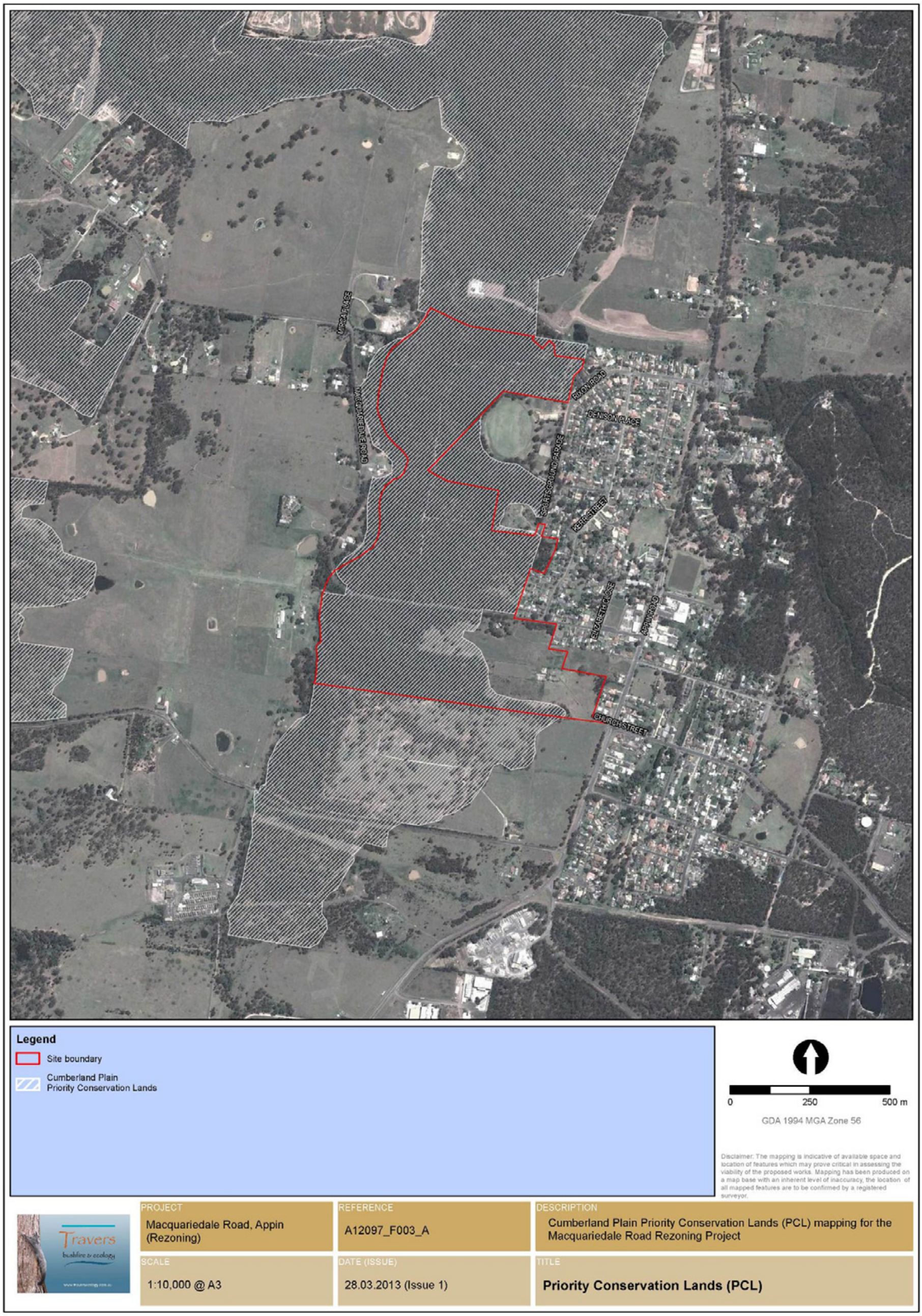

Figure 9 – Priority conservation land mapping in accordance with the Cumberland Plain Recovery Plan (2010)

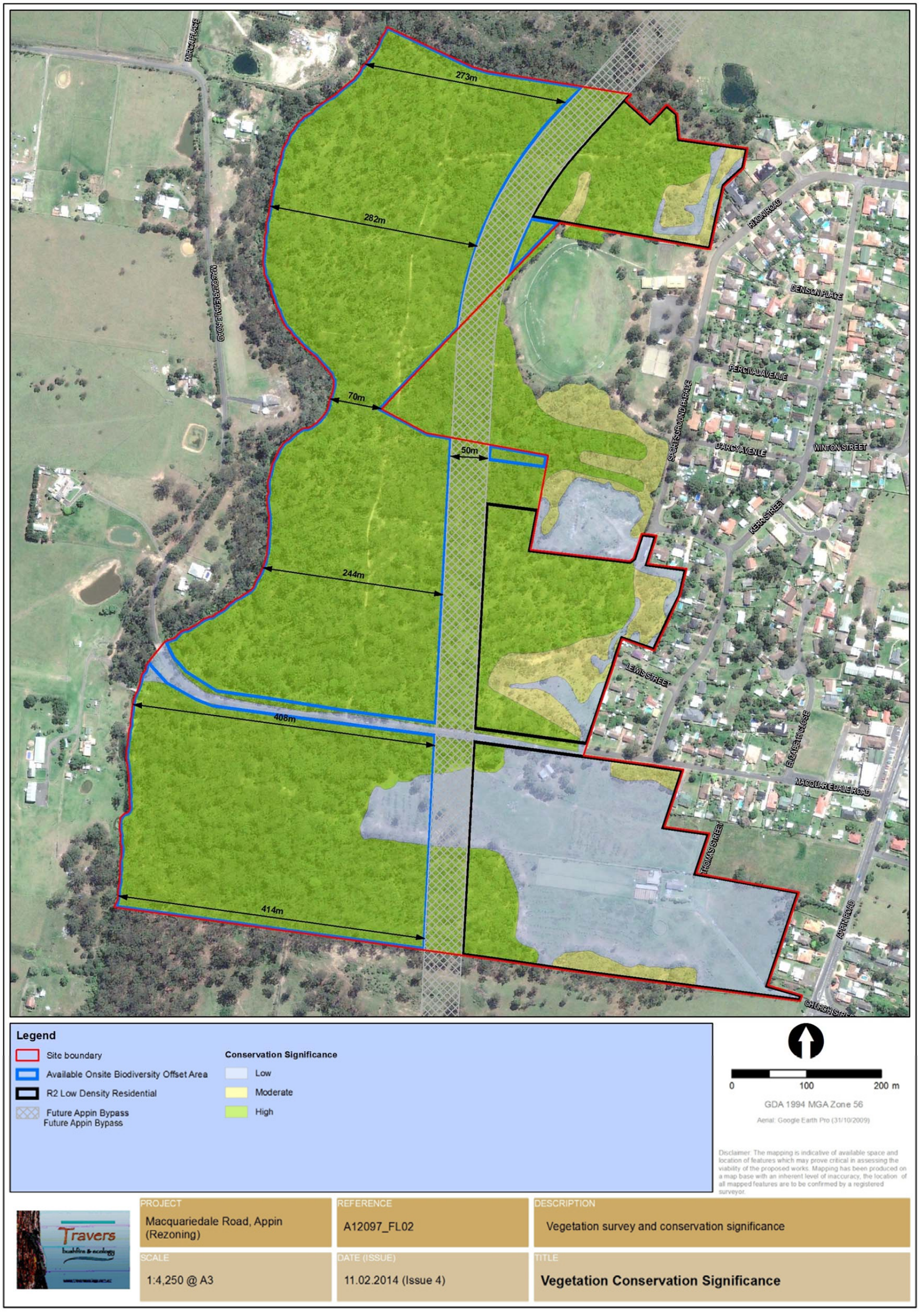

Figure 10 – Flora conservation significance

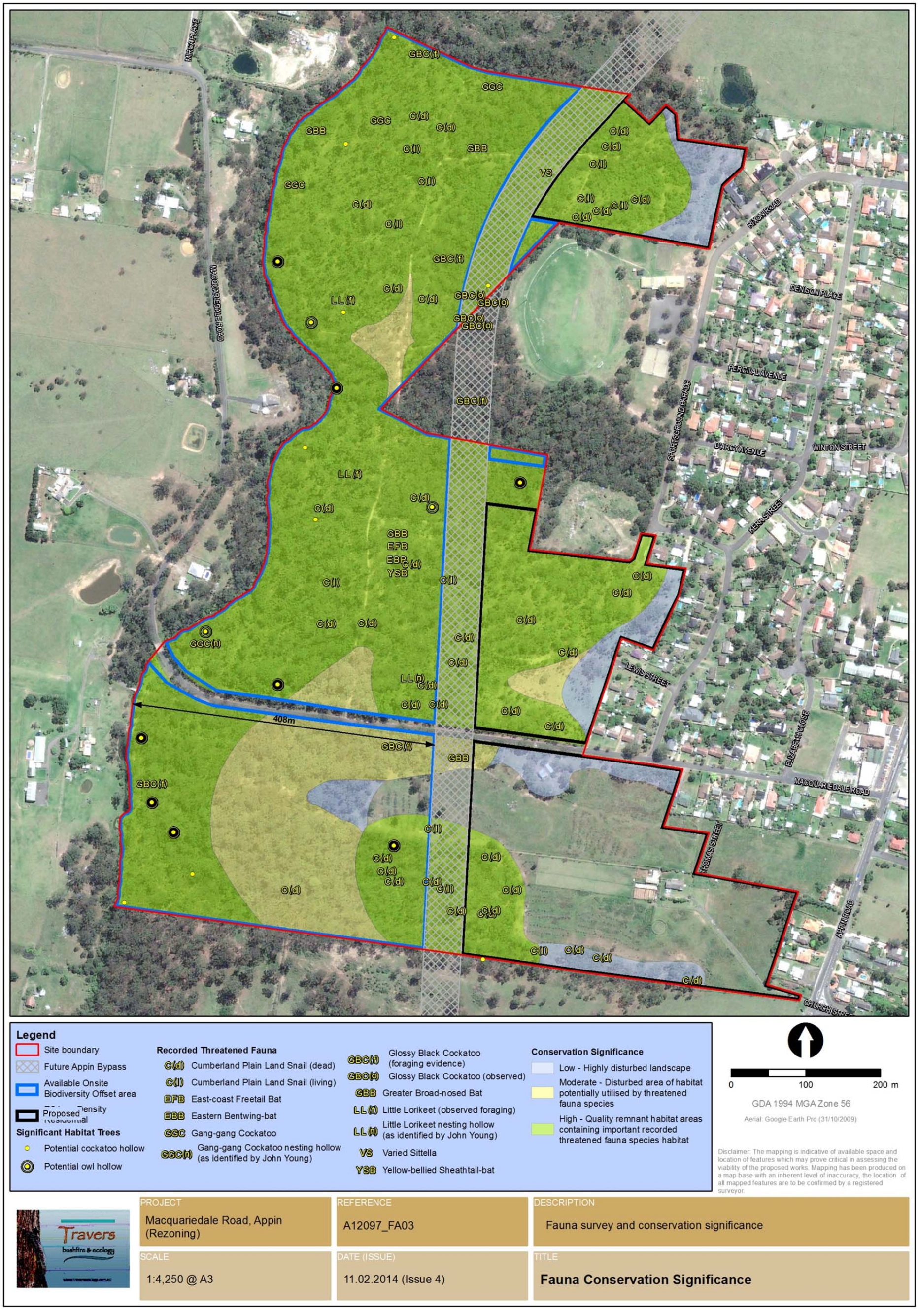

Figure 11 – Fauna conservation significance

Conclusions & Recommendations 5

5.1 Recorded threatened flora, fauna and EECs

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *EP&A Act*, the *TSC Act*, the *EPBC Act* and the *FM Act.*

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *TSC Act*, eleven (11) threatened fauna species, no threatened flora species, and two (2) EECs were recorded within the study area.

Threatened fauna species recorded include:

- Powerful Owl (*Ninox strenua*),
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*),
- Gang-gang Cockatoo (*Callocephalon fimbriatum*),
- Varied Sittella (*Daphoenositta chrysoptera*),
- Little Lorikeet (*Glossopsitta pusilla*),
- Grey-headed Flying-fox (*Pteropus poliocephalus*),
- Greater Broad-nosed Bat (*Scoteanax rueppellii*),
- East-coast Freetail Bat (*Micronomus norfolkensis*),
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*),
- Eastern Bentwing-bat (*Miniopterus orianae oceansis*) and
- Cumberland Plain Land Snail (*Meridolum corneovirens*).

Endangered ecological communities recorded include:

- Shale-Sandstone Transition Forest (SSTF)
- Cumberland Plain Woodland (CPW)

In respect of matters required to be considered under the *EPBC Act:*

- One (1) threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded within the study area
- One (1) protected migratory fauna species listed under the *EPBC Act* – White-throated Needletail (*Hirundapus caudacutus*) was recorded within the study area
- No threatened flora species were recorded within the study area.
- Two (2) EECs, Shale-Sandstone Transition Forest and Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest were recorded within the study area.

In respect of matters relative to the *FM Act,* no suitable habitat for threatened aquatic species was observed within the subject site, and there are no matters requiring further consideration under this Act.

5.2 Ecological impacts of proposed rezoning

The rezoning proposal will potentially result in the following impacts on the recorded EECs:

- Shale-Sandstone Transition Forest (SSTF) - 34.06 ha will be conserved (73.4%), and 12.14 ha will be removed or modified (26.6%).

- Cumberland Plain Woodland (CPW) – 3.78 ha will be removed or modified (100%).

The vegetation on site forms an important corridor for fauna as evidenced by the presence of several threatened fauna species. The proposal will likely cause an adverse impact upon Cumberland Plain Land Snail, in particular, those utilising the southern portions of the site or low-sandstone influenced vegetation. The presence of hollow bearing resources will be reduced and large stands of *Allocasuarinas* will be removed*,* thereby potentially impacting foraging bird species and microbats.

As a result of vegetation removal and/or modification, 13.72 ha of Cumberland Plain Land Snail habitat will be affected. This represents 43.0% of known habitat for this species including the remaining and 'preferred' CPW portions, whilst disturbed and fragmented. The impact includes areas removed or modified for the proposed residential area and APZs. It does not include the bypass but does include APZs that occur within the bypass. Based on the distribution and density of observed Cumberland Plain Land Snails within the site, the proposal is removing an equivalent proportion of the population through direct habitat removal.

The loss of Cumberland Plain Land Snail habitat within the site as a result of the rezoning is significant. Advice provided by snail expert Michael Shea (Appendix 6) indicates that it is also unclear whether the species is capable in persisting indefinitely in SSTF, considered as 'marginal habitat'. However, the CPLS habitat being removed consists of degraded CPW and SSTF which currently supports fringing habitat adjacent to long since removed CPW for the Appin township. The existing population is surviving on poorer quality substrates sparsely distributed across the site particularly where the canopy is dominated by Forest Red Gum. Therefore CPLS habitat within the site is not solely contained to CPW and may be supported within SSTF dominated by Forest Red Gum and or on appropriate soil substrates.

Given the recorded locations within the CPW and the impact of the proposed zonings, the snail population within the site will likely persist on site but over a smaller area and at a reduced population size. However, based on reported population distributions the proposed rezoning will maintain viable populations. Mitigation measures are proposed to reduce the overall losses, which include revegetation works and biodiversity offsets for the loss of CPW.

The proposed rezoning is expected to remove a breeding hollow of the Little Lorikeet and will potentially remove habitat of several threatened bird species. An expert statement from Mr John Young, has been provided which provides advice as to the significance of impacts on the recorded threatened bird species. Mr Young considers that all recorded threatened bird species will not be adversely affected as a result of the proposed R2 Residential Zone with the exception of Little Lorikeet. Mr Young has supported the proposed R2 Residential Zone on the basis of protecting the breeding location of the Little Lorikeet in a pocket park.

All other recorded threatened species are not expected to be significantly affected in association with the proposed mitigation measures and the retention of the higher quality habitat associated with the main riparian corridor.

The conserved area of SSTF is in addition to conserved remnant native vegetation within Council lands. SSTF occurs around the sports oval, on rural lots to the immediate west and into remnant bushland immediately north and south. The majority of existing SSTF remnants are in good condition, with limited weed presence and / or good resilience.

Given the occurrence of Cumberland Plain Land Snail in the SSTF, the proponent has offered to restore the available CPLS habitat within conserved lands, to relocate the existing snail populations within the site to adjoining habitat areas and to provide an appropriate off site offset for the loss of EEC and threatened species habitat.

The current RMS preferred bypass route has not been given approval by NSW Office of Environment and Heritage, nor are there any intentions by RMS to implement the bypass route in the short term. If the bypass route does not proceed, or is relocated, the lands can be returned to the larger conservation area as indicated by the proposed R2 residential zone boundary.

The vegetation within the site including the proposed onsite biodiversity offset lands are within an area mapped as PCLs within the Cumberland Plain Recovery Plan (2010) and functions as part of a discontinuous corridor. Consequently, this planning proposal is impacting on a corridor and the conservation value of the existing vegetation patch would be partially reduced. However, a significant corridor of a minimum of 150m to a maximum of 400m in total width will be retained along Ousedale Creek which will continue to function as a major environmental corridor. Should the future bypass not proceed the width of the corridor will potentially be increased to 200m to a maximum of 425m respectively. In either case, the remnant bushland corridor will continue to function as a major environmental corridor.

The proposed rezoning will maintain a viable area of SSTF. Both communities can effectively be expanded in the region by implementing a suitable biodiversity offset in a location that supports other riparian corridors or existing reserves. Whilst the RMS bypass has not been approved, it is logical to provide a significant conservation area in the form of a biodiversity offset in another locality of high conservation value. The proponents have access to significant lands in the region and can offer conservation outcomes that could significantly benefit the ecology of the region (Biodiversity offset strategy *Travers bushfire & ecology* 2014).

The loss of CPW and SSTF is a significant ecological issue, however, not such that they cannot be offset in an area of similar conservation value to create a valuable conservation outcome. The key impact of the proposed R2 Residential Zone is the loss of two (2) Cumberland Plain Land Snail habitat areas which equates to 43.0% of the total available habitat.

The proponents have offered to enrich existing habitat where possible within conserved lands, to relocate the existing snail populations into retained vegetation areas within the site and or the proposed Elladale offset site and to secure the offset sites in perpetuity under a conservation agreement or equivalent mechanism. The removal of SSTF and CPW vegetation is a ‘red flag’ issue under the NSW Biodiversity Certification process including, which will require Ministerial approval of a red flag variation report. A biodiversity offset strategy (*Travers bushfire & ecology* 2014) has been prepared which offers significant off site biodiversity offsets for both communities.

In future, these offsets may provide suitable threatened species habitat particularly if it’s enriched for Cumberland Plain Land Snail with suitable on ground log protection, planting of Forest Red Gum and sufficient ground layer and mature vegetation to support foraging snails.

5.3 Mitigation Measures

SSTF, degraded CPW and Cumberland Plain Land Snail habitat will be directly impacted by the proposed rezoning. The foraging habitat of the other recorded species will also be impacted but not such that they will be put at the risk of extinction in the locality.

The proposal is impacting on large remnant patch of Cumberland Plain vegetation which is mapped as PCLs within the Cumberland Plain Recovery Plan (2010). Consequently, the proposed rezoning will have an adverse impact on a significant remnant of moderate to high conservation value. However, the proposed R2 zone has been significantly reduced in size to reduce the impact on the recorded EECs, threatened species and associated habitat.

Given the moderate to high conservation value of the landscape, the proponent and the proposed mitigation measures recognise that a significant biodiversity outcome is needed to demonstrate an overall maintain and improve outcome. The proposed zoning of E2 Environmental Conservation for all areas to be retained is appropriate given the conservation significance of the vegetation present and its role as an environmental corridor.

A key principle of offsetting in NSW is one of avoidance or protection of threatened species habitat, EECs and endangered populations are to be implemented before considering offsetting. The proposed R2 Low Density Residential Zone involves the removal of SSTF, CPW and associated Cumberland Plain Land Snail habitat. These are considered to be 'red flag' issues under the biodiversity certification assessment process.

In addition, the removal of CPW and SSTF is a matter of NES and a referral to the SEWPAC is required. The proposal will also be subject to the Department's Environmental Offsets Policy which guides the use of offsets under the *EPBC Act*.

The following onsite mitigation measures are recommended:

- Retain the recorded Little Lorikeet nesting hollow surrounded by a minimum 15m non-development buffer such as within a pocket park. This buffer will retain the nearest trees in all directions as a screen. These trees are all maturing and are of notable good heath for retention within a pocket park scenario. The nesting tree itself is in poor health and will potentially require management of dead limbs for safety. This buffer distance should be increased to allow for protection of root zones and allow for practical long term maintenance of the pocket park.
- Prepare and implement a Cumberland Plain Land Snail translocation protocol and habitat restoration procedure consistent with advice from Michael Shea (Appendix 6) to recover snails from proposed development areas and ensure suitable recipient habitat areas are provided. This is to be refined based on further habitat assessment and the advice of a panel of current experts in this field. This should also consider the use of the southern Forest Redgum/Ironbark vegetation community and revegetation area as a recipient area for snail relocation from the southern population. Walker Corporation have committed to support further site investigations in order to obtain more detailed information on the habitat preferences for Cumberland Plain Land Snails. Such investigations would be advised by leading snail experts and would likely include soil structure and organic mineral content sampling which is expected to guide the identification of appropriate CPLS recipient areas for restoration.
- Hollow bearing trees that potentially contain roosting and breeding habitat for threatened microbats should be identified and conserved where possible (subject to condition of the tree and other development factors). Hollows should be removed under the supervision of a fauna ecologist to ensure animal welfare (particularly for

threatened species) and hollows removed should be relocated or replaced within conservation areas.
- Restore Forest Red Gum dominated vegetation in the 0.7 ha southern portion alongside the proposed bypass to support Cumberland Plain Land Snail in the long term. This will provide a long term refuge for an isolated snail population which will be placed initially in surrounding Shale-Sandstone Transition Forest areas.
- Prepare a bushland management plan for proposed conservation areas including the biodiversity offset sites.
- Zone all conservation areas as E2 Environmental Conservation and secure as biodiversity offset areas such as through a conservation agreement or transfer public land as a bushland reserve.

Biodiversity offsets are recommended to offset the loss of:

- Cumberland Plain Woodland,
- Shale-Sandstone Transition Forest, and
- Threatened species habitat.

EcoLogical Australia (2014) were engaged to undertake a preliminary maintain or improve test based upon the Biodiversity Certification Assessment Methodology utilising the Macquariedale Road site, and potential offset lands on Elladale Road a few kilometres to the west (still in Appin). *EcoLogical Australia* has identified that there is an excess in credits generated from the available offset lands. There is an excess of suitable lands present at the Elladale Road site that could be utilised for offsetting requirements.

We advise that it is current policy for offsets to be transparently evaluated through the use of the BioBanking Credit Calculator or the Biodiversity Certification Assessment Methodology (BCAM) to satisfy NSW Biodiversity offsetting principles, and the SEWPAC biodiversity offset calculator to satisfy Commonwealth Biodiversity Offsetting Policy under the *EPBC Act*. At present, both offset calculators will need to demonstrate compliance with current policies at both the state and commonwealth assessment levels. The removal of EECs and known threatened species habitat are 'red flag' matters under the Biodiversity Certification Assessment Methodology (BCAM).

The following additional documentation will be required for biodiversity offsetting purposes:

- Prepare and submit a Biodiversity Certification Analysis and Red Flag Variation report to enable approval of the proposed offset strategy under the *TSC Act.*
- Prepare and submit a referral to the Department of Environment for assessment under the *EPBC Act*. This will need to include a biodiversity offset assessment using the *EPBC Act* Biodiversity Offsets Calculator.
- Prepare bushland management plans for the proposed on site conservation areas and off site biodiversity offset which is to address the above onsite mitigation measures and habitat enrichment to support Cumberland Plain Land Snails.

5.3 Appropriateness of the proposed zonings

Based on the observed threatened species and vegetation and the size of the proposed biodiversity offset areas, the conservation areas are suitable for zoning as:

- E2 Environmental Conservation

E2 Environmental Conservation is reserved for the most significant conservation landscape in a locality. The proposed conservation lands are mapped as Priority Conservation lands

and function as major environmental corridors. A high level of protection is warranted given the long term viability of the remnant patch and the need to provide a secure conservation outcome.

The proposed R2 Low Density Residential Zone is located in a landscape of development potential but also, in part, moderate to high conservation value. In the context of the proposed offsets, the R2 zone is appropriate. The outcome achieved as part of this rezoning appears to be a balanced development versus conservation outcome that yields both a viable development area but also a viable conservation area.

The future Appin bypass has been given the proposed rezoning of SP2 Special Uses based on its possible use as a future road corridor. Infrastructure corridors are a vital part of a functioning community but there is no indication as yet whether the future Appin bypass will be built in its current location. The rezoning of the future bypass land as SP2 Special Uses allows the final use to be determined as part of broader feasibility studies or to be used as an offset for other infrastructure works.

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Fauna Survey Methodologies

A1

The fauna survey methods outlined within this Appendix are techniques employed by *Travers bushfire & ecology* based on industry standards, together with additional methods found to be effective for select fauna groups. The fauna survey techniques deployed for each specific site are outlined within the survey effort table in the main body of this report. The techniques selected will depend upon the site characteristics and extent of available habitat as well as restrictions such as available survey time and weather conditions.

If any additional or target survey techniques for fauna species are undertaken, beyond the methods outline within this Appendix, the details of these will be described within the main body of this report.

1 Standard survey techniques

1.1 Diurnal birds

Diurnal birds are typically identified visually and / or by calls during diurnal surveys. Habitat searches to identify nests, feathers, eggs, or signs of foraging may be utilised more specifically for identifying threatened diurnal bird species.

Visual observations are made more accurate with the use of binoculars and where necessary or practical, with the use of a spotting scope. Binoculars are carried by the fauna surveyor at all times during nocturnal and diurnal fauna surveys. A birding field guide is always available in the field when required for verifications.

Calls are identified in the field by the fauna surveyor. If an unknown call is heard it is cross-matched to comprehensive bird call reference libraries taken into the field. A call library of birds occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

Diurnal bird census points may be undertaken at large sites where the total area may not be effectively covered during the survey period, or as a measure to ensure focused bird only survey.

1.2 Nocturnal birds

Searches for evidence of owl roosts, key perches and potential owl roosting / breeding hollows are made during diurnal site searches. Whitewash, feathers or regurgitated pellets give key information. Pellets are sent for analysis of contents to assist in identification where necessary.

The presence of nocturnal birds during the nocturnal period is first determined by quiet listening after dusk for calls by individuals emerging from diurnal roosts. Following this, and provided no calls are heard, call-playback techniques are employed for threatened species that have suitable habitat present.

Threatened nocturnal birds known to provide response to call-playback techniques include Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Sooty Owl (*Tyto tenebricosa*), Grass Owl (*Tyto capensis*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*).

Each call is typically played for 5-minute periods with 5-minute intervals of quiet listening for a response. This is followed with spotlighting and periods of quiet listening throughout the nocturnal survey.

Separation distances between broadcasting stations during a single night of survey are advised for different species within survey guidelines. These include 1km between owl calls and 3km between Bush Stone-curlew calls. Subsequent to this, separate broadcasting stations will be deployed on the same night where sites of significant size are surveyed. Separations for bitterns are not advised and these may be broadcast at a number of stations along suitable habitat areas.

Stag-watching will be undertaken where suitable large hollows for owl nesting / roosting show signs of activity or are located within development areas. Stag-watching of nesting trees should be undertaken during the recognised nesting period for owls with potential to occur.

1.3 Arboreal mammals

Arboreal mammals may be surveyed using *Elliott* type A, B and / or C traps, small and / or large hair tubes, spotlighting, call-playback techniques, scat searches or searches for other signs of activity.

Baiting and layout for *Elliott* trapping and hair tubing are typically incorporated into terrestrial trapping and hair tubing effort, unless where target survey is undertaken. Standard baiting and layout is therefore described in Section A1.3.2 below within terrestrial survey methods. Where gliders are targeted, the standard bait mix may be additionally laced with a nectarivor powder mix used for feeding captive birds. Where Brush-tailed Phascogale is targeted, the standard bait mix may be additionally laced with an insectivore powder mix. Where Eastern Pygmy Possum is targeted, the bait mix will be more heavily laced with honey.

Elliott traps for arboreal captures are placed onto tree-mounted platforms that are attached to the trunk 2-3m above the ground at an incline to facilitate drainage during inclement weather. Plastic sleeves are placed around or over traps when there is a possibility of wet weather forecast. Arboreal hair tubes are attached to the trunk of trees using rubber bands with the tube entry facing down, preventing water entry.

For all arboreal traps and hair tubes a mixture of honey and water is sprayed onto the trunk up to 8m above the trap and around the trap as a lure. Where Eastern Pygmy Possum is targeted a high concentrate honey-water mix is also sprayed from the base of trunk up and along connective branches.

Arboreal traps and hair tubes are placed in trees selected to bias target species. These are often flowering or sap flow trees for gliders, rough-barked trees for the Brush-tailed Phascogale and Banksias for the Eastern Pygmy Possum.

Where habitat is suitable, the presence of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) may be targeted by call-playback techniques. Calls are played for 5-minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting.

1.3.1 Koala survey

Koala survey is undertaken where the site is considered to provide potential habitat under the definitions of SEPP 44 - Koala Habitat Protection or in the presence of feed trees listed in Appendix 1 of the Recovery Plan for the Koala. Habitat may also be defined according to locally prepared Koala Plans of Management.

SEPP 44 is applied to land within local government areas (LGAs) listed under Schedule 1 of the Policy. Part 2 is applied to land which has an area of greater than 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

To determine potential Koala habitat (PKH) under the definitions of SEPP 44 an estimate of the percentage density of each tree species within vegetation communities is determined by averaging the percentage of stems counted. PKH is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the Policy.

Where Koala habitat is considered to be present, the site will be surveyed on foot, with known Koala food trees being inspected for signs of use. Trees are inspected for characteristic scratch and claw marks on the trunk and scats around the base of each tree. Koalas may also be targeted during nocturnal survey, involving call-playback techniques and spotlighting.

For large sites, Koala search quadrats may be employed within portions of communities where feed trees are present at suitable densities. All Koala feed trees within quadrats are searched for signs of activity including characteristic claw marks on the trunk and faecal pellets around the base. Pellet searches are undertaken according to the tree base search methods described in *Phillips & Callaghan* (2008). Search quadrats are less labour intensive than the SAT techniques described below but may only be an initial survey effort to determine presence / absence.

Where any Koala activity is recorded the complete Spot Assessment Technique (SAT) described by *Phillips & Callaghan* (2008) may be undertaken as a measure of Koala activity. This technique may also be employed in the first instance as an indicator of presence / absence, particularly where a site has potential Koala activity based on previous records.

For any survey technique the location and density of Koala droppings, if found, are documented.

1.4 Terrestrial mammals

Various traps may be used to survey for the presence of terrestrial mammals. These include *Elliott* trapping, medium and large cage trapping, small and large hair tubing and pitfall traps. Other survey methods for terrestrial mammals include the use of camera surveillance, spotlighting and activity searches.

Arboreal and terrestrial *Elliott* traps and hair tubes are placed in grids, or more commonly along trap-lines of 5-10 traps, separated by distances of 20-50m depending on site size and variation of habitat. Trap or hair tube sizes selected at each trap station may alternate or may have an emphasis on certain sizes according to target species.

Selection of terrestrial *Elliott* trap, cage trap, hair tube or pitfall trap locations have an emphasis on nearby foliage, runways, shelters and signs of activity.

Standard bait mix for all *Elliott* traps, medium cage traps and hair tubes is a mixture of rolled oats, honey and peanut butter. Standard bait mix may be supplemented with sardines in large hair tubes or cage traps to simultaneously target Spotted-tailed Quoll. Cage traps may also be baited solely with meat or roadkill to target Spotted-tailed Quoll. Where Potoroos or Bandicoots are targeted, truffle oil may be used to lace the standard bait mix or used on its own.

Where difficult to access, sensitive or extended trapping periods are undertaken surveillance cameras can be used in terrestrial mammal surveys. The surveillance camera is mounted on a tree and directed towards a closed baited cage trap. Surveillance cameras may also be used to detect use or monitor activity at burrows, hollows, nests, etc.

During diurnal site searches assessment is made of 'found' scats, markings, diggings, runways and scratches located. Any scats or pellets not readily identifiable (particularly predator scats) may be collected and sent to identification expert, Barbara Triggs, for identification of contents, hair or bone fragments.

1.5 Bats

Micro-chiropteran bats are surveyed by echolocation using *Anabat* detectors or trapped using harp *(Constantine)* traps, mist nets or trip lines. Microchiropteran bats are also surveyed by searches of subterranean habitats such as caves, tunnels or shafts where present, or by searching structures such as under bridges and abandoned buildings or wall/ceiling cavities where entry is possible.

Anabat Mk 2 and SD-1 detectors are used in fixed passive monitoring positions and/or during active nocturnal monitoring. Active monitoring is used in conjunction with spotlighting or during stag-watching for greater accuracy of recorded call identification.

Bat call recordings are interpreted through *Anabat* V and *Anabat* CF Storage and Interface Module ZCAIM devices and analysed using *Anabat* 6 and *Analook* 3.3q computer software packages.

Harp traps and mist nets are placed along suitable flyways such as along open narrow road / river corridors to maximise the likelihood of captures. Traps may be purpose set to capture bats emerging from roosts by being placed at the entry of tunnels / caves or draped over the edge of bridges. Trip lines are placed over water to trip low flying drinking bats into the water. These bats are collected as they swim to the water's edge.

Harp traps are checked during early nocturnal survey as well as each morning. Mist nets and trip lines require constant monitoring. Captured bats are identified using field identification guides. Bats are released at the point of capture after dusk or placed under trunk bark / splits of nearby trees.

Mega-chiropteran bat species, such as Grey-headed Flying-fox, are surveyed by targeting flowering / fruiting trees during spotlighting activities and by listening to distinctive vocalisations. Suitable roosting habitat is searched for presence of small or large established camps during diurnal survey periods.

1.6 Amphibians

Amphibians are surveyed by vocal call identification, call-playback, spotlighting along the edge of water-bodies, pitfall trapping, funnel trapping, by driving along sealed roads near waterways, habitat searches and collection of tadpoles.

Calls are identified in the field by the fauna surveyor. For similar calling species or if an unknown male call is heard it is cross-matched to frog call reference libraries taken into the field. A call library of frogs occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

All threatened frog species may be targeted by use of call-playback techniques where suitable habitat exists, with some species more reliable than others in providing a response. Red-crowned Toadlet may also be targeted by clapping and loud retort along suitable habitat drainages in order to evoke a call response.

Any amphibians found are visually identified and when required to be examined are handled with latex gloves and kept moist until release. Any tadpoles requiring capture are collected with a scoop net and placed within a snap-lock clear plastic bag for analysis of colour and morphological features.

Amphibian survey yields best results during or following wet periods with seasonal breeding and subsequent male calling varying according each species. Targeted survey is thus undertaken in appropriate seasons.

1.7 Reptiles

Reptiles are surveyed opportunistically during diurnal site visit(s), but also by habitat searches, pitfall trapping, funnel trapping, by driving along roads on humid nights and by camera surveillance at burrows.

Habitat searches for reptiles are undertaken in likely localities such as under logs, rocky slabs on rock surfaces, under sheet debris, under bark exfoliations and leaf litter at the base of trees and along the edge of wetlands. Aspect and land surface thermal properties are considered to determine best search locations particularly along rocky escarpments.

During warmer months spotlighting may assist survey effort particularly during humid conditions.

1.8 Invertebrates

Target survey is undertaken for the Cumberland Plain Land Snail (*Meridolum corneovirens*) when in proximity to previous *Atlas of NSW Wildlife* database records and particularly where its typical host vegetation community is present. The most appropriate areas of observed habitat are searched. Dense areas of leaf litter with likely moisture retaining properties are scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks are also turned over. In large survey areas searches quadrats are undertaken evenly across highest quality habitat areas to estimate population size.

The top (spiral side), side (showing aperture) and underside (showing umbilicus) of snail specimens found are photographed and sent to Michael Shea of the Australian Museum Malacology Unit for confirmation of identification.

2 Habitat trees

Hollow-bearing tree surveys use a *Trimble* handheld GPS unit to log both field reference location as well as tree data. Data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height are documented. A metal tag with the tree number is placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging are also noted.

3 Survey effort table descriptors:

Target - Where effort is specifically concentrated towards an individual species. Selected target species will be identified within the survey effort table and where necessary described within the report.

Opportunistic - Where birds are identified by observation, call or indirect methods as the opportunity arises.

Habitat search - Where suitable areas of habitat for selected fauna groups such as frogs, reptiles and invertebrates are specifically searched.

Diurnal Bird Census Point(s) - Are bird surveys undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. Size and time will be specified in the survey effort table. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently census points are selected to adequately represent each of the habitat areas present and particularly areas designated for proposed development. Often census points are commenced at locations where bird activity is noticeably high.

Spotting-scope Outlook - A *Nikon* spotting scope with 16~47 zoom at x60 magnification on a mounted tripod is used for distant inspections of diurnal birds. This is undertaken at wetlands for viewing waterfowl and waders but also other difficult to access areas. It may also be used for inspecting activity at nests, hollows and combined with spotlight for a panoramic search in open areas.

Call-playback - This involves broadcasting recorded calls through a 15 watt *Toa Faunatech* amplifier to evoke a response from species known to reply. Species selected for call-playback will be indicated in the survey effort table.

Spotlighting - is carried out using a hand held 55 watt spotlight powered by a 12 volt rechargeable battery. This technique involves walking amongst the woodland areas, forest fringes, along roads, trails and fence lines so that a maximum number of trees can be observed. Spotlighting around water-bodies and particularly along the shallow fringes is used for finding frogs. Spotlighting is used in combination with binoculars or spotting scope for closer night inspections.

Stag-watching - involves watching hollows in the dusk period approximately 15 minutes prior to dark until 30 minutes following dark. Placement of the observer on the ground allows for a silhouette of any emerging fauna to be seen against the lighter sky background such that a spotlight is not required, which would likely to disrupt emergence behaviour. Where any movement is observed a spotlight may then be used for identification purposes.

Search Quadrats - are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently quadrats are selected to adequately represent each of the suitable habitat areas present and particularly areas designated for proposed development. The use of this technique simply as an initial time-effective suitable indicator of presence / absence of Koalas has been discussed with Koala expert, Stephen Phillips.

Koala Spot Assessment Technique (SAT) - Method outlined by *Phillips & Callaghan* (2008) and accepted by the Australian Koala Foundation to determine Koala activity levels. Activity levels are calculated from the proportion of trees showing signs of Koala use as indicated by the presence of scats as well as site location within the state.

***Elliott* trapping** - using *Elliott* type A (33x10x10cm) and Type B (45x15x15cm), B and/or Type C traps for trapping small sized mammals. Trapping nights' effort will be indicated in the survey effort table. Trapping layout, trap sizes, baiting and trapping period will be outlined within the site specific methodology section.

Medium Cage trapping - using medium sized cage traps (17x17x45cm foldout cages with tread-plate mechanism or 22x25x58cm rigid cage with tread-plate mechanism) for trapping up to cat / bandicoot sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Large Cage trapping - using large sized cage traps (25x25x50cm foldout cages with pull lever (meat) mechanism, 28x28x60cm foldout cages with tread-plate mechanism or 30x30x70cm rigid cage with tread-plate mechanism) for trapping up to quoll sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Hair tubing - using small (40mm diameter x 120mm long) and/or large (90mm diameter x 200mm long) PVC pipe sections for collecting mammal hair samples. At one end of each tube is an enclosed chamber where the bait is placed and capped. Small drill holes in the inside face of the chamber allow the smell of the bait to permeate out through the tube without allowing access to the bait. At the other open entry end, double-sided tape is attached around the inner rim so hair samples of animals entering the tube are collected. Hair samples collected are sent to identification expert, Barbara Triggs, for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

Pitfall trapping - is used to survey for small terrestrial mammals, frogs, reptiles and invertebrates. Pitfall trapping involves the use of 15cm diameter and 60cm long PVC stormwater pipe sections placed vertically into pre dug holes. The pipe is placed and set firm with surrounding soil so that the top rim is level with the ground surface. Drift fences made of damp-proof-course 270mm wide are held tight and upright by wooden and steel pegs and run along the length of each trap-line. Drift fences are run over the middle of each pit in the trap line ensuring at least 5m of fencing is run along each side of each pit. Ground fauna passing beyond the pitfall transect are diverted towards the pits along the fence line.

Funnel trapping - is used to survey mainly for frogs and reptiles. Funnel traps are 18cm x 18cm x 75cm long and constructed of shade cloth with an internal spring and wire frame in a similar design to yabby traps. At each end an inward facing funnel directs fauna through a 4cm hole and into the trap. Herpetofauna search the walls and corners for an exit and discover it difficult to re-find the internal exit hole. As with pitfall traps, funnel traps are used with drift fences that divert fauna towards the trap entry. At least 5m of fencing is run between each funnel trap which may be placed on either side of the fence. Trapping layout, target species, fence lengths and trapping period will be outlined within the site specific methodology section.

Passive *Anabat* monitoring - involves leaving the bat recorder in a fixed mounted position to record call-sequences of passing bats. Recording locations are determined in order to represent different available foraging structures for various micro-chiropteran bat species. Dams, cleared flyways, high insect activity areas, forest edges and ecotones are particularly targeted.

Active *Anabat* monitoring - is a method of active microbat recording during stag-watching or during complete nocturnal survey. Active monitoring involves an SD-1 recorder allied with a PDA for viewing call-sequences in real-time. When calls are heard the transducer microphone is actively directed towards the calling animal with the aid of a spotlight, so longer and clearer call sequences may be recorded. When calls of a potential threatened species are observed on the PDA screen a view by spotlight of the bat size and wing morphology is attempted for greater identification accuracy.

Active vehicle *Anabat* monitoring - is a method of active microbat recording deployed when large distances need to be covered in a nocturnal survey period. A Hi-mic extension cable allows the transducer microphone to be placed on a bracket on the roof of a travelling vehicle so calls may be viewed whilst driving. The vehicle travels at no more than 40km/h to

prevent wind interference. When calls of a potential threatened species are observed on the dash mounted PDA screen active spotlighting is undertaken.

Harp trapping - is used to capture microchiropteran bats. Harp traps have an aluminium frame with a two-bank 4.2m^2 area and calico capture bag set along the base area.

Mist netting - is used to capture microchiropteran bats. The mist net capture area is 2.4m high and 9m wide and supported by two 3.5m poles which are braced with ropes and pegs. Design is a 0.08mm ultrafine nylon monofilament thread arranged in a 14x14mm mesh, with four horizontal capture pockets. These features are specific for the use to capture micro-chiropteran bat species and are provided by the only known supplier in Poland.

Trip lining - is used to capture microchiropteran bats. Fishing line is strung tight on pegs in a zig-zag pattern across open water-bodies just above the water surface to trip drinking bats into the water.

Camera surveillance - is used to monitor activity at burrows, hollows, etc. or to survey for species presence at baited stations. A *Reconyx Hyperfire* digital weatherproof camera is used with a passive infrared motion detector and a night-time infrared illuminator. The camera is mounted on a tree or tripod and takes three consecutive photo frames on the detection of movement up to 30m away or the detection of a heat / cold source different to the ambient temperature.

Weather conditions - Survey effort for each fauna group accounting for methods undertaken, duration, and weather conditions are provided in the survey effort table. Weather details are documented for all survey techniques and include:

- Air temperature;
- Cloud cover
- Rain (e.g. none, light drizzle, heavy drizzle, heavy rain);
- Recent rain events (where relevant);
- Wind strength e.g. calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns).
- Wind direction
- Moon (where relevant) (e.g. none, 1/4 moon, 1/2 moon, 3/4 moon, full moon);

Threatened & Migratory Species Habitat Assessment

A2

Table A2.1 below provides an assessment of potential habitat within the subject site for state and nationally listed threatened flora species recorded within 10km on the *Atlas of NSW Wildlife* database (OEH) or indicated to have potential habitat present within 10km on the *EPBC Protected Matters Tool.*

Table A2.1 – Threatened flora habitat assessment

Scientific Name DATABASE SOURCE	**TSC Act**	**EPBC Act**	**GROWTH FORM AND HABITAT REQUIREMENTS**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**TO BE CONSIDERED IN 7 PART TEST (✓)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Acacia baueri subsp. *aspera* OEH	V	-	Decumbent to spreading shrub with phyllodes irregularly whorled. Grows in low heath chiefly in Blue Mountains.	x	x	-	-	x	x
Acacia bynoeana OEH EPBC	E1	V	Erect or spreading shrub to 0.3m high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. Distribution limits N-Newcastle S-Berrima.	x	limited	✓	✓	✓	✓
Asterolasia elegans EPBC	-	E	Erect shrub 1-3m high growing in moist sclerophyll forests on Hawkesbury sandstone slopes hillsides. Distribution limits Maroota region.	x	x	-	-	x	x

Scientific Name DATABASE SOURCE	**TSC Act**	**EPBC Act**	**GROWTH FORM AND HABITAT REQUIREMENTS**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**TO BE CONSIDERED IN 7 PART TEST (✓)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Caladenia tessellata OEH EPBC	E1	V	Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S-south of Eden.	x	x	-	-	x	x
Callistemon linearifolius OEH	V	-	Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. Distribution limits N-Nelson Bay S-Georges River.	x	x	-	-	x	x
Cryptostylis hunteriana OEH EPBC	V	V	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S-south of Eden.	x	x	-	-	x	x
Cynanchum elegans OEH EPBC	E1	E	Climber or twiner to 1m. Grows in rainforest gullies, scrub & scree slopes. Distribution limits N-Gloucester S-Wollongong.	x	x	-	-	x	x
Epacris purpurascens var. *purpurascens* OEH	V	-	Erect shrub to 1.5m high growing in sclerophyll forest and scrub and near creeks and swamps on Sandstone. Distribution limits N-Gosford S-Blue Mountains.	x	✓	✓	✓	✓	✓
Grevillea parviflora subsp. *parviflora* OEH EPBC	V	V	Open to erect shrub to 1m. Grows in woodland on light clayey soils Distribution limits N-Cessnock S-Appin.	x	marginal	✓	✓	✓	✓
Gyrostemon thesioides OEH	E1	-	Multi-stemmed shrub to 70cm. Grows on hillsides and riverbanks. Confined to Georges and Nepean Rivers and believed extinct.	x	x	-	-	x	x

Scientific Name DATABASE SOURCE	**TSC Act**	**EPBC Act**	**GROWTH FORM AND HABITAT REQUIREMENTS**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**TO BE CONSIDERED IN 7 PART TEST (✓)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Leucopogon exolasius OEH EPBC	V	V	Erect shrub to 2m high. Rocky hillsides and creek banks in Sydney Sandstone Gully Forest. Confined to Woronora and Georges Rivers and Stokes Creek.	x	x	-	-	x	X
Melaleuca deanei OEH EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. Distribution limits N-Gosford S-Nowra.	x	x	-	-	x	X
Pelargonium sp. *Striatellum* EPBC	E1	E	Herb to 90cm tall which grows in damp places especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Varied distribution from SE NSW to QLD.	x	x	-	-	x	X
Persoonia bargoensis OEH EPBC	E1	V	Erect shrub to 1m high. Grows in woodland to Dry sclerophyll forest, on sandstone and laterite. Restricted to the Bargo area.	x	marginal	✓	✓	low	✓
Persoonia hirsuta OEH EPBC	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. Distribution limits N-Glen Davis S-Hill Top.	x	marginal	✓	✓	low	✓
Persoonia nutans OEH EPBC	E1	E	Erect to spreading shrub. Grows in dry sclerophyll forest and woodland on laterite and alluvial sands. Distribution limits Cumberland Plain.	x	x	-	-	x	X
Pimelea curviflora var. *curviflora* OEH EPBC	V	V	Woody herb or sub-shrub to 0.2-1.2m high. Grows on Hawkesbury sandstone near shale outcrops. Distribution Sydney.	x	marginal	x	x	very low	✓

Scientific Name DATABASE SOURCE	**TSC Act**	**EPBC Act**	**GROWTH FORM AND HABITAT REQUIREMENTS**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**TO BE CONSIDERED IN 7 PART TEST (✓)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Pimelea spicata OEH EPBC	E1	E	Decumbent or erect shrub to 0.5m high. Occurs principally in woodland on soils derived from Wianamatta Shales. Distribution limits N-Lansdowne S-Shellharbour.	x	marginal	x	x	very low	✓
Pomaderris brunnea OEH EPBC	V	V	Shrub to 3m high. Confined to Upper Nepean and Colo Rivers where it grows in open forest.	x	x	-	-	x	x
Pterostylis saxicola OEH EPBC	E1	E	Terrestrial orchid. Grows in shallow sandy soil above rock shelves, usually near Wianamatta / Hawkesbury transition. Distribution limits N-Hawkesbury River S-Campbelltown.	x	limited to Ousedale Creek area	x	x	low	✓
Pultenaea aristata OEH	V	V	Shrub species to 1m tall which flowers in spring. It is usually found in dry and wet heath and scrub between Helensburgh and Mt Keira.	x	x	-	-	x	x
Pultenaea pedunculata OEH	E1	-	Prostrate shrub. Grows in dry sclerophyll forest and disturbed sites. Confined to Prestons and Villawood in NSW.	x	marginal	✓	✓	very low	✓
Streblus pendulinus EPBC	-	E	Tree or large shrub to 6m tall. Coastal species along watercourses in warmer rainforest area.	x	x	-	-	x	x
Syzygium paniculatum OEH EPBC	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N-Forster S-Jervis Bay.	x	x	-	-	x	x

Scientific Name DATABASE SOURCE	**TSC Act**	**EPBC Act**	**GROWTH FORM AND HABITAT REQUIREMENTS**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**TO BE CONSIDERED IN 7 PART TEST (✓)**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Thelymitra sp. 'Kangaloon' EPBC	-	Critic. E	A terrestrial orchid with dark blue flowers, presented in mid-late spring. Only known from the Robertson area in the Southern Highlands. Often in association with the endangered ecological community *Temperate Highland Peat Swamps on Sandstone.*	x	x	-	-	x	x
OEH	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife* database								
EPBC	- Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search								
V	- Denotes vulnerable listed species under the relevant Act								
E or E1	- Denotes endangered listed species under the relevant Act								
NOTE:	1. This field is not considered if no suitable habitat is present within the subject site 2. 'records' refer to those provided by the *Atlas of NSW Wildlife* database. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.								

Table A2.2 below provides an assessment of potential habitat within the subject site for state and nationally listed threatened fauna species recorded within 10km on the *Atlas of NSW Wildlife* (OEH) database or indicated to have potential habitat present within 10km on the *EPBC Protected Matters Tool.*

Table A2.2 – Threatened fauna habitat assessment

COMMON NAME ***Scientific Name*** DATABASE SOURCE	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT** ***Distribution Limit***	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**TO BE CONSIDERED IN 7 PART TEST**
					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Giant Burrowing Frog *Heleioporus australiacus* OEH EPBC	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. *Distribution Limit: N-Near Singleton S-South of Eden.*	×	Sub-optimal	×	-	unlikely	✓
Stuttering Frog *Mixophyes balbus* EPBC	E	V	Terrestrial inhabitant of rainforest and wet sclerophyll forests. *Distribution Limit: N-near Tenterfield S-South of Bombala*.	×	×	-	-	×	×
Giant Barred Frog *Mixophyes iteratus* EPBC	E	E	Terrestrial inhabitant of rainforest and open forests. *Distribution Limit: N-Border Ranges National Park. S-Narooma.*	×	Marginal	×	×	×	×
Red-crowned Toadlet *Pseudophryne australis* OEH	V	-	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods. *Distribution Limit: N-Pokolbin. S-near Wollongong.*	×	Marginal	×	✓	unlikely	✓
Green and Golden Bell Frog *Litoria aurea* OEH EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. *Distribution Limit: N-Byron Bay S-South of Eden.*	×	Marginal	×	×	×	×

COMMON NAME ***Scientific Name*** DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT ***Distribution Limit***	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				TO BE CONSIDERED IN 7 PART TEST
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Littlejohn's Tree Frog *Litoria littlejohnii* OEH EPBC	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. *Distribution Limit: N-Hunter River S-Eden.*	×	✓	×	✓	low	✓
Southern Bell Frog *Litoria raniformis* EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. *Distribution Limit: N-ACT Bay. S-Albury.*	×	✓	×	×	×	×
Rosenberg's Goanna *Varanus rosenbergi* OEH	V	-	Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. *Distribution Limit: N-Nr Broke. S-Nowra Located in scattered patches near Sydney, Nowra and Goulburn.*	×	×	-	-	×	×
Broad-headed Snake *Hoplocephalus bungaroides* OEH EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. *Distribution Limit: N-Mudgee Park. S-Nowra.*	×	Sub-optimal	✓	✓	low	✓
Freckled Duck *Stictonetta naevosa* OEH	V	-	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. *Distribution Limit: N- Tenterfield. S-Albury.*	×	×	-	-	×	×

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Superb Fruit-dove *Ptilinopus superbus* OEH	V	-	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. *Distribution Limit: N-Border Ranges National Park. S-Bateman's Bay.*	×	×	-	-	×	×
Black-necked Stork *Ephippiorhynchus asiaticus* OEH	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. *Distribution Limit: N-Tweed Heads. S-Nowra.*	×	Sub-optimal	×	×	unlikely	✓
Australasian Bittern *Botaurus poiciloptilus* OEH EPBC	E	E	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. *Distribution Limit: N-North of Lismore. S- Eden.*	×	×	-	-	×	×
Black Bittern *Ixobrychus flavicollis* OEH	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams and ponds, sheltered mudflats and oyster slats. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	marginal	×	×	×	×
Spotted Harrier *Circus assimilis* OEH	V	-	Utilises grassy plains, crops and stubblefields; saltbush, spinifex associations; scrublands, mallee, heathlands; open grassy woodlands. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	marginal	×	×	×	×

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Little Eagle *Hieraaetus morphnoides* OEH	V	-	Utilises plains, foothills, Open forest, Woodlands and scrublands; river red gums on watercourses and lakes. *Distribution Limit - N-Tweed Heads. S-South of Eden.*	×	✓	×	×	unlikely	✓
Square-tailed Kite *Lophoictinia isura* OEH	V	-	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. *Distribution Limit: N-Goondiwindi. S-South of Eden.*	×	✓	×	×	unlikely	✓
Osprey *Pandion haliaetus* OEH	V	-	Utilises water bodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Red Goshawk *Erythrotriorchis radiatus* EPBC	E	V	Inhabits tall open forests and woodlands. Breeds in tall trees adjacent to watercourses of wetlands. *Distribution Limit: N-Border Ranges National Park. S-Foster.*	×	×	-	-	×	×
Bush Stone-curlew *Burhinus grallarius* OEH	E	-	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. *Distribution Limit: N-Border Ranges National Park. S-Near Nowra.*	×	✓	✓	×	unlikely	✓
Comb-crested Jacana *Irediparra gallinacean* OEH	V	-	Floating vegetation of deep and permanent vegetation-choked tropical and warm temperate wetlands and dams. Occasionally feeds along muddy wetland margins. *Distribution Limit: N-Tweed Heads. S-Ku-ring-gai Chase National Park.*	×	×	-	-	×	×

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					Suitable Habitat Present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Australian Painted Snipe *Rostratula australis* OEH EPBC	E	V	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Black-tailed Godwit *Limosa limosa* OEH	V	-	Regular summer migrant that forages along tidal mudflats, estuaries, sand spits, shallow river margins, sewerage ponds, inland on large shallow fresh or brackish waters. *Distribution Limit: N-Tweed Heads. S-South of Eden*.	×	×	-	-	×	×
Gang-gang Cockatoo *Callocephalon fimbriatum* OEH	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. *Distribution Limit: mid north coast of NSW to western Victoria.*	✓	-	-	-	-	✓
Glossy Black-Cockatoo *Calyptorhynchus lathami* OEH	V	-	Open Forest with *Allocasuarina* species and hollows for nesting. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	✓	-	-	-	-	✓
Little Lorikeet *Glossopsitta pusilla* OEH	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. *Distribution Limit: N-Tweed Heads. S-South of Eden*.	✓	-	-	-	-	✓

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Swift Parrot *Lathamus discolour* OEH EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. *Distribution Limit: N-Border Ranges National Park. S-South of Eden*.	×	✓	✓	✓	✓	✓
Turquoise Parrot *Neophema pulchella* OEH	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. *Distribution Limit: N-Near Tenterfield. S-South of Eden.*	×	✓	×	×	unlikely	✓
Eastern Ground Parrot *Pezoporus wallicus wallicus* OEH	V	-	Inhabits low heath, sedgeland and buttongrass plains with dense vegetation to provide suitable roosting cover. *Distribution Limit: N-North of Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Barking Owl *Ninox connivens* OEH	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. *Distribution Limits: N-Border Ranges National Park. S-Eden.*	×	✓	×	×	low	✓
Powerful Owl *Ninox strenua* OEH	V	-	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. *Distribution Limits: N-Border Ranges National Park. S-Eden.*	✓	-	-	-	-	✓
Masked Owl *Tyto novaehollandiae* OEH	V	-	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. *Distribution Limit: N-Border Ranges National Park. S-Eden.*	×	✓	×	×	low	✓

COMMON NAME ***Scientific Name*** DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT ***Distribution Limit***	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				TO BE CONSIDERED IN 7 PART TEST
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Sooty Owl *Tyto tenebricosa* OEH	V	-	Tall, dense, wet forests containing trees with very large hollows. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	×	-	-	×	×
Brown Treecreeper *Climacteris picumnus victoriae* OEH	V	-	Occupies Eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. *Distribution Limit:(Sub species victoriae) Central NSW west of Great Dividing Range, Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.*	×	✓	×	×	low	✓
Eastern Bristlebird *Dasyornis brachypterus* OEH EPBC	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Speckled Warbler *Chthonicola sagittata* OEH	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution Limit: N-Urbanville. S-Eden.*	×	✓	×	×	low	✓
White-fronted Chat *Epithianura albifrons* OEH	V	-	Found in open damp ground, grass clumps, fencelines, heath, samphire saltmarshes, mangroves, dunes, saltbush plains. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	×	×

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Painted Honeyeater *Grantiella picta* OEH	V	-	A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. *Distribution Limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.*	×	✓	×	×	unlikely	✓
Black-chinned Honeyeater *Melithreptus gularis gularis* OEH	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. *Distribution Limit: N-Cape York Pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.*	×	✓	×	✓	low	✓
Regent Honeyeater *Xanthomyza Phrygia* OEH EPBC	E4A	E	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution Limit: N-Urbanville. S-Eden.*	×	✓	×	×	×	×
Varied Sittella *Daphoenositta chrysoptera* OEH	V	-	Open eucalypt woodlands / forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. *Distribution Limit: N-Border Ranges National Park. S-South of Eden*.	✓	-	-	-	-	✓
Hooded Robin *Melanodryas cucullata cucullata* OEH	V	-	Found in Eucalypt woodlands, *Acacia* scrubland, open forest, and open areas adjoining large woodland blocks, with areas of dead timber. *Distribution Limit: N-Central Qld. S-Spencer Gulf SA.*	×	✓	×	×	unlikely	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				TO BE CONSIDERED IN 7 PART TEST
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Scarlet Robin *Petroica boodang* OEH	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	✓	×	low	✓
Flame Robin *Petroica phoenicea* OEH	V	-	Summer: forests, woodlands, scrubs, from sea-level to *c.* 1,800 m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. *Distribution Limit: N northern NSW tablelands. S-South of Eden.*	×	✓	✓	✓	✓	✓
Diamond Firetail *Stagonopleura guttata* OEH	V	-	Found in Eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. *Distribution Limit: N-Rockhampton Q. S-Eyre Pen. Kangaroo Is. SA.*	×	✓	×	✓	low	✓
Spotted-tailed Quoll *Dasyurus maculatus* OEH EPBC	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. *Distribution Limit: N-Mt Warning National Park. S-South of Eden.*	×	✓	✓	✓	low	✓
Southern Brown Bandicoot *Isoodon obesulus* OEH EPBC	E	E	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. *Distribution Limit: N-Kempsey. S-South of Eden.*	×	marginal	×	×	×	×

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Koala *Phascolarctos cinereus* OEH EPBC	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	✓	✓	low	✓
Eastern Pygmy Possum *Cercatetus nanus* OEH	V	-	Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. *Distribution Limit: N-Tweed Heads. S-Eden.*	×	Sub-optimal	×	✓	unlikely	✓
Yellow-bellied Glider *Petaurus australis* OEH	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. *Distribution Limit- N-Border Ranges National Park. S-South of Eden*.	×	✓	×	×	unlikely	✓
Squirrel Glider *Petaurus norfolcensis* OEH	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked and high nectar producing species and hollow bearing trees. *Distribution Limit: N-Tweed Heads. S-Albury.*	×	✓	×	×	unlikely	✓
Long-nosed Potoroo *Potorous tridactylus* EPBC	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. *Distribution Limit: N-Mt Warning National Park. S-South of Eden.*	×	Sub-optimal	×	×	unlikely	✓
Brush-tailed Rock-wallaby *Petrogale penicillata* EPBC	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. *Distribution Limit: N-North of Tenterfield. S-Bombala.*	×	Sub-optimal	×	×	×	×

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Grey-headed Flying-fox *Pteropus poliocephalus* OEH EPBC	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. *Distribution Limit: N-Tweed Heads. S-Eden.*	✓	-	-	-	-	✓
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* OEH	V	-	Rainforests, sclerophyll forests and woodlands. *Distribution Limit: N-North of Walgett. S-Sydney.*	✓	-	-	-	-	✓
East-coast Freetail Bat *Micronomus norfolkensis* OEH	V	-	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. *Distribution Limit: N-Woodenbong. S-Pambula.*	✓	-	-	-	-	✓
Large-eared Pied Bat *Chalinolobus dwyeri* OEH EPBC	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. *Distribution Limit: N-Border Ranges Nation Park. S-Wollongong.*	×	✓	×	×	unlikely	✓
Eastern Falsistrelle *Falsistrellus tasmaniensis* OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	×	✓	×	✓	low	✓

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Golden-tipped Bat *Kerivoula papuensis* OEH	V	-	Rainforest and adjoining moist open forest habitats, roosting in tree hollows and dense vegetation. *Distribution Limit: N-Border Ranges Nation Park. S-South of Eden.*	×	×	-	-	×	×
Little Bentwing-bat *Miniopterus australis* OEH	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. *Distribution Limit: N-Border Ranges National Park. S-Sydney.*	×	✓	×	×	unlikely	✓
Eastern Bentwing-bat *Miniopterus orianae oceansis* OEH	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	✓	-	-	-	-	✓
Large-footed Myotis *Myotis macropus* OEH	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. *Distribution limits: N-Border Ranges National Park. S-South of Eden.*	×	✓	✓	✓	✓	✓
Greater Broad-nosed Bat *Scoteanax rueppellii* OEH	V	-	Inhabits areas containing moist river and creek systems especially tree lined creeks. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	✓	-	-	-	-	✓

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					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
New Holland Mouse *Pseudomys novaehollandiae* EPBC	-	V	Occurs in heathlands, woodlands, open forest and paperbark swamps and on sandy, loamy or rocky soils. Coastal populations have a marked preference for sandy substrates, a heathy understorey of leguminous shrubs less than 1m high and sparse ground litter. Recolonise of regenerating burnt areas. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	Sub-optimal	×	✓	unlikely	✓
Cumberland Plain Land Snail *Meridolum corneovirens* OEH	E	-	Inhabits remnant eucalypt woodland of the Cumberland Plan. Shelters under logs, debris, clumps of grass, around base of trees and burrowing into loose soil. *Distribution Limit: Cumberland Plain of Sydney Basin Region.*	✓	-	-	-	-	✓
Macquarie Perch *Macquaria australasica* EPBC	V (FM Act 1994)	E	Occurs in south east Australia at moderate to high altitudes in rivers and reservoirs. Historical records show the species was widespread and abundant in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers and their tributaries. Allen (1989) states that introduced populations are present in Nepean River and water supply dams in the Sydney area. Occurs in lakes and flowing streams, usually in deep holes.	×	marginal	×	×	×	×

OEH	-	Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife* database
EPBC	-	Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
V	-	Denotes vulnerable listed species under the relevant Act
E	-	Denotes endangered listed species under the relevant Act

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				TO BE CONSIDERED IN 7 PART TEST
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	

NOTE:

1. This field is not considered if no suitable habitat is present within the subject site
2. 'records' refer to those provided by the *Atlas of NSW Wildlife* database.
   'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.

Table A2.3 below provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10km on the *EPBC Protected Matters Tool*. Nationally *threatened* migratory species are considered in Table A2.2 above.

Table A2.3 – Migratory fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT** ***Migratory Breeding***	**Suitable Habitat Present (✓)**	**Recorded on Site (✓)**	**COMMENTS**
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. *Sedentary; dispersive.*	✓	×	-
White-throated Needletail (*Hirundapus caudacutus*)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. *Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.*	✓	✓	A large flock of White-throated Needletail were observed in flight over the study area during survey on 8 November 2012. This species is not likely to utilise the habitats present within the study area for breeding or roosting. Habitat loss will not cause significant impacts on this species. The White-throated Needle will not likely offer a constraint to rezoning.
Rainbow Bee-eater (*Merops ornatus*)	Open woodlands with sandy, loamy soil; sandridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. *Breeding resident in northern Australia. Summer breeding migrant to south-east & south-west Australia.*	Not likely	×	-
Black-faced Monarch (*Monarcha melanopsis*)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. *Summer breeding migrant to coastal south-east Australia, otherwise uncommon*.	Sub-optimal	×	-
Satin Flycatcher (*Myiagra cyanoleuca*)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. *Breeds mostly south-east Australia & Tasmania over warmer months, winters in north-east Qld.*	✓	×	-

COMMON NAME *Scientific Name*	PREFERRED HABITAT *Migratory Breeding*	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
Rufous Fantail (*Rhipidura rufifrons*)	Undergrowth of rainforests/wetter eucalypt forests/gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. *Breeding migrant to south-east Australia over warmer months. Altitudinal migrant in north-east NSW in mountain forests during warmer months.*	✓	×	-
Great Egret (*Ardea alba*)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. *Dispersive; cosmopolitan.*	limited	×	-
Cattle Egret (*Ardea ibis*)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. *Breeds in summer in warmer parts of range including NSW*.	✓	×	-
Latham's Snipe (*Gallinago hardwickii*)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000m; samphire on saltmarshes; mangrove fringes. *Breeds Japan. Regular summer migrant to Australia. Some overwinter.*	Sub-optimal	×	-
Fork-tailed Swift (*Apus pacificus*)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. *Breeds Siberia, Himalayas, east to Japan south-east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.*	✓	×	-

7 Part Test of Significance

A3

Council is required to consider the impact upon threatened species, populations and / or EECs from any development or activity via the process of a 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed species impact statement (SIS).

The following 7 part test of significance relies on the ecological assessment provided in Sections 3 and 4 of this report and should be read as such.

The following 7 part test is reliant upon the Biodiversity Offset Strategy proposed by *Travers bushfire & ecology* (2014) as a means of a mitigation measure to reduce local impacts. The offset ratios are based upon a Biocertification report prepared by *EcoLogical Australia* (2014) and the use of the EPBC offset calculators available.

For the purposes of identifying offsets for the planning proposal a target 4.4:1 offset ratio has been applied for SSTF, 3.4:1 offset ratio has been applied for CPW to identify the target offsets for both communities. These offset ratios ensure that the proposed offsets achieve a maintain or improve outcome.

Table 1 provides a summary of the target offset areas for both CPW and SSTF using a proposed 4.4:1 offset ratio for SSTF, 3.4:1 offset ratio for CPW.

Taking into account the onsite conservation areas at Macquariedale Road (approximately 34.81ha of SSTF) the offsite biodiversity offsets to be achieved at Elladale Road are estimated at approximately 15ha consisting of 10ha of CPW and 5ha of SSTF. The total area of protection and restoration offsets to be provided is subject to the parcels selected and the outcomes of the approval by Office of Environment & Heritage (OEH) and by Department of Environment (DoE) under the *EPBC Act*.

The proposed biodiversity offset areas as selected by *Travers bushfire & ecology* (54.7ha) include:

- 34.81ha (SSTF only) onsite conservation areas – Macquariedale Road, Appin
- 19.85ha (SSTF and CPW) offsite biodiversity offset – Elladale Road, Appin

A proposed SSTF/CPW transition revegetation area (0.7ha) within the conserved lands at Macquariedale Road is proposed to be enriched for CPLS through the installation of onground protection (*Euc. tereticornis* logs) and revegetation using a more desirable species mix dominated by CPW canopy species that provide higher quality foraging resources.

Travers bushfire & ecology has selected appropriately sized SSTF and CPW vegetation areas at Elladale Road as biodiversity offset sites to meet the target for each community. It includes the target vegetation communities with a minimum of 8.99ha of CPW and 7.98ha of SSTF and 1.62ha Sandstone Gully Forest (SGF). 1.26ha of CPW revegetation is also contained within the Elladale Road Offset site.

Detailed flora and fauna investigations of the subject site, together with habitat assessments, have resulted in the identification of potential habitat for a variety of threatened species. An assessment of these species is as follows:

Threatened flora

- *Acacia bynoeana*
- *Epacris purpurascens* var. *purpurascens*
- *Grevillea parviflora* subsp. *parviflora*
- *Persoonia bargoensis*
- *Persoonia hirsuta*
- *Pterostylis saxicola*
- *Pimelea curviflora* var. *curviflora*
- *Pimelea spicata*
- *Pultenaea pedunculata*

Endangered ecological communities

- *Shale Sandstone Transition Forest* *
- *Cumberland Plain Woodland* *

Threatened fauna

- Giant Burrowing Frog
- Red-crowned Toadlet
- Littlejohn's Tree Frog
- Broad-headed Snake
- Black-necked Stork
- Little Eagle
- Square-tailed Kite
- Bush Stone-curlew
- Gang-gang Cockatoo *
- Glossy Black-Cockatoo *
- Little Lorikeet *
- Swift Parrot
- Turquoise Parrot
- Barking Owl
- Powerful Owl *
- Masked Owl
- Brown Treecreeper
- Speckled Warbler
- Painted Honeyeater
- Black-chinned Honeyeater
- Varied Sittella *
- Hooded Robin
- Scarlet Robin
- Flame Robin
- Diamond Firetail
- Spotted-tailed Quoll
- Koala
- Eastern Pygmy Possum
- Yellow-bellied Glider
- Squirrel Glider
- Long-nosed Potoroo
- Grey-headed Flying-fox *
- Yellow-bellied Sheathtail-bat *
- East-coast Freetail Bat *
- Large-eared Pied Bat
- Eastern Falsistrelle
- Little Bentwing-bat
- Eastern Bentwing-bat *
- Large-footed Myotis
- Greater Broad-nosed Bat *
- Cumberland Plain Land Snail *

Endangered populations

- nil

The 7 part test of significance is as follows.

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

Species indicated with a "*" were recorded within the subject site during surveys. Despite the presence of potential habitat, the remaining listed species were not recorded during the flora and fauna survey. It is considered that the proposal is unlikely to disrupt the life cycle for any of these listed species such that a viable local population would be placed at risk of extinction.

Flora

No threatened flora species were observed, despite varied levels of potential habitat. Section 4.2.1 describes each species targeted during survey, the level of potential habitat present and where surveys were undertaken for the species. The level of survey is considered suitable in that the target species were generally non-cryptic. As no specimens have been observed, no viable local populations would likely be placed at risk of extinction.

Summary of threatened fauna species recorded

Little Lorikeet (*Glossopsitta pusilla*)

The Little Lorikeet mostly occurs in dry, open eucalypt forests and foraging in small flocks on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts. Long term investigations indicate that breeding birds are resident from April to December, and even during their non-resident period, they may return to the nest area for short periods if there is some tree-flowering in the vicinity *(Courtney & Debus 2006).*

Therefore, the study area provides suitable foraging, roosting and breeding habitat for the Little Lorikeet throughout, and particularly along, the fringes of the Ousedale Creek. This species was recorded to a 'possible' level of certainty during preliminary site surveys. The potential for this species to occur was also considered likely based on nearby local records of Little Lorikeet to the east and west.

Targeted surveys definitively recorded the presence of this species foraging at two (2) locations within the study area (see Figure 2). John Young also recorded a roosting hollow which he identified as a nesting tree given obvious high use over many years (see Figure 2).

John Young's recording details and advice on this species is provided in Appendix 5.

Mr Young advised that if the pair relocated, there were other nesting opportunities for Little Lorikeet within the proposed conservation areas. Therefore it may be concluded that the proposed rezoning will not likely significantly impact on a local population of Little Lorikeet.

Powerful Owl (*Ninox strenua*)

The Powerful Owl inhabits mature rainforest, wet and dry eucalypt forest and woodland. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal mammals. Roosting is generally within dense foliage of mid-canopy trees in sheltered gullies. Large trees with hollows of at least 45cm in diameter and 100cm deep are required for nesting. Estimates of the home range of this species vary greatly, but territories are thought to range from 800-1,500ha *(Kavanagh 1997).*

The subject site provides suitable breeding hollows for the Powerful Owl and suitable foraging habitat throughout the forest and woodland portions. Suitable roosting is also present, particularly along the creek line and drainages where denser mid-storey foliage is present.

Preferred prey species of the Powerful Owl recorded during survey, include the Common Ringtail Possum, Common Brushtail Possum, Sugar Glider and Grey-headed Flying-fox.

Powerful Owl was recorded responding to call playback on 6 November 2012. This individual flew in to perch approximately 200m to the south of the call-playback station. This may suggest that the owl was called in from further south. Call-playback may call owls away from core foraging and roosting areas, however, the study area was within the home range of a local pair. This is based on a previous recording of Powerful Owl to a reference point along Macquariedale Road, within the study area, in 1986, as well as other recorded locations along Elladale Creek to the nearby west in 2006. Despite this conclusion, there were no conclusive signs of owl roosting activity by evidence of whitewash below diurnal perches during November 2012 habitat searches.

Trees containing large hollows suitable for nesting by large forest owl species were identified during the November 2012 survey within the study area and are depicted on Figures 2 & 11. A broken egg shell potentially belonging to a large forest owl was found at this time below one suitable nesting tree located in the central eastern portions of the study area. Owl expert, John Young, made a *possible* level identification from a photograph as Masked Owl, with some potential for it to belong to the Powerful Owl, based on the feather material seen inside the shell.

Target survey of the study area by John Young was undertaken in February 2013 (Appendix 5). Mr Young concluded that "*no large forest owls of any sort inhabit the site whatsoever as they would have been detected during the search for suitable roost sites and would have been heard during the three nights of visuals and listening*."

Mr Young commented that "*In respect to the Powerful Owl that was drawn to playback by Mr Mead – either this bird was foraging in the area from its distant territory or had been attracted to the call from well off as the playback was used into the night and the bird has no doubt had time to move well away from its breeding territory*."

Following the site visit and assessment by John Young it may be concluded that the Powerful Owl is not likely to be significantly impacted by the rezoning proposal.

Grey-headed Flying-fox (*Pteropus poliocephalus*)

Grey-headed Flying-foxes are canopy feeding frugivores and nectarivores, inhabiting a wide range of habitats, including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. This species roosts in camps, which may contain tens of thousands of individuals. Camps are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy (*Tidemann 1998*). Generally, foraging is within 20km of camps but individuals are known to commute up to 50km to a productive food source.

An individual Grey-headed Flying-fox was observed in flight over the study area during nocturnal surveys on 5 November 2012.

The study area provides no suitable roosting or breeding habitat for the Grey-headed Flying-fox. The study area provides seasonal year round foraging opportunity for this species. Loss of foraging resources within the study area would not likely cause a significant impact on this species.

Varied Sittella (*Daphoenositta chrysoptera*)

Varied Sittellas inhabit open eucalypt woodlands / forests (except heavier rainforests), mallee, inland acacia, coastal tea-tree scrubs, golf courses, shelterbelts, orchards, parks and scrubby gardens (*Pizzey & Knight 1999*). The species feed mainly by gleaning arthropods from crevices on tree trunks or small branches and twigs in the tree canopy, moving downwards or along branches, searching for insects, preferring rough or decorticating barked trees, including stringybarks and ironbarks, standing dead trees, or mature trees with hollows or dead branches. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork, high in the living tree canopy and often re-uses the same fork or tree in successive years.

It is reported that the apparent decline of this species has been attributed to declining habitat cover and quality (*e.g.* Watson *et al.* 2003). The sedentary nature of the Varied Sittella makes cleared agricultural land a potential barrier to movement. Survival and population viability are sensitive to habitat isolation, reduced patch size and habitat simplification, including reductions in tree species diversity, tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter (*Watson et al. 2001; Seddon et al. 2003*).

A small party of two (2), possibly three (3), birds were observed in the north eastern portions of the study area on 7 November 2012. As this species more typically forages in parties of approximately six (6) birds, more individuals of this family group are expected to be present within the study area. No further individuals were recorded present by either *Travers bushfire & ecology* nor birding expert John Young during four (4) days of targeted survey through in February 2013.

Noske (1998) reports that Varied Sittellas hold weakly defended territories of 13-20ha in north eastern NSW which is equivalent in area to the conserved areas of the study area. The most recent rezoning proposal will retain 29ha of suitable habitat which is sufficient in size to maintain a local territory, particularly in association with connective habitat further north.

There are also records of Varied Sittella in the large local remnants to the east of Appin, as well as the other creek line remnants further west of the study area, however, the extent of the local population for which the recorded individuals form part, is difficult to predict.

It should be noted that removal of habitat for the proposed bypass, as well as habitat to the south east, may place competitive pressures on the recorded family group in the remaining remnants. Bell Miner presence and extensive tree dieback exists to the south of Macquariedale Road as well as in locations to the north of this, particularly the central drainage gully. Dominance by Noisy Miners occur in the remaining fringes of the remnant patches present. Bell Miners and noisy Miners would themselves need to recolonise following clearance works. The Varied Sittella is reported to be adversely affected by the dominance of noisy Miners in woodland patches (*Olsen et al. 2005*).

In conclusion, the Varied Sittella will not be likely significantly impacted by the rezoning for development given the size of the proposed conservation areas, the species has not been recorded within areas proposed for development and the habitat connectivity to further habitat areas will be retained.

Gang-gang Cockatoo (*Callocephalon fimbriatum*)

The Gang-gang Cockatoo is a relatively small, dark grey cockatoo. Both sexes have crests, with the male being distinguished by a bright red head. The Gang-gang Cockatoo is associated with a variety of woodland and forest habitats, and occasionally more open areas in south eastern New South Wales and Victoria (NSW Scientific Committee, 2001). This

species has been observed in eucalypt forests and exotic trees (*Morris 1997*), and is known to feed on the seeds of native shrubs and trees, in addition to some exotic species such as the Hawthorn and *Cupressus* species (*Schodde & Tideman 1976*). The Gang-gang Cockatoo nests in hollows in large, dead trees (NSW Scientific Committee, 2001).

It is considered that the study area provides suitable nesting, roosting and foraging habitat for the Gang-gang Cockatoo, particularly along the riparian forest habitat adjacent to Ousedale Creek. This was reflected by the recorded locations during the November 2012 survey which were all located proximate to this habitat. The survey was undertaken during the nesting period for this species and it was considered likely at this time that nesting was taking place close to the recorded locations.

Targeted surveys undertaken by John Young in February 2013 located the likely nesting hollow for Gang-gang Cockatoo. Use was confirmed by nearby chew marks along branches. This hollow is located along Ousedale Creek to the north of Macquariedale Road (see Figure 2).

This species will utilise the Open Forest and Woodland communities within the proposed rezoning areas for seasonal foraging requirements. The recorded nest and best quality foraging locations for Gang-gang Cockatoo are located within the areas proposed for conservation rezoning. Based on the retention of recorded breeding habitat and extent of retained foraging areas the proposed rezoning will not likely cause a significant impact on this species.

Glossy Black-Cockatoo (*Calyptorhynchus lathami*)

The Glossy Black-Cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of *Allocasuarina*. They feed almost exclusively on the fruit of *Allocasuarina* species (*Lindsey* 1992). They choose trees with larger cone crops but show no sign of selecting trees on the basis of cone size, concentrating foraging in trees with a high ratio of total seed weight to cone weight (*IClout* 1989). They breed in hollow trees or stumps, usually in eucalypts.

It is considered that the study area provides suitable foraging, roosting and nesting habitat for the Glossy Black-Cockatoo. Hollows providing potentially suitable habitat for nesting are shown on Figure 2.

A male and female pair of Glossy Black-Cockatoos was observed every day of the November 2012 survey foraging to the nearby west of Gordon Lewis Oval, within the study area. Extensive foraging by evidence of chewed *Allocasuarina* cones was found surrounding this location as well as in another area to the nearby north. Other locations indicating foraging were also found at small isolated locations within the study area (see Figure 2).

The November 2012 survey was not undertaken during the breeding period for Glossy Black-Cockatoo (March - August). Targeted surveys undertaken by John Young in February 2013 determined the significance for the species in the lead up to the breeding period (Appendix 5). One (1) additional potential foraging location was located by Mr Young. As the species was not recorded nesting at this time, it can be assumed that nesting was not taking place within the study area.

Given that the Glossy Black-Cockatoo was not found by John Young to be utilising the study area for nesting and that all extensive and high use foraging areas will be retained within conservation areas, this species will not likely be significantly impacted by the proposed rezoning.

Cumberland Plain Land Snail (*Meridolum corneovirens*)

Meridolum corneovirens is wholly restricted to western Sydney and is primarily associated with the Cumberland Plain and Castlereagh Woodland vegetation types (*Clark 2009*). The species occasionally occurs along the edges of Coastal River Flat Forest, where it meets either of the above forest types. *M. corneovirens* occurs generally in areas characterised by moist soils together with growths of various species of lichen. This species is known to shelter under logs, other debris, and in leaf litter or around the base of trees where exfoliations occur. Where conditions permit, it will bury into loose soil especially under logs and around the bases of large trees (*Clark 2009*).

Spatial autocorrelation analysis indicates that *M. corneovirens* populations are highly structured at very short distances (2m) and that the radius of a genetic neighbourhood is approximately 350m (*Clark & Richardson 2002*).

It is considered that the study area provides suitable habitat for the Cumberland Plain Land Snail in locations where the host community CPW exists as well as adjacent SSTF areas with low sandstone influence that are currently, or would have been, within a few hundred metres of CPW.

November 2012 survey

Five (5) preliminary transect searches for Cumberland Plain Land Snail were undertaken as indicated on Figure 2. Cumberland Plain Land Snail was recorded from shell remains along three transects, with two (2) of these shells being living specimens, indicating an active population. The highest number of specimens were recorded in the far southern transect which contained suitable habitat, however, later vegetation analysis has identified the vegetation as SSTF with low sandstone Influence.

Targeted Survey February 2013

The February 2013 survey aimed to conduct more detailed habitat searches across the entire study area for Cumberland Plain Land Snail to determine the extent of habitat use and populations distributions.

Site visit with Michael Shea October 2013

Searches were undertaken on site with Mr Shea on the 25th October 2013 as well as on the proposed offset site along Elladale Road on the 31st January 2014.

These surveys in total recorded Cumberland Plain Land Snail throughout the vegetated areas of the study area with the exception of the gully areas and the south western portions. Living Cumberland Plain Land Snails extended westward from CPW remnants up to 350m into SSTF.

An assessment of habitat, based on recorded locations and quality of remnant patches has been undertaken (Figure 6). Macquariedale Road and the degraded habitats immediately south, as well as the central drainage gully running east-west to the south of the sports oval both provide expected barriers to snail movement. As a result, it is considered most likely that two or three separate populations exist within the study area. This is consistent with population estimates being within the 100-300m range (pers com. Dr Stephanie Clark). However given the spread of observed snails and presence of connective habitat, the southern populations could be one population that has become partially separated.

Snails extend further into SSTF within the two (2) northern patches. In both of these patches, living specimens were located in the far western extents of the site, located over 150m to the other side of the proposed future Appin bypass. The southern patch recorded only one (1) snail shell outside of low sandstone influence SSTF, this shell was found broken on the surface of a log and was likely placed there by a small mammal or bird.

As a result of vegetation removal and/or modification, 13.72 ha of Cumberland Plain Land Snail habitat will be affected. This represents 43.0% of known habitat for this species including the remaining 'preferred' CPW portions, whilst disturbed and fragmented. The impact includes areas removed or modified for the proposed residential area and APZs. It does not include the bypass but does include APZs that occur within the bypass (an additional 3.03 ha (9.5%) if included). Based on the distribution and density of observed Cumberland Plain Land Snails within the site, the proposal is removing an equivalent proportion of the population through direct habitat removal.

The loss of Cumberland Plain Land Snail habitat within the site as a result of the rezoning is significant. Advice provided by snail expert Michael Shea (Appendix 6) indicates that it is also unclear whether the species is capable in persisting indefinitely in SSTF, considered as 'marginal habitat'. The habitat being removed consists of degraded CPW as well as SSTF which currently supports fringing habitat adjacent to long since removed higher quality CPW for the Appin township. Suitability of habitat also diminishes along the transition of soil across the SSTF from more suitable shale adjacent to CPW to the unsuitable high sandstone influence near sandstone outcroppings. The area of SSTF proposed for removal are within the higher shale influence eastern portions.

Based on the extent of habitat loss also containing the higher quality habitat areas it is concluded that the proposal will result in a significant impact on the Cumberland Plain Land Snail populations. This conclusion is concurred by snail expert Michael Shea (see report in Appendix 6).

Walker Corporation have indicated that they are likely to be proceeding with Biodiversity Certification and should they do so, the impact on Cumberland Plain Land Snail will be taken as 'not significant'. This is given that a maintain and improve outcome has been demonstrated (*Ecological Australia* 2014) and Cumberland Plain Land Snail is also treated as an ecosystem credit within CPW. The Biodiversity Certification process will provide sufficient offsetting and conservation of a patch of CPW as well as additional SSTF at Elladale Road, Appin, less than 5km from the site. This Elladale site will also offset recorded Cumberland Plain Land Snail habitat and has been investigated as a recipient area for translocation of snails from the subject site. Walker Corporation have committed to support a Cumberland Plain Land Snail Translocation Protocol on the basis of preliminary advice given by Michael Shea and as recommended within this report.

Further to the proposed relocation or translocation of living snails into selected areas as a mitigation measure, a 0.7 ha Forest Red Gum restoration offset is proposed for the southern portion. It is recognised that such restoration will not provide suitable habitat in the short-term and therefore the potential to relocate snails into the surrounding high shale influence SSTF should be investigated as an on-site option.

Despite the above conclusion of significance, *Travers bushfire & ecology* is of the opinion that given the recorded locations (including living specimens) within the SSTF, the snail population(s) within the site are expected to persist to the west of the proposed bypass but over a smaller area and a much reduced population size. Whilst the remaining habitat is the less preferred SSTF and snails within this community are recorded at lower densities, the

recorded area to the west of the bypass road for the northern and central patches may be sufficient in size to maintain viable population(s) even with the future bypass in place.

Current limited knowledge of snail habitat preference suggests that snail occurrences are primarily associated with the Cumberland Plain and Castlereagh Woodland vegetation types (Clark 2009). However, our opinion above is supported from recordings by *Travers bushfire & ecology* of living specimens persisting in small highly fragmented patches of SSTF (and isolated from CPW for decades) at other locations including a nearby site at Brooks Point Road, Appin as well as locations at Airds Bradbury and Picton. It may be that the species is showing non-typical habitat preferences at the outer extent of distribution area (*pers. comm.* M Shea). The above examples are at the southern extent of the species known distribution.

Figure 6 shows recorded snail locations extending into SSTF to the west in each portion of the site and the small CPW portions present. It should be noted that whilst dead shells may indicate that living specimens are to be expected still present, no living snails were recorded in each of the three (and degraded) CPW portions present and no shells were found at all in the northern CPW portion. Of the 59 (15 living and 44 dead specimens) shells found, 54 (91.5%) were recorded in SSTF mapped areas of the site, and only 3 of these were relatively close to CPW mapped areas. Whilst not undertaken across the SSTF gradient to date, soil sampling may find that the high shale influence extends well into the SSTF portions and this is why snail specimens were recorded at considerable distances from CPW.

The adverse impacts of habitat loss for Cumberland Plain Land Snail may be offset using te Biodiversity certification Assessment Methodology as an ecosystem credit, however, measures to recover and relocate living specimens from development areas should be appropriately implemented to mitigate any impacts on CPLS.

It is recommeded to prepare and implement a Cumberland Plain Land Snail translocation protocol and habitat restoration procedure (Appendix 6) to recover snails from proposed development areas and ensure suitable recipient habitat areas are provided. This is to be refined based on further habitat assessment and the advice current experts in this field. This should also consider the use of the southern Forest Redgum/Ironbark vegetation community and revegetation area as a recipient area for snail relocation from the southern population.

Walker Corporation have committed to support further site investigations in order to obtain more detailed information on the habitat preferences for Cumberland Plain Land Snails. Such investigations would be directed by the experts and would likely include soil structure and organic mineral content sampling to enable the identification of appropriate recipient areas.

It should be noted here also that snail searches undertaken at the proposed Elladale Road, Appin site found Cumberland Plain Land Snail in all areas of CPW across the site including highly fragmented portions containing a highly disturbed understorey. The offset strategy will include restoration of habitat areas for the species including habitat enrichment by placement of logs from the development area and planting of Forest Red Gum so that this offset site may support higher densities of snails in most suitable habitat areas.

Greater Broad-nosed Bat (*Scoteanax rueppellii*), East-coast Freetail-bat (*Micronomus norfolkensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

Each of these microbat species have their own unique roosting and microhabitat requirements, however, they are considered here together due to their dependence on hollows for roosting and breeding. There is suitable foraging, roosting and breeding habitat for all three (3) species within the study area and within the proposed rezoning area for development east of the proposed bypass road.

The Yellow-bellied Sheathtail-bat inhabits a wide variety of eucalypt forests, foraging above the canopy in high flying, high speed movements (*Richards 2008*). In mallee or open country it comes closer to the ground. Usually found in mixed sex groups of two (2) to six (6) and occasionally up to thirty (30), the Yellow-bellied Sheathtail Bat roosts in large tree hollows and has been found in the abandoned nests of Sugar Gliders (*Churchill 2008*). A colony of six (6) has been found roosting inside the trunk of a large hollow tree, clinging to the walls, hanging head down and propped up by their forearms; They were well separated but tended to cluster around the entrance hole (*Churchill 2008*). Large maternity colonies may exceed one hundred (100) individuals.

The East-coast Freetail Bat forages above the canopy of Open Forest and Woodland and in clearings at forest edges, feeding on small insects (*Allison, Hoye & Law 2008*). This species is thought to roost predominantly in tree hollows but also under loose bark and occasionally in houses and outbuildings (*Allison, Hoye & Law 2008*). Until recent findings of a roost within mangroves, all known natural roosts had occurred within hollow spouts of large mature eucalypts. *Hoye et. al* (*2008*) suggest that despite a female recorded 6km from its roost, this species generally forages within a few kilometres of roosts.

The Greater Broad-nosed Bat inhabits a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, *Melaleuca* swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree lined creeks in open areas (*Churchill 2008*). The Greater Broad-nosed Bat predominantly forages within Open Forest, Woodland, along vegetated creek lines and small river systems *(Hoye and Richards 1995).* This species roosts in tree hollows, cracks and fissures in trunks and dead branches, under exfoliating bark as well as within the roofs of old buildings (*Churchill 2008, Hoye & Richards 1995*).

The Greater Broad-nosed Bat feeds on large slow flying beetles and moths (*Dwyer 1965; Vestjens and Hall 1977*). This species is a slow flier and generally hunts for insects over understorey vegetation as well as foraging along the interface of clearings and paddocks within forested areas and along tree lined creeks (*Richards 1988*).

These microbats were all recorded during overnight passive *Anabat* monitoring on 5 and / or 6 November 2012 within the study area (see Figure 2 for recorded locations). They are all highly mobile species and local habitat would not be exclusive to the study area.

The Yellow-bellied Sheathtail-bat was recorded to a *probable* level of certainty only from a single recorded pass. The East-coast Freetail Bat also showed low dependence on the site at this time from two (2) recorded passes at the single recorded location. The Greater Broad-nosed Bat on the other hand, was recorded several times at all recording locations suggesting higher potential for a roost to be located nearby.

As it is very difficult to locate microbat roosting / breeding locations without exhaustive survey, their assessment is often based on the available foraging and hollow resources that remain in the locality. Large and sufficient area of habitat containing suitable roosting and breeding hollows will be retained within the conservation portions of the site west of the proposed bypass road. It was noted that hollow resources increased in number and sixe towards Ousedale Creek as typically expected on such a transition. This is confirmed from survey of a total of 19 large hollows considered suitable for use by threatened owls and/or cockatoos, and only 1 of these being located east of the proposed bypass.

Given that sufficient areas of available hollows for roosting and breeding will be retained within the site and suitable foraging habitat areas and connectivity will continue within the

locality, it is concluded that there will not be a likely significant impact on threatened hollow-dependent microbats as a result of the rezoning proposal.

It is recommended that to provide additional assurance of reducing the potential impact, a hollow-bearing tree assessment is undertaken within the proposed development areas.

Where the felling of hollow-bearing trees is required during subdivision stages, this should be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse. In the instance of recording the presence of threatened microbats during tree removal, maximum effort should ensure safe relocation of the roosting colony.

Re-used hollows or those with likely occupation are to be relocated to conservation areas within close proximity to the site. All other hollows removed should be replaced with nest boxes. Every second box should be a design suitable for microbat species. Boxes should be constructed all of weatherproof timber (marine ply), fasteners and external paint.

Eastern Bentwing-bat (*Miniopterus orianae oceanensis*)

The Eastern Bentwing-bat forages above and below the canopy within Open Forest and Woodland, feeding on small insects This species roosts in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (*Dwyer 1995*). Caves are an important resource, particularly for breeding, where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (*Dwyer 1995*).

The Eastern Bentwing-bat was recorded during overnight passive *Anabat* recording surveys on both 5 and 6 November 2012 located along Ousedale Creek in the north and the central southern portions of the study areas (see Figure 2). At both locations, call sequences were limited and only to a *probable* level of certainty. Given also that this highly mobile microbat species was not recorded at the other two *Anabat* stations suggests use of the study area was not high at these times.

Whilst suitable caves for roosting and breeding may be present along the rocky escarpment edge of Ousedale Creek, there are no such opportunities within the proposed rezoning areas east of the proposed bypass road. Therefore, development within the eastern portions of the study area will impact only on suitable foraging habitat for this species. Removal of foraging habitat will not likely cause a significant impact on this species.

Masked Owl (*Tyto novaehollandiae*)

The Masked Owl is distributed most widely along forested areas of coast, escarpment and tablelands, although it occurs at lower population densities in drier forests and woodlands of NSW western slopes. The species is known to utilise forest margins and isolated stands of trees within agricultural land. It is most frequently encountered in Open Forest with a sparse understorey or ground cover, or at the ecotone between Closed Forest and Open Forest or Woodland. This species is often found in heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained. The Masked Owl is dependent upon hollow bearing trees all year round, requiring old mature trees with large hollows for breeding and as diurnal roosting sites.

The subject site provides suitable breeding and roosting hollows for the Masked Owl. Suitable foraging habitat is present throughout the forest and woodland portions as well as off cleared and disturbed edges.

Two (2) distant calls consistent with Masked Owl were heard less than a minute apart during quiet listening after dusk and prior to call-playback on 6 November 2012. These calls were heard in the direction of the north western corner of the study area where a large hollow was known to be present. As the calls were distant, identification could not be conclusive at the time and may have been mistaken for cockatoos going to a roost. Owls often call soon after dusk to advertise their territory and to call to their partner before commencing nocturnal foraging. These calls often give up the important diurnal roosting locations. Searches below the tree and below surrounding potential perch locations were undertaken the following day with no conclusive signs of owl activity indicating a definite roost.

Trees containing large hollows suitable for nesting or roosting by both Masked Owl and Powerful Owl, were identified during survey within the study area (Figures 2). A broken egg shell was found during initial November 2012 survey below one suitable nesting tree located in the central eastern portions of the study area. Owl expert, John Young, concluded to a *possible* level of certainty based on photographic evidence, as most likely belonging to Masked Owl with also a possibility for Powerful Owl.

Targeted survey by John Young located further egg shell remains and concluded that the photo identification as Masked Owl or Powerful Owl shell fragments was incorrect and confirmed that they belonged to the non-threatened Australian Wood Duck. Targeted surveys by John Young at this time concluded that Masked Owl was not utilising the study area. Therefore this species will not be likely significantly impacted by the proposed rezoning.

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

There are no endangered flora or fauna populations within the Wollondilly LGA.

c) In the case of a critically endangered or endangered ecological community, whether the action proposed:

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

SSTF will be retained in the western portion of the site, west of the proposed Appin Bypass. The reduction in area of 9.1 ha for the proposal R2 lands and APZs within the future bypass accounts for approximately 19.7% loss in area of this EEC, thus 34.2 ha will be retained. As is connected to the north and south along the broader riparian corridor of Ousedale Creek, and its width being over 100m, this is likely to remain viable long term. Having a wider remnant of vegetation would likely decrease the pressures of edge effects. The proposal seeks to retain the 34.2 ha as part of an E2 zoning which would provide appropriate conservation measures and is in line with the Cumberland Plain Recovery Plan. It is expected that the proposal will not have an adverse impact such that the extent of the SSTF its local occurrence is placed at risk of extinction.

All 3.26ha of CPW vegetation will be removed as part of the proposal. Clearly, it is likely to have an adverse effect on the extent of local CPW. CPW in the local area is often limited to remnant canopy trees.

The proponent has offered to enrich existing habitat within conserved lands, to relocate the existing snail populations into retained vegetation areas within the site, and to provide threatened species biodiversity offsets on other lands in the region.

ii. Is likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction,

CPW will be removed, not adversely modified.

SSTF will be adversely modified through the application of APZs along the western perimeter of the proposed R2 lands. Although the APZ is likely to be 20m, its affection would likely be larger due to edge effects, thus indirectly impacted. The impact of APZs has been considered in the calculations provided above and included in the total extent of vegetation to be removed or modified. Although the application of APZs may cause some vulnerability to the edges of the proposed conservation area, the bushland has high resilience and very few weeds. The application of such is therefore not expected to place the EEC at risk of local extinction.

d) In relation to the habitat of threatened species, populations or ecological community:

It is considered that the habitat attributes of the subject site provide known or potential habitat for *Acacia bynoeana, Epacris purpurascens* var. *purpurascens, Grevillea parviflora* subsp. *parviflora, Persoonia bargoensis, Persoonia hirsuta, Pterostylis saxicola, Pimelea curviflora* var. *curviflora, Pimelea spicata, Pultenaea pedunculata,* Giant Burrowing Frog, Red-crowned Toadlet, Littlejohn's Tree Frog, Broad-headed Snake, Black-necked Stork, Little Eagle, Square-tailed Kite, Bush Stone-curlew, Gang-gang Cockatoo, Glossy Black-Cockatoo, Little Lorikeet, Swift Parrot, Turquoise Parrot, Turquoise Parrot, Barking Owl, Powerful Owl, Masked Owl, Brown Treecreeper, Speckled Warbler, Painted Honeyeater, Black-chinned Honeyeater, Varied Sittella, Hooded Robin, Scarlet Robin, Flame Robin, Diamond Firetail, Spotted-tailed Quoll, Koala, Eastern Pygmy Possum, Yellow-bellied Glider, Squirrel Glider, Long-nosed Potoroo, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Large-eared Pied Bat, Eastern Falsistrelle, Little Bentwing-bat, Eastern Bentwing-bat, Large-footed Myotis, Greater Broad-nosed Bat, Cumberland Plain Land Snail.

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

Approximately 12.08 ha of vegetation will be removed as part of the proposal. This figure includes all APZs. The proposal will remove the majority of potential habitat for species associated with CPW and/or species likely to prefer low sandstone influence vegetation (*Grevillea parviflora* var. *parviflora, Pimelea spicata, Pultenaea pendunculata,* Cumberland Plain Woodland and Cumberland Plain Land Snail). Some woodland birds may have a preference for the CPW and low sandstone influenced vegetation but not necessarily restricted to these areas. The remaining threatened flora species not mentioned above are more likely to be present within moderate to high sandstone influenced vegetation that is largely conserved to the west of the proposed future bypass. The proposal would not likely have any impact upon *Pterostylis saxicola* as the potential habitat was limited to that directed on the embankment of Ousedale Creek.

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

The proposal will not fragment or isolated threatened flora habitat for any species known to occur on site. As discussed previously, all CPW vegetation is likely to be removed or modified as opposed to being fragmented or isolated.

The proposal will not fragment or isolate threatened fauna habitat either as there is sufficient remnant connectivity in the western portion of the study area that will be conserved. It will make remnant patches of Cumberland Plain Land Snail smaller in size but will not disconnect it from other adjacent sites. Currently there are three (3) main areas of populations and this will remain the same post development.

Therefore, it is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated or fragmented as a result of the proposal.

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

The vegetated areas to be removed within the proposed R2 Low Density Residential zone in the eastern parts of the site between the proposed bypass road (in the west) and the existing Appin township (to the east) contains threatened species habitat of varying importance.

This area does not contain any large hollows suitable for use by large forest owls or threatened cockatoos (see Figure 2). This area however has been recorded or may contain the following important habit features for recorded threatened fauna:

- Cumberland Plain Land Snail habitat throughout and fringing vegetated areas
- Roosting/breeding habitat for hollow-dependent threatened microbats
- Breeding habitat for Varied Sittella
- Roosting/nesting hollows for Little Lorikeet

One hollow in the central portion was recorded in use by Little Lorikeet during survey by John Young. It is proposed to retain this hollow within a pocket park following advice by Mr Young. Given the extent of suitable habitat retained for these species within proposed conservation areas the importance of habitat to be removed is not considered significant to their long term survival in the locality.

The importance of habitat to be removed in respect to threatened flora is not significant in this instance as no threatened species have been detected after several surveys of the study area.

The importance of the habitat being removed as a source of CPW is considered important as it removes all remnants within the study area and it is the main host for the Cumberland Plain Land Snail. The snail has a supporting population within the SSTF community in areas of lower sandstone influence at present and is expected to continue post development, however the area of potential habitat being affected is high. The CPW remnant of close to 3 ha is impacted moderately to heavily by exotic species and appears to be regrowth over 50 years.

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

The site has not been identified as critical habitat within the provisions of the TSC Act. Therefore this matter does not require any further consideration at this time.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Draft state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Barking Owl (*Ninox connivens*) (NPWS 2003)

Approved state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Bush Stone Curlew (*Burhinus grallarius*) (DEC 2006)
- Koala (*Phascolarctos cinereus*) (DEC 2008)
- Large Forest Owls ((Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*)) (DEC 2006).
- *Pimelea spicata* (DEC 2004)
- Yellow-bellied Glider (*Petaurus australis*) (NPWS 2003)

It is considered that the proposed development is generally consistent with the objectives or actions of the above-mentioned draft and approved recovery plans.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process is defined in the *TSC Act* as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities.

The current list of key threatening processes under the *TSC Act*, and whether the proposed activity is recognised as a threatening process, is shown below.

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	**Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?**		
	Likely	**Possible**	**Unlikely**
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic Climate Change	✓		
Bushrock removal	✓		
Clearing of native vegetation	✓		
Competition and habitat degradation by feral goats			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)		✓	
Competition from feral honeybees			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant	✓		

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
psyllids and bell miners			
High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants into NSW			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae		✓	
Infection of native plants by *Phytophthora cinnamomi*		✓	
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers		✓	
Invasion and establishment of Scotch Broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Bufo marinus*)			✓
Invasion, establishment and spread of *Lantana camara*		✓	
Invasion of native plant communities by bitou bush & boneseed *Chrysanthemoides monilifera*			✓
Invasion of native plant communities by exotic perennial grasses	✓		
Invasion of native plant communities by African Olive (*Olea europaea* subsp. *cuspidata*)			✓
Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*)			✓
Loss of Hollow-bearing trees	✓		
Loss and/or degradation of sites used for hill-topping by butterflies			✓
Predation and hybridisation by feral dogs (*Canis lupus familiaris*)			✓
Predation by the European Red Fox (*Vulpes vulpes*)		✓	
Predation by the Feral Cat (*Felis catus*)		✓	
Predation by Plague Minnow or Mosquito Fish (*Gambusia holbrooki)*			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease transmission from Feral pigs (*Sus scofa*)			✓
Removal of dead wood and dead trees	✓		

The above key threatening processes have been considered in reference to the proposal. It was considered that the proposal may contribute to a small degree to a number these processes as described below. It was not considered that the proposal will have a large or significant impact on any of the following key threatening processes. Some mitigation

measures have been listed under each process to minimise or reduce such impacts upon those processes.

Summary of "likely" or "possible" Key Threatening Processes

This section identifies what mitigation measures can be implemented to address threatening processes.

Anthropogenic climate change

The proposal will require the removal of 12.08 ha of vegetation which is subject to varying levels of disturbance and density which will result in a negative contribution to climate change. Vegetation is considered to act as a sink for a range of greenhouse gases but in particular carbon dioxide. The maintenance of native vegetation cover is a key strategy to combat the contributing impacts of the proposed action on Climate Change. The proposal will include restoration of offset areas however a net loss will remain, as such the proposal is part of the accumulative effect and should be considered as contributing to this threatening process.

Bushrock removal

The proposal will remove naturally occurring surface bushrock within the development and access road areas and as such is of a class of development or activity that is recognised as a threatening process. The bush rocks present in these areas are generally individually located within the landscape and not in clumps or part of a rocky escarpment which represent higher quality habitat of this type. Such habitat will be conserved along Ousedale Creek. Bushrock removal will not likely cause a significant impact on the threatened species recorded or with considered potential to occur.

Clearing of native vegetation

The proposal will require the removal of 12.08 ha of vegetation which is subject to varying levels of disturbance and density and therefore is a class of development recognised as a threatening process. Offsetting the loss of native vegetation as well as restoration measures is considered as part of the proposed works. A Biodiversity Offset Report has been prepared to assist in minimising impacts upon this key threatening process.

Competition and grazing by the feral European rabbit

It is expected that the proposed development will increase or decrease the potential for rabbit invasion. Rabbit management and control such as through exclusion fencing, destruction of warrens and target "Pindone" baiting is recommended as a standard protocol.

Infection of native plants by Phytophthora cinnamomi

The proposal may temporarily increase the risk of fungal infection on site as it may be spread via vehicular movement and relocation of soil and vegetation. Consequently standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal pesticides.

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

'Myrtle Rust' may be spread via machinery, animals and humans as well as by environmental factors such as wind. The presence of machinery and construction works is likely to slightly increase the potential for spread of this newly listed key threatening process. Similar protocols as to *Phytophthora cinnamomi* should be applied.

Invasion and establishment of exotic vines and scramblers, Invasion, establishment and spread of Lantana camara and *Invasion of native plant communities by exotic perennial grasses*

The proposal is likely to cause edge effects in areas that are not currently subject to such. Soil disturbance, landscaping and edge effects together would provide areas on site that would be more susceptible to outbreaks of exotic vines and scramblers, Lantana and exotic perennial grasses. Therefore a weed control program is recommended to ensure there is adequate eradication, and control of such invasive species.

Forest Eucalypt dieback associated with over-abundant psyllids and bell miners

The subject site is currently subject to heavy impacts of dieback from the presence of Bell Miners. The colony is most active on either side of Macquariedale Road and particularly to the south but also in the central gully. To the south, dieback is so extensive that the overstorey foliage is heavily depleted and the understory growth of *Bursaria* is extremely difficult to penetrate. Such dieback of trees may in future contribute to on the ground refuge logs for Cumberland Plain Land Snail.

The proposal will remove habitat that is mostly free of Bell Miner presence however this habitat removal will push diurnal birds to further compete with Bell Miners in the remaining portions to the west. Therefore the proposal may be considered to contribute to this key threatening process. Whilst the management options of Bell Miners is not well known, such management may be considered for the conservation lands to ensure that this habitat remains in good health.

Loss of hollow-bearing trees

Hollow-bearing tree surveys have not been undertaken within the proposed development areas for rezoning however hollows do occur across the proposed development areas. Large hollows suitable for threatened owls and cockatoos have been identified throughout the site however none of these have been identified within proposed development areas. Remaining hollows within the development areas may contain roosting/breeding hollows for recorded threatened microbats or Little Lorikeet and therefore full hollow surveys should be undertaken so that these may be supervised at the time of removal.

Predation by the European red fox

It is expected that the proposed development will provide an opportunity to manage the area with regard to European red fox invasion. European red fox management is encouraged for the retained vegetated areas of the subject site.

Removal of dead wood and dead trees

The proposal will require the removal of deadwood and dead trees and as such is a class of development recognised as a threatening process. Threatened fauna species recorded and likely dependent on dead wood or dead trees include Varied Sittella and Cumberland Plain

Land Snail. Removal of habitat will impact on these species. Recovered living snails are proposed for relocation and deadwood habitat will be recovered as part of proposed restoration measures.

National - Significant Impact Criteria

A4

Under the EPBC Act an action will require approval from the Australian Government Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The following significant impact criteria were sourced from the EPBC Act Policy Statement 1.1 (May 2006):

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

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

- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- Introduce disease that may cause the species to decline; or
- Interfere with the recovery of the species.

>> What is a population of a species?

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion.

>> What is habitat critical to the survival of a species or ecological community?

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long term evolutionary development; or
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

VULNERABLE SPECIES

Significant impact criteria

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

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

>> What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- Reduce the extent of an ecological community;
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- Adversely affect habitat critical to the survival of an ecological community;
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - assisting invasive species, that are harmful to the listed ecological community, to become established; or
  - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- Interfere with the recovery of an ecological community.

MIGRATORY SPECIES

Significant impact criteria

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

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

>> What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

a) Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
b) Habitat that is of critical importance to the species at particular life-cycle stages; and/or
c) Habitat utilised by a migratory species which is at the limit of the species range; and/or
d) Habitat within an area where the species is declining.

>> What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

>> What is the population of a migratory species?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Threatened Birds Expert Advice

A5

Masked Owl &Hollow dependent threatened bird species survey and Advice, John Young – johnyoungwildlife.com

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Locations below on above development site.
Lot 201 DP 749272
Lot 1 209779
Lot 2 DP 558807
Lot 1 DP 1000355

Brief.
To undertake a Site Survey chiefly for Masked Owl, Powerful Owl, Gang Gang Cockatoo, Glossy Black Cockatoo, Varied Sittella and Little Lorikeet.

Priority species is the Masked and Powerful Owl as a part egg shell picked up by Mr Corey Mead of Traverse Environmental was on the ground beneath a large hollow eucalypt and from an image of a fragment sent to me it appeared as if it may have been from one of the above species.

This was of interest as a Powerful Owl was drawn into call playback by Mr Corey Mead not too far from the tree where the egg shell was discovered.

A combined survey by Mr Mead and myself would be conducted over a four day period from the 25th February – 1st March 2013 in Mr Meads case to briefly familiarise myself with the site and to show me his findings for my own investigation along with a systematic search for large hollow bearing trees by myself and night visual's strategically over the site to listen for any calls of large forest owls.

I would also be doing a systematic search over the whole site both below and above the proposed by-pass road on site for any signs of roosting Large Forest owls or indeed evidence of roost sites – ie excreta.

At the end of the site visit to prepare a report indicating whether sufficient lands will be retained to enable viable threatened species populations to survive, this would include on the proposed development site and on the proposed By-Pass route.

Methodology and the Search.
A systematic search was under taken over the whole site including to the south-east and north-west of the proposed By-Pass Road on the development site by criss-crossing in a grid pattern by foot.

All trees discovered with suitable sized hollows for large Forest owls were mapped and GPS on the below Google Image for reference including a nest site for Gang Gang Cockatoos No 131 and a Long Billed Corellas nest tree No 145 who were in attendance at the time.

During the search there was no sign of activity at any of the hollow bearing trees by any Large Forest Owl ie-Masked and Powerful nor was there any sign of roost sites or any other activity by the same on

any part of the whole site, even though there were a number of suitable locations where Powerful Owls could roost if they were in attendance.

The only owl found on the whole site during the 4 day search was a male Boobook Owl which was flushed from his roost at point marked BBO Roost on the below Google Map –GPS-S34 11 45.2 E150 46 46.7 on the western side of the proposed By-Pass around 10 metres from the main creek. This owl was seen on two separate occasions during night visuals listening for Owls within close proximity by Corey Mead and myself.

The following trees and their locations were all suitable for large forest owls with suitable hollows. If any of them had been in use then during the 4 day survey by day and by night Powerful or Masked Owls would have made their presence known as this was the onslaught of the breeding season when they would have been most vocal.

GPS-No
131 – Location – H-Hollow Bearing.

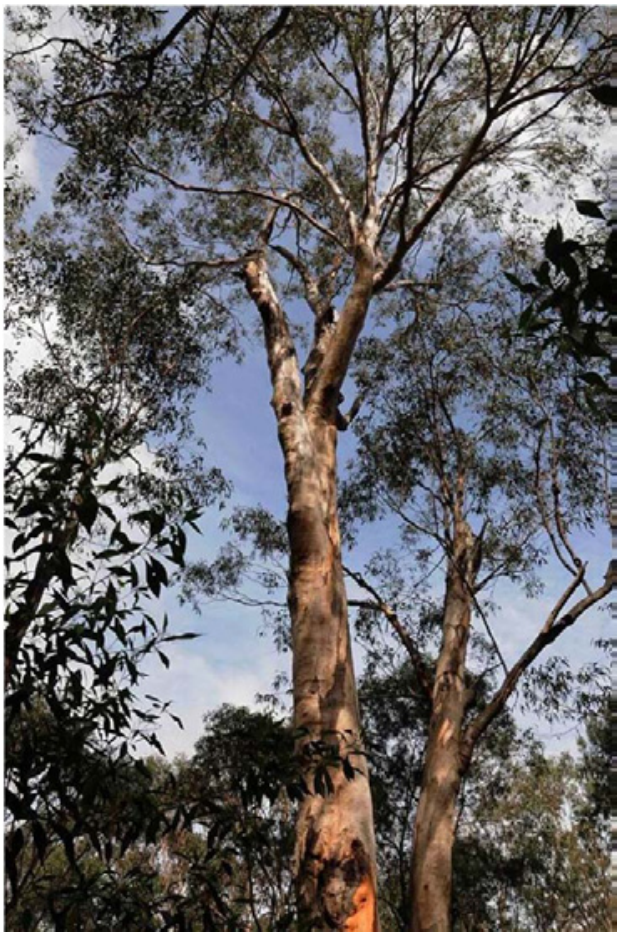
131-H S34 11 55.6 E150 46 39.6
132-H S34 11 47.9 E150 46 44.0
133-BBO Roost S34 11 45.2 E150 46 46.7 Boobook Owl Roost Site.
134-H S34 11 39.4 E150 46 43.9
135-H S34 11 49.3 E150 46 56.2 Tree where egg shell was found beneath.
136-H S34 11 46.9 E150 46 54.6
137-H S34 12 00.3 E150 46 36.3
138-H S34 12 02.9 E150 46 36.6
139-H S34 12 06.1 E150 46 38.7
140-H S34 12 05.8 E150 46 36.2
141-H S34 12 05.0 E150 46 49.2

143-LL S34 11 57.9 E150 46 50.4 Little Lorikeet Nest.

145-Long Billed Corella Nest tree S34 11 48.2 E150 46 59.4

History – Discovery of egg shell below tree 135 –S34 11 49.3 E150 46 56.2
During the summer of 2012 that was thought to be a large forest owl.

During the summer survey by Mr Corey Mead on site a fragmented piece of egg shell was discovered on the ground beneath tree 135 and seeing it was very close to where a Powerful Owl had responded to playback. At the time it was rightly held in suspicious circumstances that it may have been a Powerful Owls egg shell under a possible breeding tree or in fact maybe a Masked Owls egg shell.



Tree that egg shell was below

Egg Shell found beneath hollow Eucalypt – Wood Duck – down present.

Results on possible Masked Owl egg shell – negative (duck – image of egg shell with down)

-------- A phone call from Mr Mead to myself (JY) followed by an image of this small fragment – also alerted myself to a possible fragment of a large forest owl. At the time because of the extrapolated measurements I assumed that it may-be a Masked Owl egg fragment.

However, during my recent inspection of the site a second larger piece of egg shell fragment was picked up by Mr Mead and myself very close to the spot where the first fragment was picked up beneath tree135.

On a closer investigation of this almost half egg shell it was very evident that the owner was a Wood Duck. All Australian ducks incubate their eggs by feather plucking and removing soft down from their breasts which they cover their eggs with to keep them warm when they are off the eggs for their daily feed. This larger piece of shell contained feather down from a Wood Duck still strongly attached to the inside of the shell.

Coupled with this new irrefutable evidence along with the suspected owl tree being less than thirty metres from a clear open field where Wood Ducks were seen – clearly ruled out any possibility of these fragmented pieces of shell being any type of large forest owls egg. Also from more than 40 years, experience of looking at thousands of duck eggs there was no doubt in my mind what so ever that the owner of the egg shell was indeed the Australian Wood Duck.

The playback of the Powerful Owl had been used well after dark and bird had obviously been drawn in from a location well to the south west and nowhere near this site from habitat where there had been previous records.

Discovery of a Little Lorikeets Nest on site Tree 143
GPS Location of Nest Tree – S34 11 57.9 E150 46 50.4

During the search for large forest owls and hollow bearing trees to suit on the prosed development site – a small number of Little Lorikeets were frequently heard (*chiefly to the west of the proposed bypass road*) and seen feeding on blossom bearing eucalypts over the 4 day search period.

On the 27th March a pair of Little Lorikeets were observed at their nest hollow at tree 143 (*images below)* at a site that I (JY) deem to be a nest site that has been used for many years due to the large amount of wear that is clearly evident on the lower lip of this tiny entrance by the claws of the pair as they have been coming and going.

This nest site in my opinion is an historical breeding site and like all Little Lorikeet pairs have possibly used this site for many years.

Little Lorikeets are very faithful to their nest sites and will use them for years in succession and even continue to use them if they lose a partner as they will re-mate with a new partner and continue to use the site.

In saying this they are also a very approachable species and are not easily disturbed from their nest sites and will frequently nest through urban areas where ever there is a suitable gum eucalypt that has large smooth branches with their favourite small holes within.

After discovering this nest a considerable effort was put in by myself to see if any further nest sites on the proposed development site were present and no others were found.

Little Lorikeet nest (image of tree wide + up close of nest)

Little Lorikeets Nest **Little Lorikeets Nest**

In an attempt to retain this nest site I see no reason why a 15 metre buffer (*30 metre diameter*) would not easily be sufficient to retain this nest site – possible even create a small park within which should retain the pairs breeding site for many years to come.

In the unlikely event that the disturbance is too much for them then the breeding resources along the corridor to the north west of the proposed development has numerous smooth barked eucalypts where trees are more than suitable for nest sites for them to move to should this unlikely event occur.

It is also worth bearing in mind that Little Lorikeets are extremely numerous in some parts of NSW particularly around the Tamworth and Inverell areas where I personally know of numerous nests where they compete with Musk Lorikeet for nest sites.

Gang Gang Cockatoos

It was brought to my attention that Gang Gang Cockatoos had also been heard along the creek corridor to the north west of the Bypass and for this very reason I put particular effort into also keeping an eye out for these birds breeding sites as well along the water way where large suitable eucalypts were present.

At a point marked around 25 metres north-west and across the creek on the western banks of point 131 – GPS 34 11 55.6 E150 46 39.6 a tall eucalypt with the typical signs of chewing around the hollow – very indicative of a Gang Gang Cockatoos nest was found.

Many cockatoos chew around the entrance hole to their hollows but (*from numerous personal experiences*) only one species chews the bark off surrounding branches in a horizontal line directly out from the entrance to the hollow where ever branches are present as some sort of marker to their nest sites. These hollows are used for years in succession between October and January and from the chew marks around this hollow – the only one like it through the whole site – I feel comfortable in

nominating this tree to a local pairs home – even though the birds were not seen or heard on site during my visit.

Glossy Black Cockatoos
During the summer 2012 surveys by Mr Mead a number of sites were found on the development site where there was evidence of Glossy Black Cockatoos feeding. Chewed up fruits below Casuarinas in a number of places indicated that birds were regularly using this site as a feeding resource and in fact on a couple of occasions Glossy Black Cockatoos were seen feeding on Casuarina fruits.

During my visit between the 25th and 28th March a further Casuarina was found with numerous freshly chew up seeds was found at point 142 (on Google Map) GPS Location 34 12 00.7 E150 46 49.4

At no time during my visit which was within the onslaught of this Cockatoos breeding season did I see or hear any sign of the birds even though we were there till well after dark listening for owls on three successive nights right across the site.

At this time of year Glossy Black Cockatoos would be visiting their hollows every evening as they do this for up to 2 months before they lay their single egg in late March to early April.

There is no doubt that on occasions this whole area is used as a feeding resource however, this is not their main feeding location and like all Glossy Black Cockatoos, they will travel many kilometres in all directions from their breeding sites to where ever Casuarinas occur to feed.

This site is simply not their breeding site nor their main feeding site it is simply a supplemental site and not of strong significance to where ever the birds are living.

Long-billed Corellas
It is worth mentioning hear that a pair of Long-billed Corellas were seen in attendance to their nest site at point 145 on Google Map – GPS S34 11 48.2 E150 46 59.4.

I believe this tree is on Council land – however I wanted to satisfy myself that all prospective hollows for large forest owls or indeed Glossy Black Cockatoos were examined.

Conclusion
During my visit an extensive search was made for all large hollow bearing trees that may be suitable for large forest owls and all discovered and inspected have been listed and GPS as per the Google Map above along with a list of all GPS locations of same.

No sign of any large forest owls were found on any part of the proposed development site – including to the north west of the proposed bypass along the creek corridor.

The whole site was carefully and systematically searched for large hollows and three nights were spent up till well after dusk listening for owls at three strategic locations across the site which easily covered all bases if any owl called from its roost on site which there was no signs what so ever.

It is my strong belief that no large forest owls of any sort are inhabiting the site what soever as they would have been detected during the search for suitable roost sites and would have been heard during the three nights visual's listening for same.

In respect to the Powerful Owl that was drawn to playback by Mr Mead – either this bird was foraging in the area from its distant territory or had been attracted to the call from a well off as the playback was used into the night and the bird has no doubt had time to more well away from its breeding territory.

Value of Creek Corridor

The main creek corridor to the north west of the proposed bypass of the development site is without doubt the most productive piece of habitat on the whole proposed development site. This is where most of the large hollow bearing trees are along with a much larger species diversity than any part of land can even come close to on the south eastern side of the bypass where some areas are proposed for development.

I believe this creek corridor has the best habitat diversity for a range of species in respect to large hollow bearing trees and a great range of other habitats for an array of species and should be preserved. In fact off the development to the south there seems to be some fragmentation of this important corridor and it is a shame that further interest could not be taken to enhance more southerly connections.

John Young.
Johnyoungwildlife.com

Cumberland Plain Land Snail Expert Advice

A6

AM Consulting Ref: 1300996

28 March 2014

Michael Sheather-Reid
Travers Bushfire & Ecology
38A The Avenue, Mt Penang Parklands
Central Coast Highway, Kariong NSW 2250

Dear Michael,

Specialist Report on the Cumberland Plain Land Snail Meridolum corneovirens at Macquariedale Road, Appin

I refer to the specialist report on the Cumberland Plain Land Snail (*Meridolum corneovirens*) (CPLS) at Macquariedale Road, Appin, commissioned by Travers Bushfire & Ecology (Travers). I wish to advise that I have visited the Macquariedale Road site and have also visited a potential offset site identified by Travers at Elladale Road My advice regarding the CPLS population at the Macquariedale Road site is provided below.

Background

On the basis of information provided by Travers, it is understood that a proportion of the study area at Macquariedale Road is the subject of a development proposal and that Travers performed surveys for the CPLS in the proposed development area and in the adjoining bushland to the west. It is also understood that a number of individuals and shells of the CPLS were found in these areas, in both degraded Cumberland Plain Woodland (CPW) and good condition Shale Sandstone Transition Forest (SSTF) (Figure 1).

It is understood that Travers have identified a potential offset area in relation to the development proposal and have performed surveys for the CPLS in this area, with the results indicating that a number of individuals and shells of the species were also found in the potential offset (Figure 2).

It is further understood that a part of the area is likely to be subject to the future development of the Appin Bypass and that the planning proposal was reviewed by the NSW Office of Environment and Heritage (OEH), who recommended a development layout that will remove all of the 'better' CPW habitat onsite. Travers are therefore seeking advice regarding the CPLS at this site and have proposed a number of management options:

1. Destruction of the existing habitat and of the insitu population (i.e. no specific management options).
2. Translocation to another site providing suitable habitat.
3. Relocation within the site to conserved areas (SSTF) with enriched snail habitat.
4. Retention of part of the proposed development area for conservation of the snail population.
5. Combination of the above.

Site Visit

Australian Museum malacologist Michael Shea and Australian Museum Consulting ecologist Lisa McCaffrey conducted a site visit to the proposed development area on 25 October 2013 and to the Elladale offset site on 31 January 2014. During these site visits observations were made on the condition and connectivity of the habitat present and some snail surveys were conducted in areas of potential CPLS habitat.

Results

During the site visit Michael Shea confirmed the presence of habitat for the CPLS and the presence of live specimens and shells of the CPLS in a number of locations in the proposed development site, the adjoining bushland area and in the proposed offset area. Habitat for the CPLS varied in condition throughout these areas according to plant community type and plant community condition.

The introduced Brown Garden Snail (*Cornu aspersum*) was also encountered during the surveys and these were mainly found in patches of CPW surrounded by grazed areas.

Key Considerations

1. **The number of affected populations.**

Based on the survey results provided by Travers, Michael Shea's observations of the habitat present and the results of Clark and Richardson (2002), the CPLS at the site appears to consist of two separate populations (possibly three). The two populations are:

1. Northern part of site - includes all CPLS north and west of Gordon Lewis Oval.
2. Southern part of site - includes all CPLS south of Darcy Avenue.

Population 1 (north) appears to be geographically separated from population 2 (south) by more than 350 metres and an area that is probably unsuitable habitat (being a sandstone gully that extends west-east between the two populations, south of Gordon Lewis Oval oval). Clark and Richardson (2002) found CPLS populations to be highly structured at very short distances and have a genetic radius of approximately 350m.

Population 2 (south) comprises individuals found on both sides of Macquariedale Road, which is a potential geographic separation; however, the road in this location is relatively thin, is an unsealed surface, and there is potential habitat for the CPLS adjacent to both sides. It is possible that individuals of the CPLS would cross such a track occasionally, in good conditions. Evidence of the species (individuals and shells) can be found within 350 m of each other in areas of relatively contiguous habitat.

It is important to note that the assessment of the snails probably forming two populations is based on expert opinion. Further study (such as a genetic study of the snails in this area) would be required to confirm this.

2. **Whether the population is likely to persist in the landscape i.e. remain viable in the long term.**

There is some risk that the population would not persist in the landscape post-development. The proposed development would remove all of the Cumberland Plain Woodland (CPW). Although the species has been recorded in the adjoining Shale Sandstone Transition Forest (SSTF), it is unclear whether the species would be capable of persisting indefinitely in this community. It is my opinion that the SSTF is marginal habitat for this species. It is possible that the CPLS population originated in the CPW at the site and have colonised the SSTF in the absence of other *Meridolum* species.

3. **The key CPLS habitat attributes on site and a map of the likely 'important habitat'.**

Travers supplied AM Consulting with maps outlining potential CPLS habitat in both the development and offset sites. All CPW is to be removed in the proposed development sites, leaving marginal habitat in the SSTF. There is a large patch of CPW that is good habitat for the CPLS as well as smaller managed areas of CPW within the offset site. Other potential (but marginal) CPLS habitat exists in SSTF in the offset area. These areas are shown in the vegetation maps supplied by Travers.

4. **A brief explanation of CPLS ecology as it relates to the site and the potential use of both the CPW and SSTF within the site for foraging and breeding purposes.**

CPW in good condition is the preferred habitat for the CPLS. However, it may move into adjoining sandstone transition forest, where it typically occurs in lower densities, where there is no competition from other *Meridolum* species, as appears to be the case at the Macquariedale Road site (M. Shea, pers. obs.). The CPLS populations in this area are at the southern edge of the species' known range. CPLS live under litter of bark, leaves and logs, or shelter in loose soil around grass clumps, occasionally sheltering in rubbish (NPWS 2000). Little is known of its biology. It is known to be hermaphroditic, laying clutches of n20-25 small, round, white eggs in moist dark areas (such as under logs) (NPWS 2000).

5. **A discussion of the management options, summarising the pros and cons of each option and recommending a preferred approach.**

Destruction of the existing habitat and of the insitu population (i.e. no specific management options).
This option would result in the loss of all of the CPW at the site, as well as a proportion of the snail populations, leaving much smaller populations of the snails in areas of SSTF, which is not the primary habitat for the species.

Translocation to the Elladale biodiversity area.
The proposed offset area at Elladale Road contains areas of CPW that are suitable for the CPLS and is less than 3 km from the snail populations at Macquariedale Road (or less than 2 km, from the southern-most individuals recorded). However, it is important to note that all potential CPLS habitat in the offset area is currently supporting a CPLS population (or populations). Measures that could be undertaken to avoid or minimise impacts on the populations occurring in the recipient site include:

1. Rehabilitation or regeneration of cleared or partially cleared areas to CPW and translocation of CPLS to the regenerated CPW.
2. Enhancement of CPLS habitat in existing CPW and removal of existing threats.

The advantage of translocation of CPLS individuals to areas of regenerated CPW is that there are unlikely to be individuals of the recipient population occurring in those areas for some time after rehabilitation. The disadvantage is that it may take some time before habitat becomes suitable. The best areas for such work are likely to be around and in between existing patches of CPW, particularly areas where the understorey retains a high proportion of native species, and it is understood that many of these areas at the Elladale site are currently zoned 'residential' and likely to be the subject of future development applications (M. Sheather-Reid, pers. com.).

Enhancement of CPLS in existing CPW and removal of threats could potentially be achieved by removal of grazing, removal of weeds, control of feral animals, installation of habitat features that could be used by the CPLS (such as logs) and bush regeneration (i.e. restoring CPW and CPW plant species in cleared or partially cleared patches within and around the existing large patch of CPW in the southern part of the Elladale Road site). These measures would need to continue for at least several years and would need to be monitored to ensure that implementation of one measure (such as removal of grazing) does not increase the threat from another source (such as weeds).

Retention of part of the proposed development area for conservation of the snail population.
The best management option for this species at this site would be to set aside areas of the proposed development site for the conservation of the CPLS, particularly areas that contain CPW. For example, if one of the three proposed development areas were set aside as a conservation site for CPW and the snail, it would likely secure the future of at least one of the two populations occurring in this part of the landscape, which is at the edge of the species' range. These areas would, however, need work to improve the condition of the CPW and manage ongoing threats (human interference, weed invasion etc.) to be effective.

Relocation within the site to conserved areas (SSTF) with enriched snail habitat.
As indicated above, SSTF is not typically the preferred habitat of this species. The species typically occurs in lower densities in this type of habitat, where it occurs at all. However, on the basis of the information provided by Travers, it is understood that a proportion of the south-eastern part of the study area that has been identified as SSTF exhibits more similarity with CPW than does SSTF in other parts of the study area; in particular, the presence of a relatively high proportion of *Eucalyptus tereticornis*, which suggests a shale influence in the soil. Species composition in SSTF varies as a function of the degree of sandstone influence in the soil; areas close to outcropping sandstone may contain a large component of sclerophyll shrub species while those remote from the sandstone boundary contain more grasses and herbs, and resemble CPW (Tozer *et al.* 2010).

It is also understood that a 0.7 ha part of the more shale-influenced area that is currently largely cleared will be rehabilitated to SSTF containing a high proportion of *E. tereticornis* (M. Sheather-Reid, pers. comm.). It is possible that relocation of a proportion of the Cumberland Land Snails affected by the proposal to this area would be successful.

6. Advise whether the insitu populations will be significantly affected and recommend mitigation measures that can potentially be implemented to conserve the population within the adjoining landscape or proposed offset lands.

It is recommended that Travers carry out a 7 Part Test to determine significance. My advice is, however, that the CPLS populations are likely to be significantly affected by the development. This is because on the evidence provided, a relatively large proportion of the habitat of each population would be directly impacted by the development and that all of the CPW would be removed, leaving the remaining individuals in SSTF.

Conclusion

There is high potential for the proposed development to impact on two populations of the CPLS. The best management option for the species would be to avoid such impacts by altering the development footprint (or perhaps part of the development footprint) and managing the CPW for the conservation of the snail. Where impacts cannot be avoided, then mitigation and offset measures are recommended. Of the mitigation and offset measures considered, it is my opinion that translocation of living snails from the Macquariedale Road site to CPW in the Elladale offset area is preferable to moving the snails into the remaining SSTF at Macquariedale Road. If moving the snails into an area where no snails currently exist is not possible, then enhancement and expansion of the existing large patch of CPW at the Elladale site is recommended. There may also be potential to move snails into the shale-influenced area of SSTF in the southern part of the site, after rehabilitation. Both areas would need to be actively managed and monitored for some years, and protected from threats (including from human interference, if residential development occurs adjacent to the CPW in the future).

Should you require any additional information or if I can be of assistance in any way please contact me on (02) 9320 6311or email michael.shea@austmus.gov.au.

Yours sincerely

M. Shea

Michael Shea
Australian Museum Malacologist.

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