

22 August 2013

The General Manager
Attention: Theo Zotos - Senior Strategic Planner
Warringah Council
Civic Centre
725 Pittwater Road
DEE WHY NSW 2099

Dear General Manager,

Metropolitan Local Aboriginal Land Council (MLALC) – Response to Council Officers Requests Relating to Rezoning of Land at Ralston Avenue, North Belrose

1 Introduction

The following is provided to Council in response to the Council's request for additional information provided in email correspondence by Theo Zotos on 10th and 16th of July 2013, and through our subsequent discussions with Council.

2 Changes to the Planning Proposal

This letter also outlines the changes to the Planning Proposal that have arisen through responding to Councils requests outlined in their correspondence. The changes include:

Zoning

The originally proposed E3 Environmental Management zoning of the non-developable lands, has been changed to E2 Environmental Conservation. The proposal maintains the zoning of the R2 Low Density Residential Zoning, and the RE1 Public Recreation zoning. Adjustments to the boundaries of the zones have been made to reflect changes to the preliminary site layout plan.

The R2 Low Density Residential and RE1 Public Recreation zones consist of 13.15% of the site, or 17.79ha of the land

The E2 Environmental Conservation zone, includes proposed Asset Protection Zones and makes up 86.5% of the site or 117.51ha of land.

Lot Sizes and Provision

The proposed preliminary site layout has been amended and includes 171 residential lots, with a minimum lot size of 600m².

Public Recreation Provision

The preliminary site layout plan now only provides for one park with an area of 2,079m². The proposed park is now larger than the originally proposed park. The amended layout also removes the previously provided pocket parks, and amalgamates these into one central park.

Amendments to Road Layout and Design

The road layout has been amended through the realignment of the perimeter road, including its widening to 17m. The realignment has occurred to respond to topography and site levels.

Voluntary Planning Agreement

The applicant has provided a letter of offer to enter into a Voluntary Planning Agreement and includes matters for consideration and negotiation, however no commitment is made by the applicant until further discussions have commenced.

3 Supporting Documentation and Plans

The following plans and documents have been updated to reflect the changes to the Planning Proposal and are also provided to respond to Council's specific additional information requests.

Attachment 1: Response table to Council's email of 16 July 2013

Attachment 2: Environmental Reports

Attachment 3: Proposed Preliminary Subdivision Plan

Attachment 4: Zoning Plans and Building Height Plans

Attachment 5: Asset Protection Zone Fuel Management Plan outline

Attachment 6: Preliminary Primary Evacuation Routes Plan

Attachment 7: Voluntary Planning Agreement Letter of Offer

We look forward to progressing the Planning Proposal with Council, and are available to clarify any matters that arise throughout the continued assessment of this Planning Proposal.

Yours sincerely,



Matthew O'Donnell
Associate Director

Attachment 1

ITEM NO.	COUNCIL COMMENTS	RESPONSE	ATTACHMENT
1.0	Items from Council Email of 16 July 2013		
1.1	<p>Biodiversity</p> <p>As per our phone discussion on 8 July and email dated 10 July Council cannot progress the assessment of the proposal without the specialist reports. In order to efficiently utilise our staff resources, Council encourages Urbis to forward any of the six completed studies/reports ASAP rather than wait for the whole suite of documents to be completed.</p> <p>Assuming the proposal is to progress after the review of the above specialist studies, Council requires an undertaking from the landowner indicating the intent to pursue a Biodiversity Certification Agreement or the like. The undertaking shall be in the form of a legally binding agreement (eg Deed of Agreement) and include the terms of reference and commitments of the Certification Agreement including but not limited to the required offset works, monitoring and reporting regime, financial commitment and management. Such a Deed would illustrate an intent to Council and the public that the required measures to satisfy the "maintain or improve" test for biodiversity will be carried out</p>	<p>The following reports are provided to Council at Attachment 2.</p> <ul style="list-style-type: none"> ▪ Biodiversity Assessment ▪ 7 part test ▪ Goanna Report (Swann) ▪ Red Crowned Toadlet (Mahoney) ▪ Eastern Pigmy Possum (Law) ▪ Giant Burrowing Frog <p>It is noted that council has requested an assessment and survey of the Long Nosed Bandicoot species. The applicant wishes to advise Council that they will not be providing this report as significant survey work across the site over the last 18 months has not located or sited this species. It is considered unreasonable of Council to request the applicant to invest in undertaking this assessment, when there have been no known siting's at the site, and as part of the applicants extensive surveying to date.</p> <p>In light of the current planning proposal there is no requirement to undertake an assessment of threatened species in accordance with Section 5A of the EPA Act. Such an assessment will be undertaken at the appropriate time which is during the preparation of a part 4 development</p>	2

ITEM NO.	COUNCIL COMMENTS	RESPONSE	ATTACHMENT
		<p>application. Alternatively should the proponent and the Council determine that the best route is for a Bio Certification approach, then the matter of threatened species, endangered ecological communities and populations will be given appropriate assessment under the Bio Certification legislation.</p> <p>The applicant proposes that Bio Certification be included in their letter of offer for a VPA (Attachment 7) for negotiation during the preparation of the VPA, and to be finalised prior to determination of a subdivision DA.</p>	
1.2	<p>Land Management</p> <p>I understand the designation of the conservation lands (now proposed to be zoned E2) is ongoing and subject to legal advice. eg Part 4A National Park</p>	<p>The MLALC has met with Council staff and agreed that while the lot may not have been granted under section 36A, a large proportion of the proposed additional Part 4A Park adjacent to Garigal National Park is able to be granted pursuant to section 36A of the ALRA, and 36A(4) allows for additional lands, such as these already granted lands to be added, with MLALC consent. We also refer Council to s 71BC NPW Act 1974</p>	
1.3	<p>RE1 Public Recreation</p> <p>Council is not in a position to embellish or maintain the large 7500sqm+ park at the north-western corner of the site. The attributes of the land (vegetation and topography) tend to reflect that of the adjoining conservation land (proposed E2) and as such, this parcel should be amalgamated with the proposed conservation lands. From an recreational point of view, the establishment of the proposed hilltop park, existing parks in the Belrose area and the retention of exist gin connections to walking tracks etc. is deemed to meet the needs of existing and additional residents in this locality.</p>	<p>The applicant has amended the site layout plan submitted with the Planning Proposal in April 2013. The plan now only provides for one park with an area of 2,079m². (Attachment 3). The proposed park is now larger than the originally proposed park. The amended layout also removes the previously provided pocket parks, and amalgamates these into one central park.</p>	3

ITEM NO.	COUNCIL COMMENTS	RESPONSE	ATTACHMENT
	<p>In the event the applicant continues to pursue the large park, Council may support an RE2 Private Recreation zone with the ongoing management and responsibility being retained by the land owner. In deciding whether to pursue this option, Council may need to exclude certain permissible uses (eg Registered clubs) from being established on this parcel.</p>	<p>It was the applicant's intention to dedicate this space to Council for their ongoing management and maintenance. It is now understood that Council do not wish to be responsible for the management of this lot.</p> <p>Therefore it is proposed that management and ownership issues will form part of negotiations of a future VPA relating to the site to be finalised prior to the approval of a subdivision application.</p>	
1.4	<p>Water management</p> <p>Many of Council's issues in respect to water management remain outstanding, particularly the ownership and responsibility of water retention quality facilities. Councils require clarification as to the timing of the proposed 'watercourse assessment under separate cover'. Further, the ongoing management is stated to be part of a future Conservation Agreement.</p> <p>The proposal for a lot by lot OSD is not supported due to the risk of failure in the long term, that is individual land owners are less likely to inspect clean and maintain OSD facilities compared to holistic infrastructure.</p>	<p>The applicant has considered Council's request for a Watercourse Assessment, and considers the request unnecessary at this stage and a matter that can be addressed through a Condition of the Gateway process. Given the levels of uncertainty about the outcome of the Planning Proposal it would be deemed an unnecessary cost and commitment that can be secured through a planning Condition.</p> <p>The proposed details of OSD will be finalised at subdivision stage and would be subject to further detailed investigation and planning as part of the detailed design process.</p> <p>It is proposed that management and ownership issues, location and indicative footprints of OSD will form part of negotiations of a future VPA relating to the site to be finalised prior to the determination of a subdivision application.</p>	

ITEM NO.	COUNCIL COMMENTS	RESPONSE	ATTACHMENT
1.5	<p>Bushfire</p> <p>A draft APZ Fuel Management Plan shall be drafted now and considered by Council as the Planning Proposal is developed and progressed to Gateway. It is acknowledged that further updates to the Travers and Ecological reports are required in respect to vegetation loss related to APZ's, back burning, extension of fire trails etc.</p> <p>Further, the Travers bushfire report does not designate the 'primary evacuation routes'.</p>	<p>The applicant provides at the request of Council a draft outline of an APZ Fuel Management Plan (FMP) that will be prepared by the applicant prior to determination of a subdivision application. The draft outline is included at Attachment 5 and will be finalised through negotiations of the proposed VPA.</p> <p>Proposed primary evacuation routes are shown at Attachment 6 and will be further investigated and finalised in the future once the site layout is finalised. This requirement can be secured as a condition of consent for applications post Gateway.</p>	5 & 6
1.6	<p>Traffic</p> <p>The proposed road carriageways are 9m and 6.5 which accords with Travers bushfire report, however Council standard is 8m and 10m carriageway with 3.5m verges on both sides. No justification has been provided regarding the non-compliant verge and road widths. Council engineers have indicated that variations from Council standards will only be accepted where the road asset is retained in 'private' ownership however further discussion should be held in this regard.</p> <p>The updated Local Road cross section does not show a separate off road footpath which is contrary to the statement that all road reserves will include an off-road pathway.</p> <p>The commitment to build a seagull arrangement has been stated however further discussion will be required as to the timing for the provision of this item eg VPA?</p>	<p>The indicative design of the subdivision road layout has been amended since the lodgement of the Planning Proposal. The new indicative road layout is provided at Attachment 3. The implementation of the road layout design is proposed to be subject of a VPA, and forms part of the VPA matters for discussion included at Attachment 7.</p> <p>The northern perimeter road has now moved to the south slightly and all perimeter roads have been to 17m in width. All internal roads remain the widths as submitted.</p> <p>The roads have been realigned due to level and topography considerations.</p> <p>The final subdivision layout will consider adopting Council's Standards for road carriageways and verges.</p>	3 & 7

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		It is agreed with Council that the timing for the provision of a seagull arrangement will be subject of future VPA matters and agreement between both Council and the applicant.	
1.7	Housing needs The indicative subdivision layout includes lots under 600sqm; being the minimum subdivision lot size of the adjoining residential areas and majority of land zoned R2 in Warringah.	The design of the site layout has been amended since the lodgement of the Planning Proposal (included at Attachment 3). The new lot layout provides all proposed lots at a minimum size of 600m². The final design of lot layouts and sizes will be provided with a future subdivision DA.	3
1.8	VPA or DCP It is apparent that a VPA and possibly a DCP amendment will be required to provide the necessary infrastructure and outcomes negotiated through the planning proposal process. Some items of relevance include; <ul style="list-style-type: none"> ▪ Construction of a seagull treatment at Ralston Avenue ▪ Desired road layout including cross sections ▪ Location, indicative footprint, ownership and maintenance of water management facilities (OSD and water quality) ▪ Park embellishment ▪ The need to finalise 'other' agreements and documents e.g. Vegetation Management Plans, Offset Strategy, Biodiversity Certification Agreements and Conservation agreement etc. 	The applicant as outlined at Attachment 7 that they would be willing to negotiate with Council the potential for a VPA. Matters for consideration and negotiation include those items listed in the VPA letter at Attachment 7, however no commitment is made by the applicant until further discussions have commenced.	7

Attachment 2

A photograph of a koala climbing a tree trunk, positioned on the left side of the cover. The koala is grey and has its claws hooked into the bark. The tree bark is rough and textured. The background is a solid blue gradient.

Travers

bushfire & ecology

Ecological Assessment

Planning Proposal for
Lot 1 DP 1139826
Ralston Avenue, Belrose

August 2013
(REF: A12079)



Ecological Assessment

Planning Proposal for Lot 1 DP 1139826 Ralston Avenue, Belrose

Project Manager	Michael Sheather-Reid
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Plans prepared	Peter Tolley & Trent Matheson
Directorial Review	John Travers
Date	21 August 2013
File	A12079

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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.

Survey effort has been reduced to provide an indication of the insitu vegetation and fauna habitat present. The 7 part test of significance is based on this survey data and further survey may result in the observation of threatened species not considered in this assessment. Consequently further target threatened species survey may be required by the determining authority. 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. Consequently, the location of all mapped features is to be confirmed by a registered surveyor.

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Executive Summary

Travers bushfire & ecology has been engaged to undertake ecological and bushfire assessments for a proposed residential development of land located off Ralston Avenue, Belrose within Lot 1 DP 1139826.

Those studies were undertaken over 135.3 ha of lands owned by *Metropolitan Local Aboriginal Land Council (MLALC)*. Following initial constraint assessments between 2008 and 2011 a development precinct was determined which focused on approximately 23.32ha of plateau lands.

It is proposed that the developable area will be rezoned to accommodate a variety of residential uses that will meet the existing and likely future housing demand within the local area. The concept plan report and indicative development concept plan prepared by *Urbis* provides for approximately 171 lots with the average lot size across the site is expected to be 600m².

The balance of the developable area of the site will comprise public open space, stormwater management infrastructure and asset protection zones for bushfire protection. The proposed development landscape is identified within Warringah Local Environmental Plan (LEP) 2011 as 'deferred land' and as such LEP 2000 applies until a review of deferred lands is complete and a rezoning occurs.

The concept plan for the site is shown on figure 1. The planning proposal aims to create three (3) distinct land uses;

- **Development precinct** - Rezone approximately a 17.79 ha portion of Lot 1 DP 1139826 for future residential development (Zoned R2). A small park of approximately 0.2 ha in size will be zoned as RE1.
- **Conservation Lands** - This environmental protection zone will be used as a biodiversity offset. The conservation lands will also be zoned as E2 Conservation to allow integrated management of the asset protection zones and conservation lands by Metro Local Aboriginal Land Council. The proposed offset area is an ecologically significant landscape which is known to contain threatened flora, fauna, ROTAP species and the EEC, Coastal Upland Swamp. It will create a conservation parcel of 111.98ha which would ideally become an addition to Garigal National Park (with dual management with MLALC).
- **Asset protection zones** - Create 5.53ha of asset protection zones – proposed to be zoned as part of the E2 Conservation Lands . These lands will be managed as asset protection zones in full compliance with NSW Rural Fire Service limitations in regard to APZ management. Habitat retention will be a key priority for the fuel management works given the dual role that the asset protection zones play in buffering the impacts of development on the urban/ bushland interface. Retention of trees, shrubs and surface fuels will be targeted for their intrinsic ecological value with ongoing management specified through a legally applied 'fuel management plan'.

Ecological survey

Ecological survey has been undertaken to identify the presence of listed threatened flora and fauna species, endangered ecological communities (EECs) and threatened fauna habitat.

Initial ecological surveys were undertaken in 2008 to advise of potential ecological constraints to future development. Extensive ecological surveys began in late 2011 and were completed in August 2013.

Recorded threatened flora, fauna and EECs

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979 (EP&A Act)* and relating to the species / provisions of the *TSC Act*:

- Eight (8) threatened fauna species have been recorded within, and immediately surrounding, the proposed development area. These include Giant Burrowing Frog (*Helioporus australiacus*), Red-crowned Toadlet (*Pseudophryne australis*), Rosenberg's Goanna (*Varanus rosenbergii*), Powerful Owl (*Ninox strenua*), Little Lorikeet (*Glossopsitta pusilla*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Little Bentwing-bat (*Miniopterus australis*) and Eastern Bentwing-bat (*Miniopterus orianae oceanensis*).
- Warringah Council observed the threatened fauna species Eastern Pygmy Possum (*Cercartetus nanus*) present within the proposed development area.
- Two (2) threatened flora species, *Tetratheca glandulosa* and *Grevillea caleyi*, were recorded
- One (1) EEC, Coastal Upland Swamp of the Sydney Basin Bioregion, was recorded.

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

- Two (2) threatened fauna species, Giant Burrowing Frog (*Helioporus australiacus*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) were recorded
- No protected migratory bird species were recorded
- Two (2) threatened flora species, *Tetratheca glandulosa* (listed as vulnerable) and *Grevillea caleyi*, (listed as endangered) were recorded
- No EECs listed under this act were recorded within the total land parcel.

Specialist reports have been prepared and are considered within the 7 part test of significance for the following threatened fauna species:

- Rosenberg's Goanna (Mr Gerry Swan)
- Giant Burrowing Frog (Prof Michael Mahony)
- Red-crowned Toadlet (Prof Michael Mahony)
- Eastern Pygmy Possum (Dr Ross Goldingay)

Indirect impacts such as caused by stormwater have been considered at a high level and modelling is yet to be completed that demonstrates that the proposed urban landscape can adequately incorporate measures that achieve a no net change in the quality and quantity of runoff and groundwater discharge into the surrounding landscape.

The 7 part test of significance assumes that appropriate quality and quantity targets can be achieved to avoid a significant impact on the recorded threatened species to avoid significant indirect impacts.

Bushfire management, road access and emergency egress

The bushfire protection Assessment Report (*Travers bushfire & ecology 2012*) has found that the site is capable of supporting the required bushfire protection measures and can comply with *Planning for Bush Fire Protection 2006 (PBP)*. The extent of managed land for asset protection purposes defines the outer extent of the land proposed for development or management.

The key bushfire management principle for the proposed planning scheme is to ensure that future development is capable of complying with *PBP*.

The bushfire protection assessment found that bushfire can potentially affect the site from the surrounding forest and heath vegetation communities, resulting in possible ember, radiant heat and, potentially, flame attack. The previous fire history of the surrounding landscape is such that considerable planning focus has been undertaken for traffic capability, asset protection, emergency management, fire trail construction, hazardous fuels management, building construction standards, water management and peripheral land management. The bushfire risk posed to the rezoning proposal, however, can be mitigated by a suite of bushfire protection measures which are implemented and managed in perpetuity.

Bushfire protection measures include the imposition of APZs in accordance with *PBP*. The bushfire risk inherent within the site requires not only adequate asset protection but also adequate perimeter access for defence, emergency egress and evacuation, several evacuation routes in the event one or more options are closed, adequate water and fire fighting capabilities.

The 7 part test of significance has considered the impacts of the proposed APZs. The 7 part test of significance considers that APZs are fully impacted despite the fact that managed native landscapes for APZs are used by fauna for foraging and also act as a buffer between the development and surrounding landscape.

The APZs have been modified to minimise impact on ecologically sensitive areas and integrated landscape based solutions will be implemented and managed to minimise habitat loss within the APZs.

A detailed fuel management plan will be prepared to detail the very specific management of the insitu ecological resources to achieve bushfire protection and ecological responsibility.

Floristic impacts

Target threatened flora searches have been undertaken within the development precinct and the proposed offset lands. Additional survey has been undertaken in July 2013 within the electrical substation lands to identify the extent of *Grevillea caleyi* after the 2012 hazard reduction burn and to clarify the extent of the current local population.

The vegetation communities within the proposed development area and offset lands (inclusive of affected road corridors) include:

Table 1 - Vegetation communities present within the planning study area

Veg. code	Vegetation community	Within offset lands (ha)	Total within development and APZ (ha)	Total in study area (ha)	% Loss due to proposed development
A	Short Heath (to 2.5m tall)	2.21	2.29	4.5	51%
B	Tall Heath (2.5-5m tall)	18.13	6.92	25.05	28%
B2	Damp Tall Heath	2.65	0.45	3.10	15%
C	Low Open Forest (to 10m tall)	38.71	8.40	47.11	18%
D	Open Forest (10+m tall)	27.55	3.82	31.37	12%
E	Cleared, Managed, Landscaped or Weed Plume	5.48	3.11	8.59	N/A
F	Coastal Upland Swamp (EEC)	1.81	0.13	1.94	6.7%
G	Sandstone Gully Forest	17.33	0.26	17.59	1.5%
H	Riparian Woodland / Forest	0.34	0	0.34	Nil
	Total	114.21	25.38	139.59	18.2%

The proposed development area, associated road corridors and offset areas provide known habitat for the following threatened flora species and an EEC:

- *Tetratheca glandulosa* one hundred and forty nine (149) plants mostly within the proposed residential zone)
- *Grevillea caleyi* eight (8) plants within the proposed residential zone (an additional thirty eight (38) plants recorded within adjoining substation lands) – all juvenile specimens with seven (7) on the fence line along Wyatt Avenue)
- EEC, Coastal Upland Swamp (1.94ha in total in several locations within the offset lands)

In addition, the study area also contains two (2) populations of rare or threatened Australian plants (ROTAP) listed threatened species:

- *Eucalyptus luehmanniana* (estimated three thousand and sixty two (3,062) plants within study area including offset lands), although difficult to estimate because of lignotubers and multi-stemmed trunks.
- *Angophora crassifolia* (estimated 978 plants within study area, including offset lands).

The EEC, Coastal Upland Swamp occurs on the southern aspect of Ralston Avenue and in the north of the proposed Wyatt Avenue and occurs in several patches covering a total of 1.94ha. 1.81ha (93%) of the Coastal Upland Swamp will be retained as part of the proposed planning scheme. The Coastal Upland Swamp is also a protected groundwater dependent ecosystem under the NSW Groundwater Dependent Ecosystem Policy. The EEC, Coastal Upland Swamp of the Sydney Basin Bioregion provides the most significant vegetation constraint to development of the land.

A buffer is typically imposed around such sensitive groundwater dependent ecosystems. Ralston Avenue, which currently extends through to the south western boundary, provides a physical barrier for the existing Coastal Upland Swamp. The planning proposal provides a natural vegetation buffer of 30m to the north west of the largest patch of Coastal Upland Swamp. An APZ provides additional separation.

Following ecological surveys in May 2008 and December 2011, target survey for potential threatened flora species was undertaken in October (spring) 2012. *Pimelea curviflora* var. *curviflora* has not been detected within the proposed residential zone. *Tetratheca glandulosa* and *Grevillea caleyi* were resurveyed in October 2012 to ascertain their full coverage across the development site. Target surveys in August 2013 were conducted in the offset lands and the substation lands adjoining the development area to ascertain the extent of the *Grevillea caleyi* population.

Based upon the floristic survey, the current potential botanical constraints are;

- *Tetratheca glandulosa* and *Grevillea caleyi*, threatened plant species under both the TSC Act and EPBC Act.
- Coastal Upland Swamp (EEC) TSC Act, which will require buffers for future protection.
- *Angophora crassifolia*, a rare (ROTAP) species found within the taller vegetation stratas and occasionally in Tall Heath / Damp Tall Heath.
- *Eucalyptus luehmanniana*, a rare (ROTAP) species has been observed, usually within tall heath or low open woodland in close proximity to Ralston Avenue, mostly on the southern side of the road on south west to south east facing slopes.

The offset lands provide extensive areas of habitat for these species. The offset lands are also expected to provide habitat for *Tetratheca glandulosa* and marginal habitat for *Grevillea caleyi*, as well as the unsighted *Pimelea curviflora* var. *curviflora*.

Given the estimated large numbers of *Eucalyptus luehmanniana* and *Angophora crassifolia* in the offset lands, approximately 80% of the estimated *Eucalyptus luehmanniana* population (3,062 records) and 80% of the estimated *Angophora crassifolia* population (978 records) will be retained by the planning proposal.

Due to the lack of target survey in peak flowering seasons for *Tetratheca glandulosa* within the offset lands, the total loss of the population cannot currently be fully estimated. Significant areas of habitat are present within the offset lands, therefore, it is expected that the loss of these plants within the proposed development is not likely to be significant in terms of the percentage of habitat loss (15.6% loss of habitat consisting of Open Forest and Low Open Forest).

A population of *Grevillea caleyi* exists mostly within the adjoining substation lands (38 plants recorded in August 2013, and another 8 specimens have been recorded within the proposed development area. Based on the proposed road design, one (1) of these specimens will be affected. All seven (7) specimens adjoining Wyatt Road will be retained. Anecdotal evidence suggests that a population of up to three hundred (300) individuals occurred on restored soil landscape within the adjoining *Transgrid* lands. However, this estimate is yet to be confirmed. The current target survey for *Grevillea caleyi* was conducted post fire with most seedlings recorded being 5-30cm in height. It is highly likely that survey undertaken in October 2013, after more regeneration has occurred, would show increased numbers *Grevillea caleyi*.

Fauna impacts

A total of nine (9) threatened fauna species have been recorded within, or in close proximity to, the development area during surveys or site investigations to date. The recorded species include:

- Powerful Owl (*Ninox strenua*),
- Eastern Pygmy Possum (*Cercartetus nanus*)

- Grey-headed Flying-fox (*Pteropus poliocephalus*),
- Eastern Bentwing-bat (*Miniopterus orianae oceanensis*),
- Little Bentwing-bat (*Miniopterus australis*),
- Little Lorikeet (*Glossopsitta pusilla*),
- Rosenberg's Goanna (*Varanus rosenbergi*),
- Red-crowned Toadlet (*Pseudophryne australis*), and
- Giant Burrowing Frog (*Heleioporus australiacus*)

Although not recorded within the proposed development area during surveys, it is considered that the proposed development area has varying potential for the following additional threatened fauna species to occur and offer constraints to development:

- Southern Brown Bandicoot (*Isodon obesulus*)
- Spotted-tailed Quoll (*Dasyurus maculatus*), and
- New Holland Mouse (*Pseudomys novaehollandiae*).

Southern Brown Bandicoot, Spotted-tailed Quoll and New Holland Mouse have not been recorded on site.

Based on the observation or recording of threatened fauna species, four (4) recorded threatened fauna species were considered to have potential to offer a constraint to development within the proposed residential area due to a dependence on the habitat in part within, and extending beyond, the proposed development area. These are:

- Rosenberg's Goanna (*Varanus rosenbergi*),
- Eastern Pygmy Possum (*Cercartetus nanus*)
- Red-crowned Toadlet (*Pseudophryne australis*), and
- Giant Burrowing Frog (*Heleioporus australiacus*).

Specialist advice was sought for each of these species; the following is a summary of their assessment reports provided in Appendices 5, 6 & 7.

Eastern Pygmy Possum was observed opportunistically by Council within a hollow during a site inspection. This observation suggests that parts of the subject site are utilised by Eastern Pygmy Possum for foraging in the banksia dominated communities and nesting within suitable hollows. Based on the known habitat preferences of this species, the proposed residential rezoning will result in the loss of 18.2% of the suitable nesting and foraging habitat within the entire study area (including the offset lands). However, the degree of habitat use and the importance of that habitat being lost for a local population of Eastern Pygmy Possum needs to be determined in consultation with specialists. A specialist report has been prepared by Professor Ross Goldingay (University of Southern Queensland).

Prof Goldingay concluded that important areas of foraging habitat and breeding habitat will be affected by the proposed development and hollow surveys are required to determine the adequacy of the offset for breeding before a conclusion of significance can be made. Dr Goldingay also suggests that opportunities for individuals to disperse east and west across the Forest Way should also be investigated.

Mr Gerry Swan was engaged to undertake a preliminary site study which resulted in the location of one (1) termite mound with a juvenile exit point and several more burrows (see Appendix 5 - Specialist Report on Rosenberg's Goanna - *Cygnets Surveys and Consultancy* November 2012). The termite mound and recorded burrows have however been located outside of the proposed development area. Further burrows have been identified in suitable habitat areas to the north and north west of the proposed development area.

Mr Swan has concluded that the proposed development site is not critical to the survival of the population, that there is adequate habitat surrounding the proposed residential development site to maintain a viable population, and the proposed residential development is not likely to result in a significant restriction to the local population. Mr Swan also states that the proposed development is not likely to have a significant impact on the Rosenberg's Goanna population. Mr Swan has also verbally confirmed that the APZs, resembling a managed native vegetation landscape, are likely to be used for foraging purposes (Gerry Swan *pers.com*. 31 July 2013).

Prof Michael Mahony, a recognised frog specialist was engaged to undertake target survey, habitat assessment and advice in respect to Red-crowned Toadlet and Giant Burrowing Frog (see Appendix 6 - Assessment of the distribution and habitat use by the Giant Burrowing Frog and Red Crowned Toadlet at Ralston Ave Belrose, Prof Michael Mahony, June 2013).

In respect to Giant Burrowing Frog, Prof Mahony concluded that the considerable distance of the identified breeding habitat from the plateau, and the relatively large area of surrounding habitat, indicate that indirect impacts on hydrology are unlikely to impact on the Giant Burrowing Frog breeding habitat such that it is not likely that the proposal will impact on the local viable population of the Giant Burrowing Frog.

In respect to Red-crowned Toadlet, Prof Mahony concluded that four (4) breeding locations have been identified within the subject site and twelve (12) breeding locations were identified within the study area outside the subject site. Movement of the Red-crowned Toadlet will mostly be in the escarpment and mid-slope areas.

Development of the plateau will not have a significant effect on the local population due to any removal of habitat or the breaking of corridors. The potential for impact on the population of the Red-crowned Toadlet is assessed to be related mostly to indirect impacts on the hydrology of the breeding habitat (rate, volume, and water quality of discharge). Specific mitigation measures are required to ensure that the hydrology of these sites is not altered by the proposal.

It may be concluded that significant areas of potential breeding habitat within the proposed offset lands are available for Rosenberg's Goanna, Giant Burrowing Frog and the Red-crowned Toadlet. This may also prove to be the case for Eastern Pygmy Possum, subject to further survey and advice. Despite this, indirect impacts such as stormwater on frog breeding areas and other edge effects such as cat predation need to be considered and mitigated to minimise impacts on threatened fauna species.

Proposed offsetting

Travers bushfire & ecology has been requested to undertake a preliminary offset analysis of the lands surrounding the proposed development area, owned by *MLALC*, as a means of offsetting the loss of flora and fauna habitat as a result of the proposed planning proposal.

The offset analysis in this report identifies the losses of each vegetation community due to the planning proposal, potential restoration gains and the estimated loss of rare and threatened flora populations (*Tetratheca glandulosa*, *Grevillea caleyi*, *Eucalyptus leuhmanniana* and *Angophora crassifolia*) based on the ecological survey results. This is a primary step in understanding the quantum of the biodiversity offsets being provided.

Prior to the consideration of biodiversity offsets, it is a general biodiversity management principle to avoid or mitigate against the potential biodiversity impacts. Accordingly, the identification of important threatened species habitat is a part of the process of designing and assessing a planning proposal or development resulting in, the proposal providing

protection for 93% of the insitu EEC, the Coastal Upland Swamp and road design has been modified to conserve 98% of the recorded *Grevillea caleyi* population.

The offset lands are significant in area and strategically located adjoining Garigal National Park which would feasibly form part of a biodiversity offset package involving mostly a protection offset and minor restoration of offset areas.

Table 1 provides a summary of the offset ratios that can be achieved based on comparison of vegetation communities retained and impacted. This data is derived from Table 6.2. The offset ratios below indicate:-

- Protection offset ratio – representing the minimum biodiversity offset ratio that can be achieved through protection of the offset area.
- Potential restoration offsets - identify the area of land potentially available for restoration within the offset lands to enhance the biodiversity value. This does not include any offsite restoration or protection offsets.
- Combined restoration and protection offset ratio – representing the biodiversity offset ratio that can be achieved through protection and restoration works within the proposed offset area.
- Average offset ratio indicates the overall offset ratio for all vegetation impacted by the proposed development.

Table 1 - Summary of vegetation community offset ratios

Veg code	Vegetation community	Protection offset ratios	Potential restoration offsets (ha)	Combined restoration & protection offset ratios
A	Short Heath (to 2.5m tall)	0.97:1	Nil	0.97:1
B	Tall Heath (2.5-5m tall)	2.62:1	Nil	2.62:1
B2	Damp Tall Heath	5.89:1	Nil	5.89:1
C	Low Open Forest (to 10m tall)	4.61:1	2.83	4.95:1
D	Open Forest (10+m tall)	7.21:1	Nil	7.21:1
E	Cleared, Managed, Landscaped or Weed Plume	N/A	Nil	N/A
F	Coastal Upland Swamp	13.9:1	Nil	13.9:1
G	Sandstone Gully Forest	66.6:1	Nil	66.6:1
H	Riparian Woodland / Forest	Nil Loss	0.47	Gain (0.47 ha)
Average Offset Ratio		4.78:1	3.30	4.93:1

It is expected that the conservation value of the offset lands, for recorded and potential fauna populations in particular, will be assessed through the use of the biodiversity certification maintain or improve test.

A biodiversity credit assessment has been prepared by *EcoLogical Australia* (2013).

The offset analysis based on the known vegetation and estimated populations provide an indication that the offset area is likely to provide an adequate offset outcome overall.

The most impacted vegetation communities are Short Heath, Tall Heath and Open Forest as these are most prevalent within the proposed development area on the more exposed

plateau areas. The landscape value of the impacted areas for threatened species will also have a bearing on the adequacy of the proposed offsets.

Conclusion

Survey to date has indicated that, in particular for threatened flora species, there are likely to be adequate rare and threatened species populations conserved within the proposed offset lands and adjoining landscapes to not result in a significant impact. The impacts on the recorded EEC, Coastal Upland Swamp, are also low with the proposed residential development area conserving 93% of all swamp areas.

The proposed offset areas provide a major contribution to the adjoining national park estate and appear to provide typically acceptable offsets based on the loss and gain of vegetation communities.

The proposed residential development has potential to have an undetermined impact on Eastern Pygmy Possum. Further target survey of the offset lands is proposed to occur in accordance with the requirements of Dr Goldingay in terms of establishing additional foraging, breeding and nesting habitat.

Of the threatened species with potential to occur, the endangered Southern Brown Bandicoot has not been recorded on site.

It is considered that there is no likely significant impact for any remaining threatened species recorded present, or with potential to occur, populations or EECs, particularly based on the advice of specialists on the recorded Rosenberg's Goanna, Red-crowned Toadlet and Giant Burrowing Frog.

As the Southern Brown bandicoot is nationally listed under the *EPBC Act*, a referral to the Department of Sustainability, Environment, Water, Populations and Communities (SEWPAC) is required.

Target survey in accordance with the same guidelines may be required for the *EPBC Act* referral. The proposed development is not expected to have a significant impact on any remaining matters of national environmental significance (NES), particularly based on the advice of Prof Michael Mahony in respect to the Giant Burrowing Frog.

In light of the current planning proposal there is no requirement to undertake an assessment of threatened species in accordance with Section 5A of the EPA Act. Such an assessment will be undertaken at the appropriate time which is during the preparation of a part 4 development application. Alternatively should the proponent and the Council determine that the best route is for a biocertification approach, then the matter of threatened species, endangered ecological communities and populations will be given appropriate assessment under the biocertification legislation.

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

John Travers *BaSc / Ass Dip / Grad Dip*
Managing Director – **Travers bushfire & ecology**

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 OEHS from 4/11)
EEC	endangered ecological community
EPA	Environmental Protection Agency
<i>EP&A Act</i>	<i>Environmental Planning and Assessment Act 1979</i>
<i>EPBC Act</i>	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESMP	ecological site management plan
FF	flora and fauna assessment
<i>FM Act</i>	<i>Fisheries Management Act 1994</i>
FMP	fuel management plan
GBF	Giant Burrowing Frog
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
OEHS	Office of Environment and Heritage (Part of the NSW Department of Premier and Cabinet)
OPA	outer protection area
PBP	<i>Planning for bushfire protection 2006: A Guide for Councils, Planners, Fire Authorities and Developers</i>
POM	plan of management
<i>RF Act</i>	<i>Rural Fires Act</i>
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SEPP 44	<i>State Environmental Protection Policy No 44 – Koala Habitat Protection</i>

SEWPAC	Federal Department of Sustainability, Environment, Water, Population and Communities
SIS	species impact statement
SULE	safe useful life expectancy
<i>TBE</i>	<i>Travers bushfire & ecology</i>
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
<i>TSC Act</i>	<i>Threatened Species Conservation Act 1995</i>
VMP	vegetation management plan

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Introduction

1

Travers bushfire & ecology has been engaged to undertake ecological and bushfire assessments for a proposed residential development of land located off Ralston Avenue, Belrose within Lot 1 DP 1139826.

Those studies were undertaken over 135.3 ha of lands owned by *Metropolitan Local Aboriginal Land Council (MLALC)*. Following initial constraint assessments between 2008 and 2011 a development precinct was determined which focused on approximately 23.32ha of plateau lands.

It is proposed that the developable area will be rezoned to accommodate a variety of residential uses that will meet the existing and likely future housing demand within the local area. The concept plan report and indicative development concept plan prepared by *Urbis* provides for approximately 171 lots with the average lot size across the site is expected to be 600m².

The balance of the developable area of the site will comprise public open space, stormwater management infrastructure and asset protection zones for bushfire protection. The proposed development landscape is identified within Warringah Local Environmental Plan (LEP) 2011 as 'deferred land' and as such LEP 2000 applies until a review of deferred lands is complete and a rezoning occurs.

The study area, including the entirety of the offset lands, is identified in Figures 2 and 3.

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 the constituent species; and the condition of the community
- Carry out a fauna survey for the detection and assessment of species and their habitats
- Complete target surveys for threatened species, populations
- 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 (TSC Act)*

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 (EP&A 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 (FM Act)

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, an SIS is required to be prepared.

1.2.3 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

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 the action would have a significant effect on an NES matter.

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 SEWPAC for assessment. In the case where no listed federal species are located on site, 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 apply to specific NES matters which may determine whether a referral is or is not required, such as for the *EPBC Act* listed ecological communities. 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 Planning proposal

The concept plan for the site is shown on figure 1. The planning proposal aims to create three (3) distinct land uses;

- **Development precinct** - Rezone approximately a 17.79ha portion of Lot 1 DP 1139826 for future residential development (Zoned R2). A small park of approximately 0.2 ha in size will be zoned as RE1.
- **Conservation Lands** - This environmental protection zone will be used as a biodiversity offset. The conservation lands will also be zoned as E2 Conservation to allow integrated management of the asset protection zones and conservation lands by Metro Local Aboriginal Land Council. The proposed offset area is an ecologically significant landscape which is known to contain threatened flora, fauna, ROTAP species and the EEC, Coastal Upland Swamp. It will create a conservation parcel of 111.98ha which would ideally become an addition to Garigal National Park (with dual management with MLALC)
- **Asset protection zones** - Create 5.53ha of asset protection zones – proposed to be zoned as part of the E2 Conservation Lands . These lands will be managed as asset protection zones in full compliance with NSW Rural Fire Service limitations in regard to APZ management. Habitat retention will be a key priority for the fuel management works given the dual role that the asset protection zones play in buffering the impacts of development on the urban/ bushland interface. Retention of trees, shrubs and surface fuels will be targeted for their intrinsic ecological value with ongoing management specified through a legally applied 'fuel management plan'.

The 135.3ha owned by MLALC area will be termed the 'study area' for the purposes of this report. The development precinct including the APZ will be termed 'subject site' for the purposes of this report.

Outside of Lot 1 the proposed development area impacts an additional 4.31ha within Lot 2634 DP 1139826; and unformed road corridors, including Wyatt Avenue.

Lot 1 DP 1139826 includes lands immediately;

- Adjacent to the electrical sub station DP752038 (various lots)
- Peripheral to the insitu residential dwelling on Lot 2634 DP752038.
- Peripheral to Council Lot 1 DP602729
- Adjacent to Belrose Waste Management Facility Lot 2 DP1144741



Figure 1 – Plan of proposed development Lot 1 DP1139826

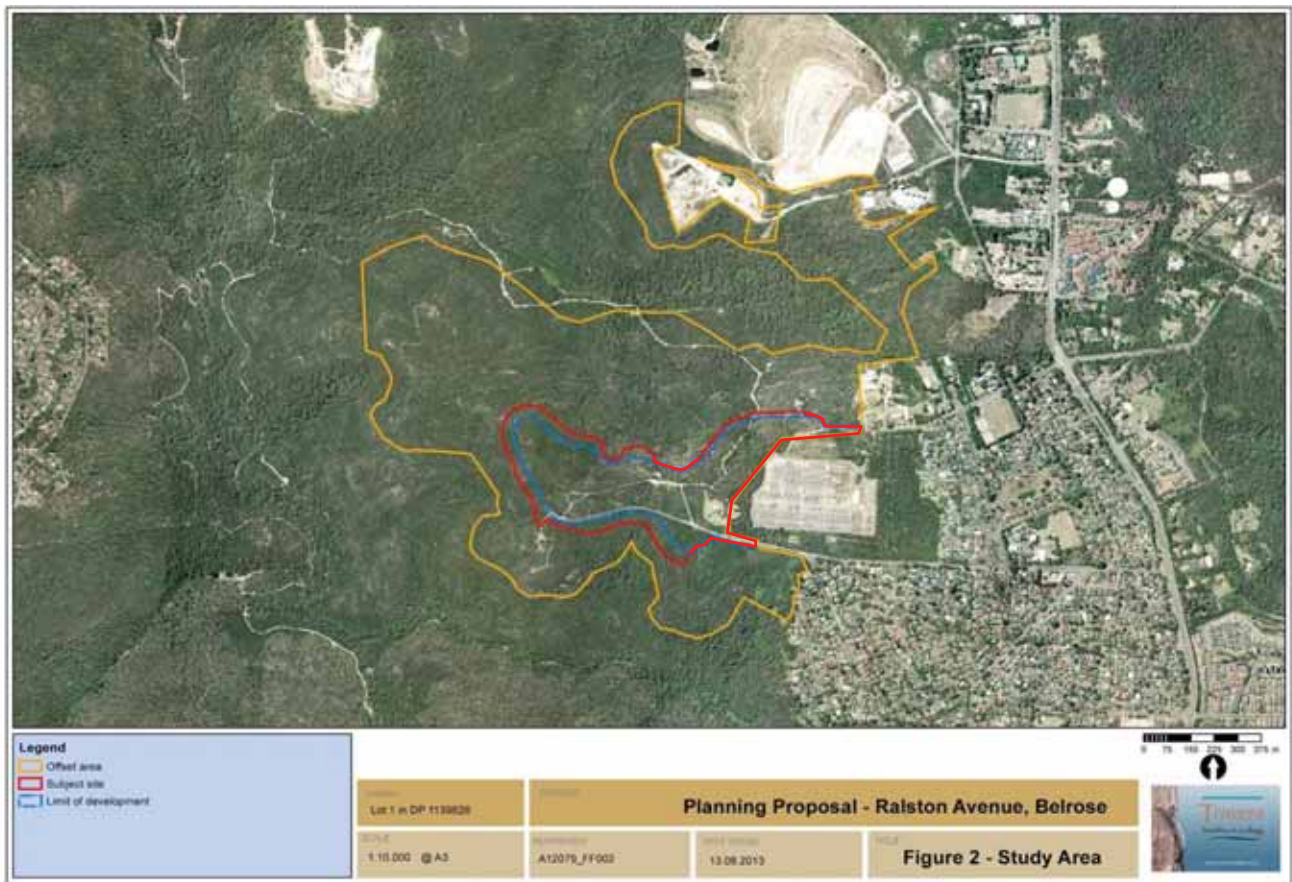


Figure 2 – Study area inclusive of development lands within Lot 1 DP1139826

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 – Site features

Location	Part of Lot 1 DP 1139826
Size	Approximately 22ha
Local government area	Warringah
Grid reference	333600E 6266800N
Elevation	Approximately 150-170m AHD
Topography	Situated upon a sandstone plateau area with minor peripheral slopes, increasing near the northern and southern development boundary.
Geology and soils	Geology; sandstone Soils; Lambert Soil Landscape, Somersby Soil Landscape and Hawkesbury Soil Landscape
Catchment & drainage	French's Creek (to the south) and Fireclay Creek (to the north) into Middle Harbour Creek.
Vegetation	Coastal Sandstone Heath and Sydney Sandstone Ridgetop Woodland (predominately)
Existing land use	Crown Land and part residential
Clearing	Clearing for the existing residence and APZs, any road, track and existing electrical structures.



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:

- Plan of proposal prepared by *Lockley Land Title Solutions*

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*)
- 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).

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* (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 help determine whether matters of 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 in accordance with the *Atlas of NSW Wildlife* 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).

Egg shells, scats, feathers, hair samples were sent to identification expert, Barbara Triggs, for identification.

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: SL100848.

Travers bushfire & ecology staff is 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

Aerial images from *Spatial Information Exchange* and *Google EarthPro* were utilised in the field to aid in the identification of the various vegetation communities. This was then ground truthed from foot traverses. Each quadrat and transect was marked using *Trimble* GPS that has an accuracy of within 1-2m.

Many quadrats have been undertaken within the proposed development area and study area with various sets of quadrats used to confirm the presence or absence of EEC vegetation types (Duffys Forest and Coastal Upland Swamps).

Target threatened flora searches have been undertaken thoroughly and extensively throughout the proposed development area in winter, spring, summer and autumn. Additional target searches were undertaken within the offset lands, however, many of the observations were more incidental and may not reflect the full extent (population) of the various species due to the size of the area being covered, seasonal survey and limitations of accessibility. The approximate distribution of known threatened flora occurrences is mapped on Figure 3.

Target searches were undertaken for those listed threatened species known to occur, or with habitat potential within the local area.

Field survey in 2011 was conducted over a three (3) day period which included refinements to the vegetation mapping undertaken in 2008, target searches for threatened species, a further eleven (11) quadrats undertaken and general random plots within tall heath or Open Forest to test further for the presence of Duffys Forest EEC utilising Smith and Smith's Duffys Forest Index.

In March 2012, flora survey was undertaken to the north east of the proposed development area, off Wyatt Avenue.

In August and September 2012, studies were undertaken within the offset areas to assist in defining vegetation communities and threatened species potential, with incidental and additional target survey of threatened species.

In October 2012, target threatened species survey was undertaken for (primarily) *Tetratheca glandulosa*, *Haloragodendron lucasii*, *Lasiopetalum joyceae*, *Microtis angusii*, *Persoonia hirsuta*, *Pimelea curviflora* var. *curviflora*, *Grevillea caleyi*, *Angophora crassifolia* and *Eucalyptus luehmanniana*.

In July-August 2013, a biocertification analysis was undertaken by *EcoLogical Australia*. As most of the quadrats within the development area were undertaken by Braun-Blanquet or

similar styled methodology, additional quadrats using the biometric methodology was required. Twelve (12) additional quadrats were undertaken and a brief survey for *Grevillea caleyi* was undertaken in the north eastern portion of the development area. It was noted that seven (7) stems were present after the 2012 Rural Fire Service (RFS) hazard reduction burn, all within a 2m radius of the main clump. No new locations were present.

Target survey within the substation lands for *Grevillea caleyi* was undertaken on 5 of August 2013. This resulted in the recording of thirty eight (38) individuals as post-burn specimens.

On 6 August, 2013, target survey for *Grevillea caleyi* and *Tetradlea glandulosa* was undertaken throughout some parts of the offset area, north of the development precinct. No specimens were sighted immediately south of Challenger Drive. Between the development and the Heath Track, a total of thirteen (13) *Tetradlea glandulosa* specimens were observed. Early August is outside the typical flowering season for this species and thus likely to only be representative of a small proportion of potential numbers within the offset area.

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.2 and are depicted on Figures 2, 3 & 4.

Current standard 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 2.5.

2.4 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the subject site.

Table 2.1 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Aerial photographic interpretation and ground-truthing	7 May 2008, 6 December 2011 28 March 2012 30 March 2012 16-17 August 2012 3-4 September 2012 12-16 September 2012 23-24 October 2012
Stratified sampling	20x20m quadrats in all existing vegetation communities excluding landscaped areas and two (2) flora transects	5-7 May 2008 6-8 December 2011 28 March 2012 30 March 2012 16-17 August 2012 3-4 September 2012 12-16 September 2012 23-24 October 2012 4 July 2013
Target searches	Target searches in known habitats	6-7 May 2008 6-8 December 2011 28 March 2012 30 March 2012 16-17 August 2012 3-4 September 2012 12-16 September 2012 17, 19, 23-24 October 2012 4 July 2013 5-6 August 2013

Table 2.2 – Fauna survey effort

Fauna group	Date	Weather Conditions	Survey Method	Survey Effort / Time (24hr)
Diurnal birds	1/05/08	7/8 cloud, light NE wind, no rain, temp 18°C	Diurnal opportunistic	3hrs 55min 1005 - 1400
		8/8 cloud, no wind, no rain, temp 19.5°C	Diurnal opportunistic	1hr 20min 1440 - 1600
	2/05/08	0/8 cloud, no wind, no rain, temp 24°C	Diurnal opportunistic	4hrs 30min 1300 - 1730
	12/12/11	8/8 cloud, moderate gusty SE wind, early showers, temp 18-20°C	Diurnal opportunistic	4hrs 30min 1345 - 1815
		8/8 cloud, light SE wind, no rain, temp 18°C	Diurnal opportunistic	1hr 35min 1845 - 2020
	13/12/11	8-4/8 cloud, light gusty SE wind, no rain, temp 20-24°C	Diurnal opportunistic	9hrs 45min 1035 - 2020
	14/12/11	8/8 cloud, light-mod SE wind, no rain, temp 18-20°C	Diurnal opportunistic	4hrs 50min 1040 - 1530
	15/12/11	7-5/8 cloud, no wind, no rain, temp 18-22°C	Diurnal opportunistic	4hrs 45min 0955 - 1440
		2/8 cloud, no wind, no rain, temp 24°C	Diurnal opportunistic	35mins 1600 - 1635
	16/12/11	6-8/8 cloud, no wind, no rain, temp 17-21°C	Diurnal opportunistic	6hrs 55min 0950 - 1645
	15/10/12	0/8 cloud, no wind, no rain, temp 27-20°C	Diurnal opportunistic	6hrs 30min 1300 - 1930
	16/10/12	5/8 cloud, light NE wind, no rain, temp 23-34°C	Diurnal opportunistic	7hrs 30min 0900 - 1630
	17/10/12	3/8 cloud, light NE wind, no rain, temp 22-28°C	Diurnal opportunistic	8hrs 20min 0750 - 1610
	18/10/12	8-4/8 cloud, no wind, no rain, temp 18-26°C	Diurnal opportunistic	6hrs 20min 0740 - 1400
	19/10/12	8-2/8 cloud, no wind, no rain, temp 17-28°C	Diurnal opportunistic	3hrs 40min 0800 - 1140
		2/8 cloud, no wind, no rain, temp 28°C	Diurnal opportunistic	2hrs 50min 1220 - 1510
	20/10/12	0/8 cloud, no wind, no rain, temp 18-30°C	Diurnal opportunistic	4hrs 25min 0735 - 1200
	21/10/12	7/8 cloud, no wind, no rain, temp 17-24°C	Diurnal opportunistic	2hrs 20min 0740 - 1000
	22/10/12	8/8 cloud, mod SE wind, showers, temp 13-18°C	Diurnal opportunistic	8hrs 10min 1040 - 1850
	23/10/12	2/8 cloud, no wind, no rain, temp 16-22°C	Diurnal opportunistic	4hrs 10min 1050 - 1500
		1/8 cloud, no wind, no rain, temp 19-15°C	Diurnal opportunistic	3hrs 15min 1600 - 1915
	24/10/12	0/8 cloud, light SW wind, no rain, temp 18-28°C	Diurnal opportunistic	4hrs 50min 0930 - 1420
	25/10/12	0/8 cloud, light NE wind, no rain, temp 17-29°C	Diurnal opportunistic	4hrs 40min 0750 - 1230
Nocturnal birds	2/05/08	0/8 cloud, light SW wind, no rain, temp 15°C	Owl call playback and spotlighting	2hrs 15min 1815 - 2030
	12/12/11	8/8 cloud, no wind, no rain, temp 17°C	Spotlighting Call playback (Powerful, Barking and Masked Owls)	1hr 5min 2035 - 2140 commenced @ 2050
	13/12/11	7/8 cloud, light SE wind, no rain, temp 18°C	Spotlighting Call playback (Powerful, Barking and Masked Owls)	1hr 30min 2045 - 2215 commenced @ 2050

Nocturnal birds (cont.)	23/10/12	3/8 cloud, no wind, no rain, temp 15-13°C	Spotlighting	3hrs 15min 1925 - 2240
	25/10/12	0/8 cloud, no wind, no rain, ¾ moon, temp 22-18°C	Call playback (Powerful, Barking and Masked Owls) Spotlighting Call playback (Powerful, Barking and Masked Owls)	commenced @ 1940 2hrs 50min 1930 - 2220 commenced @ 1940
Arboreal mammals	2/05/08	0/8 cloud, light SW wind, no rain, temp 15°C	Spotlighting + call playback (Koala)	2hrs 15min 1815 - 2030
	12/12/11	8/8 cloud, no wind, no rain, temp 17°C	Spotlighting	1hr 5min 2035 - 2140
		8/8 cloud, none-light wind, no rain, temp ~15°C	Call playback (Koala and Yellow-bellied Glider)	Commenced @ 2110
	13/12/11	7/8 cloud, light SE wind, no rain, temp 18°C	<i>Elliott</i> trapping	15 trap nights
		8/8 cloud, light SE wind, no rain, temp ~16°C	Spotlighting	1hr 30min 2045 - 2215
	14/12/11	8/8 cloud, no wind, no rain, temp ~16°C	Call playback (Koala and Yellow-bellied Glider)	Commenced @ 2110
	15/12/11	8/8 cloud, no wind, no rain, temp ~16°C	<i>Elliott</i> trapping	30 trap nights
	22/10/12	8/8 cloud, mod SE wind, previous showers, temp >9°C	<i>Elliott</i> trapping	30 trap nights
	23/10/12	no wind, no rain, temp >9°C	Hair tubes (alternating large & small)	45 trap nights
	24/10/12	3/8 cloud, no wind, no rain, temp 15-13°C	Hair tubes (alternating large & small)	45 trap nights
Terrestrial mammals	2/05/08	0/8 cloud, light SW wind, no rain, temp 15°C	Spotlighting	3hrs 15min 1925 - 2240
	12/12/11	8/8 cloud, no wind, no rain, temp 17°C	Call playback (Koala and Yellow-bellied Glider)	commenced @ 1955
		8/8 cloud, none-light wind, no rain, temp ~15°C	Hair tubes (alternating large and small)	45 trap nights
	13/12/11	7/8 cloud, light SE wind, no rain, temp 18°C	Hair tubes (alternating large and small)	45 trap nights
		8/8 cloud, light SE wind, no rain, temp ~16°C	Spotlighting	2hrs 50min 1930 - 2220
	14/12/11	8/8 cloud, no wind, no rain, temp ~16°C	Call playback (Koala and Yellow-bellied Glider)	commenced @ 1955
	15/12/11	8/8 cloud, no wind, no rain, temp ~16°C	<i>Elliott</i> trapping	45 trap nights
			Cage trapping (small bandicoot size)	2hrs 50min 1815 - 2030
			Cage trapping (small - bandicoot size)	1hr 5min 2035 - 2140
			Cage trapping (large - quoll size)	15 trap nights

Terrestrial mammals (cont.)	15/10/12	no wind, no rain, temp >15°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
	16/10/12	light NE wind, no rain, temp >19°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
	17/10/12	no wind, no rain, temp >14°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
	18/10/12	no wind, no rain, temp >13°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
	19/10/12	no wind, no rain, temp >15°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
	20/10/12	no wind, no rain, temp >12°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
	21/10/12	no wind, no rain, temp >12°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
	22/10/12	8/8 cloud, mod SE wind, previous showers, temp >9°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
			Hair tubes (alternating large and small)	45 trap nights
	23/10/12	3/8 cloud, no wind, no rain, temp 15-13°C	Spotlighting	3hrs 15min 1925 - 2240
		no wind, no rain, temp >9°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
			Hair tubes (alternating large and small)	45 trap nights
	24/10/12	light SW wind, no rain, temp >12°C	Cage trapping (small - bandicoot size)	20 trap nights
			Cage trapping (large - quoll size)	15 trap nights
			Surveillance camera	3 camera nights
			Hair tubes (alternating large and small)	45 trap nights
	25/10/12	0/8 cloud, no wind, no rain, ¼ moon, temp 22-18°C	Spotlighting	2hrs 50min 1930 - 2220
		light NE wind, no rain, temp >15°C	Hair tubes (alternating large and small)	45 trap nights
	6/8/13	2/8 cloud, light W wind, no rain, temp 20-22 °C	Habitat assessment & searches for EPP	4hrs 1230 - 1630
Bats	2/05/08	0/8 cloud, light SW wind, no rain, temp 15°C	<i>Anabat</i> II x3 / spotlighting	2hrs 55min 1735 - 2030
	12/12/11	8/8 cloud, no wind, no rain, temp 17°C	Spotlighting / <i>Anabat</i> active monitoring	1hr 5min 2035 - 2140
		8/8 cloud, none-light wind, no rain, temp ~15°C	Harp (<i>Constantine</i>) trapping	1 trap night
	13/12/11	7/8 cloud, light SE wind, no rain, temp 18°C	Spotlighting	1hr 30min 2045 - 2215
		8/8 cloud, light SE wind, no rain, temp ~16°C	<i>Anabat</i> passive monitoring	O'night from 2035

Bats (cont.)	13/12/11	/8 cloud, light SE wind, no rain, temp ~16°C	Harp (<i>Constantine</i>) trapping	2 trap nights
	14/12/11	8/8 cloud, no wind, no rain, temp ~16°C	Harp (<i>Constantine</i>) trapping	2 trap nights
	15/12/11	8/8 cloud, no wind, no rain, temp ~16°C	Harp (<i>Constantine</i>) trapping	2 trap nights
	16-18/12/11	Various (mostly fine)	<i>Anabat</i> passive monitoring	O'night for 3 nights
	23/10/12	3/8 cloud, no wind, no rain, temp 15-13°C	Spotlighting	3hrs 15min 1925 - 2240
		no wind, no rain, temp >9°C	<i>Anabat</i> passive monitoring	O'night from 1925
	25/10/12	0/8 cloud, no wind, no rain, ¾ moon, temp 22-18°C	Spotlighting	2hrs 50min 1930 - 2220
Reptiles		light NE wind, no rain, temp >15°C	<i>Anabat</i> passive monitoring	2hrs 25min 1925 - 2150
	1/05/08	7/8 cloud, light NE wind, no rain, temp 18°C	Habitat search, opportunistic	3hrs 55min 1005 - 1400
		8/8 cloud, no wind, no rain, temp 19.5°C	Habitat search, opportunistic	1hr 20min 1440 - 1600
	2/05/08	0/8 cloud, no wind, no rain, temp 24°C	Habitat search, opportunistic	4hrs 30min 1300 - 1730
	12/12/11	8/8 cloud, moderate gusty SE wind, early showers, temp 18-20°C	Diurnal opportunistic	4hrs 30min 1345 - 1815
		8/8 cloud, light SE wind, no rain, temp 18°C	Diurnal opportunistic	1hr 35min 1845 - 2020
	13/12/11	8-4/8 cloud, light gusty SE wind, no rain, temp 20-24°C	Opportunistic habitat searches	9hrs 45min 1035 - 2020
	14/12/11	8/8 cloud, light-mod SE wind, no rain, temp 18-20°C	Diurnal opportunistic	4hrs 50min 1040 - 1530
	15/12/11	7-5/8 cloud, no wind, no rain, temp 18-22°C	Opportunistic habitat searches	4hrs 45min 0955 - 1440
		2/8 cloud, no wind, no rain, temp 24°C	Opportunistic habitat searches	35mins 1600 - 1635
	16/12/11	6-8/8 cloud, no wind, no rain, temp 17-21°C	Diurnal opportunistic	6hrs 55min 0950 - 1645
	15/10/12	0/8 cloud, no wind, no rain, temp 27-20°C	Opportunistic / habitat searches	6hrs 30min 1300 - 1930
	16/10/12	5/8 cloud, light NE wind, no rain, temp 23-34°C	Opportunistic / habitat searches	7hrs 30min 0900 - 1630
			Funnel trapping	24 trap days
	17/10/12	3/8 cloud, light NE wind, no rain, temp 22-28°C	Opportunistic / habitat searches	8hrs 20min 0750 - 1610
			Funnel trapping	24 trap days
	18/10/12	8-4/8 cloud, no wind, no rain, temp 18-26°C	Opportunistic / habitat searches	6hrs 20min 0740 - 1400
			Funnel trapping	24 trap days
	19/10/12	8-2/8 cloud, no wind, no rain, temp 17-28°C	Opportunistic / habitat searches	3hrs 40min 0800 - 1140
			Funnel trapping	24 trap days
		2/8 cloud, no wind, no rain, temp 28°C	Opportunistic / habitat searches	2hrs 50min 1220 - 1510
			Funnel trapping	24 trap days
	20/10/12	0/8 cloud, no wind, no rain, temp 18-30°C	Opportunistic / habitat searches	4hrs 25min 0735 - 1200
			Funnel trapping	24 trap days
	21/10/12	7/8 cloud, no wind, no rain, temp 17-24°C	Opportunistic / habitat searches	2hrs 20min 0740 - 1000
			Funnel trapping	24 trap days
	22/10/12	8/8 cloud, mod SE wind, showers, temp 13-18°C	Opportunistic / habitat searches	8hrs 10min 1040 - 1850
		1/8 cloud, no wind, no rain, temp 19-15°C	Opportunistic / habitat searches	3hrs 15min 1600 - 1915
			Funnel trapping	24 trap days
	24/10/12	0/8 cloud, light SW wind, no rain, temp 18-28°C	Opportunistic / habitat searches	4hrs 50min 0930 - 1420
			Funnel trapping	24 trap days
	25/10/12	0/8 cloud, light NE wind, no rain, temp 17-29°C	Opportunistic / GPS cotton line to find burrows	4hrs 40min 0750 - 1230
			Funnel trapping	24 trap days

Amphibians	23/10/12	2/8 cloud, no wind, no rain, temp 16-22°C	Opportunistic / habitat searches Funnel trapping	4hrs 10min 1050 - 1500 24 trap days
	13/12/11	8-4/8 cloud, light gusty SE wind, no rain, temp 20-24°C	Opportunistic habitat searches	9hrs 45min 1035 - 2020
	15/12/11	7/8 cloud, light SE wind, no rain, temp 18°C	Spotlighting + call Identification	1hr 30min 2045 - 2215
		7-5/8 cloud, no wind, no rain, temp 18-22°C	Opportunistic habitat searches	4hrs 45min 0955 - 1440
		2/8 cloud, no wind, no rain, temp 24°C	Opportunistic habitat searches	35mins 1600 - 1635
	15/10/12	no wind, no rain, temp >15°C	Funnel trapping	24 trap nights
	16/10/12	light NE wind, no rain, temp >19°C	Funnel trapping	24 trap nights
	17/10/12	no wind, no rain, temp >14°C	Funnel trapping	24 trap nights
	18/10/12	no wind, no rain, temp >13°C	Funnel trapping	24 trap nights
	19/10/12	no wind, no rain, temp >15°C	Funnel trapping	24 trap nights
	20/10/12	no wind, no rain, temp >12°C	Funnel trapping	24 trap nights
	21/10/12	no wind, no rain, temp >12°C	Funnel trapping	24 trap nights
	22/10/12	8/8 cloud, mod SE wind, previous showers, temp >9°C	Funnel trapping	24 trap nights
	23/10/12	1/8 cloud, no wind, no rain, temp 19-15°C	Diurnal habitat searches	3hrs 15min 1600 - 1915
		no wind, no rain, temp 15-13°C	Spotlighting /call identification / tadpole searches	3hrs 15min 1925 - 2240
		no wind, no rain, temp >9°C	Funnel trapping	24 trap nights
	25/10/12	0/8 cloud, no wind, no rain, ¾ moon, temp 22-18°C	Spotlighting / call Identification / tadpole searches	2hrs 50min 1930 - 2220
	22/4/13	1/8 cloud, no wind, prev. weeks heavy rain, 23-18°C	Red-crowned Toadlet habitat / tadpole searches	2hrs 55min 1505 - 1800
		0/8 cloud, no wind, prev. weeks heavy rain, 18-16°C	Spotlighting /call identification / tadpole searches	2hrs 55min 1800 - 2100
	24/4/13	0/8 cloud, no wind, no rain, 21-17°C	Red-crowned Toadlet habitat / tadpole searches	4hrs 1400 - 1800
		0/8 cloud, no wind, no rain, 4/4 moon, 16-10°C	Spotlighting /call identification / tadpole searches	6hrs 1800 - 2400
	7/5/13	8/8 cloud, no wind, prev. night rain, 18°C	Red-crowned Toadlet habitat / tadpole searches	2hrs 45min 1515 - 1800
		3-7/8 cloud, no wind, no rain, no moon, 17-10°C	Spotlighting /call identification / tadpole searches	4hrs 55min 1830 - 2325

2.5 Site specific survey techniques

2.5.1 Diurnal birds

All diurnal bird surveys have been opportunistic observations during other survey methods. This is considered to be adequate based on the high number of diurnal hours spent in the field to date.

2.5.2 Nocturnal birds

Given the suitability of habitat present, Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*) were targeted by call playback techniques.

Observations for large hollows suitable for owls and signs of owl activity, in particular whitewash below perches / roost sites, were undertaken during survey.

2.5.3 Arboreal mammals

Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) were targeted by call playback only from locations identified on Figure 4.

2011 surveys

Thirty three (33) arboreal Type A *Elliott* traps were used along seven (7) trap-lines indicated on Figure 4, consisting of five (5) traps each separated by 20-50m. Eastern Pygmy Possum was principally targeted and, accordingly, arboreal traps were placed more commonly in larger flowering *Banksia* trees.

2012 surveys

Arboreal hair tubes were placed along six (6) transect lines indicated on Figure 4, consisting of five (5) tubes each separated by 20-50m. Again, Eastern Pygmy Possum was principally targeted and accordingly arboreal traps were placed more commonly in larger flowering *Banksia* trees. The honey-water lure sprayed onto the branches and down to the base of the tree was a high honey concentrate.

2.5.4 Terrestrial mammals

2011 surveys

Bandicoot sized cage traps were used to target Southern Brown Bandicoot. These were placed along trap lines of five (5) traps baited with the standard bait mix and laced with white truffle oil.

Elliott type B traps were placed along the same trap-lines as arboreal traps. These were baited with the standard bait mix and also laced with white truffle oil as an additional effort towards targeting Southern Brown Bandicoot. This method captured three (3) of the larger Long-nosed Bandicoot.

Large cage traps were used to target Spotted-tailed Quoll. Four (4) traps were placed at the outer limits of the site above sandstone edges. These traps were baited with sardines and nearby trees were smeared with jelly meat cat food as a lure.

Two (2) surveillance cameras were placed within heath vegetation at opposing ends of the proposed development area. The viewing area was baited with standard bait mix, truffle oil and sardines to target the trap shy Southern Brown Bandicoot and the Spotted-tailed Quoll.

2012 surveys

Bandicoot sized cage traps and larger quoll sized cages were used to target Southern Brown Bandicoot. These were placed along trap lines of four to six (4-6) traps (Figure 4), baited with the standard bait mix and laced with white truffle oil. Five (5) individually placed large cage traps were also placed and baited, targeting bandicoot (see Figure 4). A total of fifteen (15) quoll sized traps and twenty (20) bandicoot sized traps were placed targeting bandicoot over ten (10) consecutive nights, however five (5) of the large traps were also baited to target Spotted-tailed Quoll and Rosenberg's Goanna in the last four (4) days / nights.

Five (5) large cage traps targeting quoll were used at the outer limits of the site above sandstone edges. These traps were baited with sardines, two-week old dead chickens and nearby trees were smeared with jelly meat cat food as a lure.

Three (3) surveillance cameras were placed within the proposed development area. These cameras were moved after the first five (5) nights to a second location for the next four (4) nights totalling six (6) surveillance camera locations. At four (4) locations the camera was placed facing cage traps to assist in determining trap shy animals on site. Three (3) of these traps were baited targeting both bandicoot and quoll. It should be noted here that Northern Brown Bandicoot (*Isoodon macrourus*) and Long-nosed Bandicoot (*Parameles nasuta*) have been captured by *Travers bushfire & ecology* on meat baits alone.

The other two (2) camera locations were placed facing bait placed on the ground. One (1) of these was the standard bait mix with truffle oil the other also had sardines. See Figure 4 for trap and camera locations.

2013 surveys

Specialist Dr Ross Goldingay was engaged to undertake a site habitat assessment for Eastern Pygmy Possum. The assessment by Dr Goldingay is outlined within his report within Appendix 6.

Travers bushfire & ecology assisted Dr Goldingay by providing a site introduction and preliminary habitat searches for den locations within the subject site area on 6 August 2013.

2.5.5 Bats

2011 surveys

Two (2) harp traps were placed along flyways of internal vehicle trails where an overhanging tree branch could funnel captures into the trap.

Active *Anabat* monitoring and passive recording stations were undertaken.

2012 surveys

Bats were targeted by passive *Anabat* recording, spotlighting and habitat searches.

2.5.6 Amphibians

2011 surveys

Searches for Red-crowned Toadlet were undertaken along all drainage lines; and in response to where a previous recording made in 2008.

2012 surveys

Diurnal habitat searches were undertaken around the escarpment edge to determine suitable locations for Red-crowned Toadlet and / or Giant Burrowing Frog breeding potential. The survey period followed a dry spring period and most ephemeral drainages were completely dry, including both locations where the species was recorded previously. Where pools were found, tadpole searches were undertaken, as well as during nocturnal surveys. Clapping and yelling was carried out to evoke a call response where suitable habitat was present.

During nocturnal searches along drainage lines, spotlighting was undertaken to search for Giant Burrowing Frog. This species is best spotlighted on wet nights down to 13°C, however, both survey nights were under dry conditions. The first nocturnal surveys were undertaken the night after the only rainy day and night of the survey period. This wet night was however also very windy and generally inappropriate for frog survey.

2013 surveys

Frog specialist Prof Michael Mahony was engaged to undertake additional frog surveys and provided expert advice following the recording of Red-crowned Toadlet breeding locations within and surrounding the subject site and location of a Giant Burrowing Frog juvenile within a funnel trap. Specific survey effort and measures deployed by Prof Mahony are outlined within his report within Appendix 6.

Travers bushfire & ecology assisted Prof Mahony in undertaking targeted habitat searches specifically for Red-crowned Toadlet. The effort by *Travers bushfire & ecology* is provided within Table 2.2. The joint survey effort and habitat assessment is depicted in Figure 7.

2.5.7 Reptiles

2011 surveys

Two (2) surveillance cameras were placed within heath vegetation at opposing ends of the proposed development area. The viewing area was baited with sardines to target Rosenberg's Goanna. Two (2) afternoons (13 & 15/12/11) during the survey week were considered most suitable for Rosenberg's Goanna activity. The species was only opportunistically surveyed at this time.

2012 surveys

Four (4) funnel trap transects were placed within the proposed development area targeting reptiles and frogs. Six (6) funnel traps were placed on either side of the approximately 10-15m long fence line at each transect. Funnel trap transects were located within or near to representations of different vegetation communities.

Five (5) large cage traps targeting Rosenberg's Goanna and Spotted-tailed Quoll were placed at the outer limits of the site, above sandstone edges. These traps were baited with

sardines and two week old dead chickens and nearby trees were smeared with jelly meat cat food as a lure.

Three (3) surveillance cameras were faced to baited cages targeting goanna, bandicoot and quoll. One (1) additional camera location was baited with sardines. See Figure 2 for trap and camera locations. Locations indicated with a “Q” on Figure 2 were baited with meat targeting goanna and quoll.

2013 surveys

Reptile specialist Gerry Swan was engaged to undertake additional targeted surveys and to provide expert advice on Rosenberg's Goanna. Survey effort by Mr Swan is summarised within his report in Appendix 5.

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.

Flora survey limitations

- *Tetratheca glandulosa* – more populations are likely to be present in offset lands, however, target surveys for the species would take at least a further two (2) weeks to complete. The upper half of the gullies below the main ridge lines within the offset areas which are not too sheltered would provide some levels of potential habitat for this species. Surveys have been undertaken over two (2) flowering seasons within the subject site. Therefore, there should be no significant limitation to such surveys within the development areas, however, the total population size is unknown given the minimal surveys undertaken within offset lands.
- *Grevillea caleyi* – more of the local population is likely to be present in the adjoining electrical substation lands as the vegetation associations are more prevalent and Duffys Forest EEC has been recorded which it has some preference for. The total population size is not known as surveys have not been extended into lands of higher habitat potential.
- Post burn surveys within the 2012 burn areas may yield greater flora species numbers.

Fauna survey limitations

Extensive survey effort has been undertaken for threatened fauna species occurrence. The New Holland Mouse and Southern Brown Bandicoot have not been recorded present during surveys undertaken to date, however, habitat is suitable and local records of these species do occur.

The Southern Brown Bandicoot has been previously recorded within 300m to the north, within 1km to the west and within 600m to the south-west (OEH *Atlas of NSW Wildlife* 2013). The Southern Brown Bandicoot survey effort has been extensive in terms of general

requirements for a 7 part test of significance and suggested effort outlined by DEC *Survey Guidelines* (2004), including an extended ten consecutive days targeted trapping session. This was undertaken to address one of two trapping phases required for a previous SIS survey for a separate site in Warringah in 2009. SEWPAC has prepared more recent national draft referral guidelines for the Southern Brown Bandicoot (2011) which outlines the following summarised effort (*in italics*):

- *Survey should preferably be undertaken in autumn. Travers bushfire & ecology (TBE) has undertaken small cage effort over four (4) nights in December 2011 and large cage trapping effort over ten (10) nights in October 2012).*
- *Infrared cameras are the preferred method and should be used in addition to secondary survey techniques.* Infrared cameras have been used as a secondary survey technique to cage trapping to less than the recommended level of effort. For an impact area of 23ha such as the subject site the guidelines are *1 camera per 2 hectares over 2 weeks* (equating to 13 cameras for the subject site). TBE has undertaken 6 cameras over 4 nights.
- Hair tunnels are also a considered a primary survey method with a recommended *10 hair tunnels per 2 hectares* (110 hair tunnels required for the subject site). The hair tube survey undertaken to date comprised 6 transects each of which had 5 hair tunnels, thus 30 in all.
- *Live trapping (using wire cage traps) is not recommended to determine presence due to its inefficiency (SBB are often considered to be "trap shy"), potential for injury and the tendency of females to eject pouch young when trapped.*
- *Failure to detect Southern Brown Bandicoots should not be considered indicative of their absence. Primary surveys (using hair tunnels and remote infrared cameras) conducted outside of the preferred times indicated should be validated by supporting evidence.*
- *For both primary methods a minimum of two surveys, each of 14 days duration, timed at least one month apart and at least one following significant rainfall is recommended.*

Therefore, further survey effort for Southern Brown Bandicoot is recommended to reach nationally recommended guidelines.

New Holland Mouse may be further targeted with terrestrial traps during additional effort undertaken. Not many records are known of this species in Northern Sydney, however, one (1) recent (2001) record exists to the south west.

Therefore, based on the level of survey undertaken, nearby local records and the suitable habitat present, further targeted survey for New Holland Mouse and Southern Brown Bandicoot is recommended.



Survey Results

3

Vegetation communities, flora survey effort and results are shown on Figures 3 (study area) & 5 (subject site) and fauna survey effort and results are shown on Figure 4.

3.1 Flora results

3.1.1 Flora species

A total of two hundred and ninety nine (299) flora species were observed within the study area during the survey. This number comprised 226 native species and 73 exotic species. It should be noted that the majority of exotic species were only recorded adjacent to the Ralston Avenue entrance into the development area, around the existing residence or adjacent to prominent tracks. The remainder of the development area contained very few weeds. During the investigations, two (2) threatened flora species were sighted, *Tetratheca glandulosa* and *Grevillea caleyi*.

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

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name	Form
Mimosaceae	<i>Acacia brownii</i>	-	s
Mimosaceae	<i>Acacia decurrens</i>	Black Wattle	t
Mimosaceae	<i>Acacia floribunda</i>	Sally Wattle	s
Mimosaceae	<i>Acacia longifolia</i> var. <i>longifolia</i>	Sydney Golden Wattle	s
Mimosaceae	<i>Acacia lunata</i>	Box-leaved Wattle	s
Mimosaceae	<i>Acacia myrtifolia</i>	Red Stem Wattle	s
Mimosaceae	<i>Acacia parramattensis</i>	Sydney Green Wattle	t
Mimosaceae	<i>Acacia saligna</i> *	Orange Wattle	s
Mimosaceae	<i>Acacia suaveolens</i>	Sweet Scented Wattle	s
Mimosaceae	<i>Acacia terminalis</i>	Sunshine Wattle	s
Mimosaceae	<i>Acacia ulicifolia</i>	Prickly Moses	s
Polygonaceae	<i>Acetosa saggitata</i> *	Turkey Rhubarb	g
Asteraceae	<i>Actinotus helianthi</i>	Flannel Flower	g
Asteraceae	<i>Actinotus minor</i>	Lesser Flannel Flower	g
Asteraceae	<i>Ageratina adenophora</i> *	Crofton Weed	g
Casuarinaceae	<i>Allocasuarina distyla</i>	Scrub She-oak	s
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak	t
Myrsinaceae	<i>Anagallis arvensis</i> var. <i>caerulea</i> *	Blue Pimpernel	g
Poaceae	<i>Andropogon virginicus</i> *	Whisky Grass	g
Myrtaceae	<i>Angophora costata</i>	Smooth-barked Apple	t
Myrtaceae	<i>Angophora crassifolia</i>	-	t
Myrtaceae	<i>Angophora hispida</i>	Dwarf Apple	s
Poaceae	<i>Anisopogon avenaceus</i>	Oat Speargrass	g

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name	Form
Apocnyaceae	<i>Araujia sericifera</i> *	Mothvine	v
Poaceae	<i>Aristida vagans</i>	Three-awn Speargrass	g
Asparagaceae	<i>Asparagus aethiopicus</i> *	Asparagus Fern	g
Asteraceae	<i>Aster subulatus</i> *	Wild Aster	g
Araliaceae	<i>Astrotricha floccosa</i>	-	s
Poaceae	<i>Austrodanthonia</i> sp.	Wallaby Grass	g
Poaceae	<i>Avena fatua</i> *	Wild Oats	g
Poaceae	<i>Axonopus affinis</i> *	Narrow-leaved Carpet Grass	g
Myrtaceae	<i>Baeckea diosmifolia</i>	-	s
Myrtaceae	<i>Baeckea imbricata</i>	-	s
Restionaceae	<i>Baloskion gracile</i>	-	g
Proteaceae	<i>Banksia ericifolia</i> var. <i>ericifolia</i>	Heath-leaved Banksia	s
Proteaceae	<i>Banksia marginata</i>	Silver Banksia	s
Proteaceae	<i>Banksia oblongifolia</i>	-	s
Proteaceae	<i>Banksia serrata</i>	Old Man Banksia	t
Proteaceae	<i>Banksia spinulosa</i>	Hairpin Banksia	s
Cunoniaceae	<i>Bauera rubioides</i>	River Rose	s
Asteraceae	<i>Bidens pilosa</i> *	Cobbler's Pegs	g
Pittosporaceae	<i>Billardiera scandens</i> var. <i>scandens</i>	Apple Dumplings	v
Blandfordiaceae	<i>Blandfordia nobilis</i>	Christmas Bells	g
Blechnaceae	<i>Blechnum cartilagineum</i>	Gristle Fern	g
Rutaceae	<i>Boronia ledifolia</i>	Sydney Boronia	s
Rutaceae	<i>Boronia pinnata</i>	Pinnate Boronia	s
Rutaceae	<i>Boronia serrulata</i>	Native Rose	s
Fabaceae	<i>Bossiaea heterophylla</i>	Variable Bossiaea	s
Fabaceae	<i>Bossiaea obcordata</i>	Spiny Bossiaea	s
Fabaceae	<i>Bossiaea scolopendria</i>	-	s
Poaceae	<i>Briza maxima</i> *	Quaking Grass	g
Poaceae	<i>Briza minor</i> *	Shivery Grass	g
Poaceae	<i>Bromus cartharticus</i> *	Prairie Grass	g
Cunoniaceae	<i>Callicoma serratifolia</i>	Black Wattle	t
Myrtaceae	<i>Callistemon linearis</i>	Narrow-leaved Bottlebrush	s
Dicksoniaceae	<i>Calochlaena dubia</i>	Rainbow Fern	g
Lauraceae	<i>Cassytha pubescens</i>	Common Devil's Twine	v
Cyperaceae	<i>Caustis flexuosa</i>	Curly Sedge	g
Cyperaceae	<i>Caustis pentandra</i>	-	g
Gentianaceae	<i>Centaurium erythraea</i> *	Pink Stars	g
Apiaceae	<i>Centella asiatica</i>	Swamp Pennywort	g
Carophyllaceae	<i>Cerastium glomeratum</i> *	Mouse-ear Chickweed	g
Poaceae	<i>Chloris gayana</i> *	Rhodes Grass	g
Asteraceae	<i>Chrysanthemoides monilifera</i> subsp. <i>monilifera</i> *	Bitou Bush	s
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle	g
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard	v
Polygalaceae	<i>Comesperma ericinum</i>	Matchheads	s
Proteaceae	<i>Conospermum longifolium</i> subsp. <i>longifolium</i>	Smokebush	s
Asteraceae	<i>Conyza bonariensis</i> *	Flax-leaf Fleabane	g
Asteraceae	<i>Conyza sumatrensis</i> *	Fleabane	g

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name	Form
Asteraceae	<i>Coreopsis lanceolata</i> *	-	g
Poaceae	<i>Cortaderia selloana</i> *	Pampas Grass	g
Myrtaceae	<i>Corymbia gummifera</i>	Red Bloodwood	t
Malaceae	<i>Cotoneaster pannosus</i> *	Cotoneaster (cultivar)	s
Asteraceae	<i>Crassocephalum crepidioides</i> *	Thickheads	g
Orchidaceae	<i>Cryptostylis erecta</i>	Bonnet Orchid	g
Orchidaceae	<i>Cryptostylis subulata</i>	Targe Tongue Orchid	g
Cyatheaceae	<i>Cyathea cooperi</i>	Straw Treefern	t
Apiaceae	<i>Cyclospermum leptophyllum</i> *	Slender Celery	g
Poaceae	<i>Cynodon dactylon</i>	Common Couch	g
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge	g
Goodeniaceae	<i>Dampiera stricta</i>	Blue Dampiera	g
Myrtaceae	<i>Darwinia fascicularis</i> subsp. <i>fascicularis</i>	-	s
Asteraceae	<i>Delairea odorata</i> *	Cape Ivy	v
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	Flax Lily	g
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>	Blue Flax Lily	g
Phormiaceae	<i>Dianella prunina</i>	-	g
Poaceae	<i>Digitaria sanguinalis</i> *	Crab Grass	g
Fabaceae	<i>Dillwynia floribunda</i> var. <i>floribunda</i>	Parrot Pea	s
Fabaceae	<i>Dillwynia glaberrima</i>	Parrot Pea	s
Fabaceae	<i>Dillwynia retorta</i> var. <i>retorta</i>	Eggs and Bacon	s
Orchidaceae	<i>Dipodium punctatum</i>	Hyacinth Orchid	g
Asteraceae	<i>Dittrichia graveolens</i> *	Stinkwort	g
Sapindaceae	<i>Dodonaea triquetra</i>	Hop Bush	s
Droseraceae	<i>Drosera peltata</i>	Sundew	g
Droseraceae	<i>Drosera spathulata</i>	Common Sundew	g
Poaceae	<i>Ehrharta erecta</i> *	Panic Veldtgrass	g
Eleocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	t
Poaceae	<i>Eleusine indica</i> *	Crowsfoot Grass	g
Restionaceae	<i>Empodisma minus</i>	-	g
Poaceae	<i>Entolasia marginata</i>	Bordered Panic	g
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	g
Epacridaceae	<i>Epacris longiflora</i>	Native Fuschia	s
Epacridaceae	<i>Epacris microphylla</i>	Coral Heath	s
Epacridaceae	<i>Epacris obtusifolia</i>	-	s
Epacridaceae	<i>Epacris pulchella</i>	NSW Coral Heath	s
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	g
Poaceae	<i>Eragrostis curvula</i> *	African Lovegrass	g
Asteraceae	<i>Erigeron karvinskianus</i> *	Mexican Daisy	g
Fabaceae	<i>Erythrina sykesii</i> *	Coral Tree	t
Myrtaceae	<i>Eucalyptus haemastoma</i>	Scribbly Gum	t
Myrtaceae	<i>Eucalyptus luehmanniana</i>	Yellowtop Ash	t
Myrtaceae	<i>Eucalyptus oblonga</i>	-	t
Myrtaceae	<i>Eucalyptus piperita</i> subsp. <i>piperita</i>	Sydney Peppermint	t
Myrtaceae	<i>Eucalyptus punctata</i>	Grey Gum	t
Myrtaceae	<i>Eucalyptus sieberi</i>	Silvertop Ash	t
Asteraceae	<i>Euchiton sphaericus</i>	Cudweed	g
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry	v
Cyperaceae	<i>Ficinia nodosa</i>	Knobby Club-rush	g

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name	Form
Cyperaceae	<i>Gahnia clarkei</i>	Tall Saw-sedge	g
Cyperaceae	<i>Gahnia melanocarpa</i>	Black-fruit Saw-sedge	g
Cyperaceae	<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge	g
Asteraceae	<i>Gamochaeta spicata</i> *	Cudweed	g
Gleicheniaceae	<i>Gleichenia dicarpa</i>	Pouched Coral Fern	g
Euphorbiaceae	<i>Glochidion ferdinandii</i>	Cheese Tree	t
Fabaceae	<i>Glycine microphylla</i>	-	v
Fabaceae	<i>Gompholobium grandiflorum</i>	Golden Glory Pea	s
Fabaceae	<i>Gompholobium latifolium</i>	Broad-leaf Wedge-pea	s
Haloragaceae	<i>Gonocarpus teuroides</i>	Raspwort	g
Goodeniaceae	<i>Goodenia bellidifolia</i>	Daisy-leaved Goodenia	g
Goodeniaceae	<i>Goodenia dimorpha</i> var. <i>dimorpha</i>	-	g
Goodeniaceae	<i>Goodenia hederacea</i>	Ivy-leaved Goodenia	g
Proteaceae	<i>Grevillea buxifolia</i> subsp. <i>buxifolia</i>	Grey Spider Flower	s
Proteaceae	<i>Grevillea caleyi</i> ^{TS}	-	s
Proteaceae	<i>Grevillea linearifolia</i>	Linear-leaf Grevillea	s
Proteaceae	<i>Grevillea sericea</i>	Pink Spider Flower	s
Proteaceae	<i>Grevillea</i> sp. (cultivar)*	-	s
Proteaceae	<i>Grevillea speciosa</i>	Red Spider Flower	s
Haemodoraceae	<i>Haemodorum corymbosum</i>	Bloodroot	g
Haemodoraceae	<i>Haemodorum planifolium</i>	Bloodroot	g
Proteaceae	<i>Hakea dactyloides</i>	Broad-leaved Hakea	s
Proteaceae	<i>Hakea salicifolia</i>	Willow Hakea	s
Proteaceae	<i>Hakea sericea</i>	Needlebush	s
Proteaceae	<i>Hakea teretifolia</i>	Dagger Hakea	s
Zingiberaceae	<i>Hedychium gardnerianum</i> *	Ginger Lily	g
Lamiaceae	<i>Hemigenia purpurea</i>	Narrow-leaved Hemigenia	s
Dilleniaceae	<i>Hibbertia aspera</i>	Rough Guinea Flower	g
Dilleniaceae	<i>Hibbertia bracteata</i>	-	s
Dilleniaceae	<i>Hibbertia cistiflora</i>	-	s
Dilleniaceae	<i>Hibbertia empetrifolia</i> subsp. <i>uncinata</i>	-	g
Dilleniaceae	<i>Hibbertia linearis</i>	-	g
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart	s
Fabaceae	<i>Hovea linearis</i>	-	g
Apiaceae	<i>Hydrocotyle bonariensis</i> *	Kurnell Curse / Pennywort	g
Clusiaceae	<i>Hypericum gramineum</i>	Small St Johns Wort	g
Asteraceae	<i>Hypochaeris glabra</i> *	Smooth Catsear	g
Asteraceae	<i>Hypochaeris radicata</i> *	Flatweed	g
Restionaceae	<i>Hypolaena fastigata</i>	Tassel Rope-rush	g
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass	g
Convolvulaceae	<i>Ipomoea indica</i> *	Coastal Morning Glory	v
Proteaceae	<i>Isopogon anemonifolius</i>	Flat-leaved Drumsticks	s
Proteaceae	<i>Isopogon anethifolius</i>	Round-leaved Drumsticks	s
Fabaceae	<i>Jacksonia scoparia</i>	Dogwood	s
Juncaceae	<i>Juncus articulatus</i>	Jointed Rush	g
Juncaceae	<i>Juncus planifolius</i>	Broad Rush	g
Juncaceae	<i>Juncus usitatus</i>	Common Rush	g
Fabaceae	<i>Kennedia rubicunda</i>	Dusky Coral Pea	v
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush	s

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name	Form
Myrtaceae	<i>Kunzea capitata</i>	Pink Buttons	s
Proteaceae	<i>Lambertia formosa</i>	Mountain Devil	s
Verbenaceae	<i>Lantana camara</i> *	Lantana	s
Sterculiaceae	<i>Lasiopetalum ferrugineum</i> var. <i>ferrugineum</i>	Rusty Velvet-bush	s
Sterculiaceae	<i>Lasiopetalum parviflorum</i>	-	s
Rutaceae	<i>Leionema diosmeum</i>	-	s
Cyperaceae	<i>Lepidosperma filiforme</i>	-	g
Cyperaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge	g
Cyperaceae	<i>Lepidosperma limicola</i>	-	g
Restionaceae	<i>Leptocarpus tenax</i>	Slender Twine-rush	g
Myrtaceae	<i>Leptospermum grandifolium</i>	Woolly Tea-tree	s
Myrtaceae	<i>Leptospermum laevigatum</i>	Coast Tea-tree	s
Myrtaceae	<i>Leptospermum polygalifolium</i>	Lemon Scented Tea-tree	s
Myrtaceae	<i>Leptospermum squarrosus</i>	-	s
Myrtaceae	<i>Leptospermum trinervium</i>	Flaky-barked Tea-tree	s
Restionaceae	<i>Lepyrodia scariosa</i>	Scale Rush	g
Epacridaceae	<i>Leucopogon esquamatus</i>	-	s
Epacridaceae	<i>Leucopogon lanceolatus</i>	Lance-leaf Beard-heath	s
Epacridaceae	<i>Leucopogon microphyllus</i>	Small-leaved Whitebeard	s
Oleaceae	<i>Ligustrum sinense</i> *	Small-leaved Privet	s
Liliaceae	<i>Lilium formosanum</i> *	Formosan Lily	g
Lindsaeaceae	<i>Lindsaea linearis</i>	Screw Fern	g
Lindsaeaceae	<i>Lindsaea microphylla</i>	Lacy Wedge-fern	g
Lomandraceae	<i>Lomandra cylindrica</i>	-	g
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush	g
Lomandraceae	<i>Lomandra glauca</i> subsp. <i>glauca</i>	-	g
Lomandraceae	<i>Lomandra gracilis</i>	-	g
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush	g
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush	g
Lomandraceae	<i>Lomandra obliqua</i>	Twisted Mat-rush	g
Proteaceae	<i>Lomatia myricoides</i>	River Lomatia	s
Proteaceae	<i>Lomatia silaifolia</i>	Crinkle Bush	s
Caprifoliaceae	<i>Lonicera japonica</i> *	Japanese Honeysuckle	v
Myrtaceae	<i>Melaleuca armillaris</i>	Bracelet Honey Myrtle	s
Myrtaceae	<i>Melaleuca hypericifolia</i>	-	s
Meliaceae	<i>Melia azedarach</i> var. <i>australasica</i>	White Cedar	t
Euphorbiaceae	<i>Micranthemum ericoides</i>	-	s
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Rice Grass	g
Myrtaceae	<i>Micromyrtus ciliata</i>	-	s
Fabaceae	<i>Mirbelia rubiifolia</i>	-	s
Loganiaceae	<i>Mitrasacme polymorpha</i>	Mitrewort	g
Davalliaceae	<i>Nephrolepis cordifolia</i> *	Fish-bone Fern	g
Apocynaceae	<i>Nerium oleander</i> *	Oleander Bush	s
Rubiaceae	<i>Opercularia aspera</i>	Common Stinkweed	g
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass	g
Poaceae	<i>Oplismenus imbecillis</i>	-	g
Oxalidaceae	<i>Oxalis exilis</i>	-	g
Asteraceae	<i>Ozothamnus diosmifolius</i>	Ball Everlasting	s

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name	Form
Poaceae	<i>Panicum simile</i>	Two Colour Panic	g
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum	g
Iridaceae	<i>Patersonia glabrata</i>	Leafy Purple-flag	g
Iridaceae	<i>Patersonia sericea</i>	Wild Iris	g
Poaceae	<i>Pennisetum clandestinum</i> *	Kikuyu	g
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed	g
Proteaceae	<i>Persoonia isophylla</i>	-	s
Proteaceae	<i>Persoonia lanceolata</i>	Lance-leaved Geebung	s
Proteaceae	<i>Persoonia levis</i>	Broad-leaved Geebung	s
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung	s
Proteaceae	<i>Persoonia oblongata</i>	-	s
Proteaceae	<i>Petrophile pulchella</i>	Conesticks	s
Rutaceae	<i>Phebalium squamulosum</i> subsp. <i>squamulosum</i>	-	s
Euphorbiaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge	s
Faboideae	<i>Phyllota phyllicoides</i>	Heath Phyllota	s
Phytolaccaceae	<i>Phytolacca octandra</i> *	Inkweed	s
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	Slender Rice Flower	s
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum	s
Plantaginaceae	<i>Plantago lanceolata</i> *	Ribwort	g
Apiaceae	<i>Platysace ericoides</i>	Heathy Platysace	s
Apiaceae	<i>Platysace lanceolata</i>	Lance-leaf Platysace	s
Apiaceae	<i>Platysace linearifolia</i>	Narrow-leaved Platysace	s
Rhamnaceae	<i>Pomaderris ferruginea</i>	-	s
Rubiaceae	<i>Pomax umbellata</i>	Pomax	g
Euphorbiaceae	<i>Poranthera ericifolia</i>	-	s
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken	g
Cyperaceae	<i>Ptilothrix deusta</i>	-	g
Fabaceae	<i>Pultenaea scabra</i>	-	s
Fabaceae	<i>Pultenaea stipularis</i>	-	s
Fabaceae	<i>Pultenaea tuberculata</i>	-	s
Rubiaceae	<i>Richardia brasiliensis</i> *	White Eye	g
Euphorbiaceae	<i>Ricinus communis</i> *	Castor Oil Plant	s
Rosaceae	<i>Rubus fruticosus</i> subsp. <i>agg.</i> *	Blackberry	s
Polygonaceae	<i>Rumex crispus</i> *	Curled Dock	g
Goodeniaceae	<i>Scaevola ramosissima</i>	Purple Fan Flower	g
Cyperaceae	<i>Schoenus apogon</i>	Fluke Bog-rush	g
Cyperaceae	<i>Schoenus brevifolius</i>	Bog-rush	g
Schizaeaceae	<i>Schizaea bifida</i>	Forked Comb-fern	g
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed	g
Cesalpinoideae	<i>Senna pendula</i> var. <i>glabrata</i> *	-	s
Poaceae	<i>Setaria parviflora</i> *	-	g
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne	g
Smilacaceae	<i>Smilax glycyphylla</i>	Sarsaparilla	v
Solanaceae	<i>Solanum mauritianum</i> *	Wild Tobacco	s
Solanaceae	<i>Solanum nigrum</i> *	Black Nightshade	g
Solanaceae	<i>Solanum sisymbriifolium</i>	-	s
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sow-thistle	g
Anthericaceae	<i>Sowerbaea juncea</i>	Vanilla Lily	g

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name	Form
Poaceae	<i>Sporobolus africanus</i> *	Parramatta Grass	g
Epacridaceae	<i>Sprengelia incarnata</i>	Swamp Heath	s
Stackhousiae	<i>Stackhousia nuda</i>	-	g
Stackhousiae	<i>Stackhousia viminea</i>	-	g
Poaceae	<i>Stenotaphrum secundatum</i> *	Buffalo Grass	g
Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine	v
Gleicheniaceae	<i>Sticherus flabellatus</i>	Umbrella Fern	g
Stylidiaceae	<i>Stylidium graminifolium</i>	Trigger Plant	g
Stylidiaceae	<i>Stylidium lineare</i>	Trigger Plant	g
Epacridaceae	<i>Styphelia laeta</i> subsp. <i>latifolia</i>	Five Corners	s
Epacridaceae	<i>Styphelia tubiflora</i>	-	s
Asteraceae	<i>Tagetes minuta</i> *	Stinking Roger	g
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion	g
Elaeocarpaceae	<i>Tetradlea ericifolia</i>	Black-eyed Susan	g
Elaeocarpaceae	<i>Tetradlea glandulosa</i> ^{TS}	Black-eyed Susan	g
Elaeocarpaceae	<i>Tetradlea thymifolia</i>	Black-eyed Susan	g
Poaceae	<i>Themeda australis</i>	Kangaroo Grass	g
Anthericaceae	<i>Thysanotus tuberosus</i>	Fringed Lily	g
Commelinaceae	<i>Tradescantia fluminis</i> *	Wandering Jew	g
Fabaceae	<i>Trifolium repens</i> *	White Clover	g
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop	g
Verbenaceae	<i>Verbena quadrangularis</i> *	-	g
Fabaceae	<i>Vicia sativa</i> subsp. <i>sativa</i> *	Common Vetch	v
Fabaceae	<i>Viminaria juncea</i>	Native Broom	s
Fabaceae	<i>Wisteria sinensis</i> *	Wisteria	v
Epacridaceae	<i>Woollsia pungens</i>	-	s
Xanthorrhoeaceae	<i>Xanthorrhoea arborea</i>	Broad-leaf Grass Tree	s
Xanthorrhoeaceae	<i>Xanthorrhoea media</i> subsp. <i>media</i>	Forest Grass Tree	g
Xanthorrhoeaceae	<i>Xanthorrhoea resinosa</i>	-	g
Apiaceae	<i>Xanthosia pilosa</i>	Woolly Xanthosia	g
Apiaceae	<i>Xanthosia tridentata</i>	Rock Xanthosia	g
Proteaceae	<i>Xylomelum pyrifolium</i>	Woody Pear	t
Xyridaceae	<i>Xyris gracilis</i>	Slender Yellow-eye	g
Araeaceae	<i>Zantedeschia aethiopica</i> *	White Arum Lily	g
Rutaceae	<i>Zieria smithii</i>	Sandfly Zieria	s
t = tree s = shrub g = groundcover v = vine w = water/wetland plant ^{TS} indicates threatened species			

3.1.2 Vegetation communities

A total of seven (7) vegetation structures were identified that conform to five (5) separate and distinct communities. The vegetation communities observed are:

- Coastal Sandstone Heath and comprising Short Heath, Tall Heath and Damp Tall Heath variations. Damp Tall Heath fits the description afforded by Smith and Smith (2005) for Sandstone Coastal Heath (vegetation unit 19, sub unit iv).
- Sydney Sandstone Ridgetop Woodland and comprising Low Open Forest and Open Forest variations.
- Disturbed areas - Cleared, Managed, Landscaped or Weed Plume.
- Coastal Upland Swamp - EEC
- Sandstone Gully Forest.

Vegetation Community A – Short Heath



Photo 1 – Low Heath vegetation approximately 200m west of the existing dwelling

Occurrence – In relation to the proposed development area, this community occurs near to the centre of the site to the north of Ralston Avenue. The Low Heath vegetation is most similar to Sydney Coastal Heath as mapped by Smith and Smith (2000).

Structure – Low heath vegetation consisting of many *Fabaceae* plants generally to a height of up to 2.5m, with very occasional emergents. There is a dominance of shrub species and herbaceous groundcovers that are generally very dense. The species diversity within this community is generally lower than the Forest communities.

Disturbances – This vegetation community is impacted by walking / driving tracks.

Common Species

Angophora hispida (Dwarf Apple), *Grevillea speciosa* (Red Spider Flower), *Banksia ericifolia* var. *ericifolia* (Heath-leaved Banksia), *Hemigenia purpurea* (Narrow-leaved Hemigenia), *Actinotus minor* (Lesser Flannel Flower), *Hakea teretifolia* (Dagger Hakea), *Phyllota phyllicoides* (Heath Phyllota), *Xanthorrhoea media* subsp. *media* (Forest Grass Tree), *Persoonia lanceolata* (Lance-leaved Geebung), *Tetratheca ericifolia* (Black-eyed Susan), *Dillwynia floribunda* var. *floribunda* (Parrot Pea) and *Epacris pulchella* (NSW Coral Heath).

Significance – Not endangered or threatened within Warringah LGA.

Vegetation Community B & B2 – Tall Heath and Damp Tall Heath

Occurrence – In relation to the proposed development area, this community occurs frequently to the south of Ralston Avenue, along the northern edge of Ralston Avenue, and within the north west portion of the flora study area. The Tall Heath and Damp Tall Heath vegetation is most similar to Sydney Coastal Heath as mapped by Smith and Smith (2000).

The Damp Tall Heath appears to have been artificially created by concentrated stormwater drainage from development areas upslope on adjoining lands, or is associated with an existing surface drainage line.

Structure – Tall heath vegetation consisting of a dominance of *Allocasuarina distyla* with several other heath species. Some emergent trees exist. The dominance by the *Allocasuarina distyla* limits the diversity of plant species within those surveyed quadrats. The average height of vegetation within this community is 2.5-5m.

Damp Tall Heath vegetation is typically a moderately dense scrub comprising of *Banksia ericifolia* with a combination of *Hakea*, *Allocasuarina* and *Leptospermum* species. South of Ralston Avenue, the vegetation community has been caused through disturbance and the structure varies more so with the presence of some tree ferns and weeds.

Disturbances – This vegetation community is impacted by walking / driving tracks.



Photo 2 – Tall Heath vegetation in Quadrat 5 (2008) looking east

Common Species

Allocasuarina distyla (Scrub She-oak), *Leptospermum squarrosum*, *Darwinia fascicularis*, *Banksia ericifolia* var. *ericifolia* (Heath-leaved Banksia), *Hakea teretifolia* (Dagger Hakea), *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Actinotus minor* (Lesser Flannel Flower), *Lepyrodia scariosa* (Scale Rush) and *Leptocarpus tenax* (Slender Twine-rush).

Significance – Likely to provide some good quality habitat for the threatened or ROTAP species *Tetratheca glandulosa*, *Eucalyptus luehmanniana*, *Angophora crassifolia* and *Lomandra brevis*.

Vegetation Community C – Low Open Forest

Occurrence – In relation to the proposed development area, this community occurs around the fringes on higher degrees of sloping land, in addition to small patches within the central portion of the site and more extensively to the north western corner. The Low Open Forest vegetation is most similar to Sydney Sandstone Ridgetop Woodland as mapped by Smith and Smith (2000). In 2005, Smith and Smith described a wider extent of communities with a description for (Vegetation Community 21). This community is a scrubland with *E. luehmanniana* and *C. gummifera* as dominants with heath and sedge understorey species. This community is not considered threatened within the Warringah local government area (LGA) but *E. luehmanniana* is a rare species.

Whilst the Low Open Forest is diverse with a mix of upper strata species, the area containing *E. luehmanniana* was prevalent within approximately 100m north and south of Ralston Avenue. It was generally never found more than 100m north of Ralston Avenue within the proposed development area, although some smaller patches were located on south westerly slopes to the west of the proposed development area. The extent of the *E. luehmanniana* to the south of Ralston Avenue was extensive and it crept downslope to the edges of the sandstone gully forest, although was less prevalent within the taller surrounding vegetation.

Structure – Low Open Forest vegetation consists of a high proportion of heath species in the lower layers of vegetation with a low proportion of grass species. This community contains trees typically to a height of between 5-10m with a projected foliage cover (PFC) of 20-35%.

Disturbances – This vegetation community is impacted by walking / driving tracks.

Common Species

Trees: *Corymbia gummifera* (Red Bloodwood), *Eucalyptus piperita* (Sydney Peppermint), *Eucalyptus haemastoma* (Scribbly Gum), *Eucalyptus luehmanniana* (Yellow top Ash), *Angophora hispida* (Dwarf Apple) and *Angophora crassifolia*.

Shrubs: *Allocasuarina distyla* (Scrub She-oak), *Banksia ericifolia* var. *ericifolia* (Heath-leaved Banksia), *Hakea teretifolia* (Dagger Hakea), *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Leptospermum polygalifolium* (Lemon Scented Tea-tree), *Gompholobium grandiflorum* (Golden Glory Pea), *Grevillea speciosa* (Red Spider Flower), *Grevillea buxifolia* (White Spider Flower), *Hakea sericea* (Needlebush), *Phyllota phyllicoides* (Heath Phyllota) and *Platysace linearifolia* (Narrow-leafed Platysace).

Groundcovers: *Actinotus minor* (Lesser Flannel Flower), *Caustis flexuosa* (Curly Sedge), *Xanthorrhoea media* subsp. *media* (Forest Grass Tree), *Patersonia sericea* (Wild Iris), *Xanthosia tridentata* (Rock Xanthosia), *Lomandra glauca* subsp. *glauca*, *Pimelea linifolia* subsp. *linifolia* (Slender Rice Flower) and *Lomandra gracilis*.

Significance – Two (2) rare (ROTAP) species were quite common within this community, *Eucalyptus luehmanniana* and *Angophora crassifolia*. The threatened species *Tetratheca glandulosa* has also been observed.



Photo 3 – Low Open Forest within the central portion of the proposed development area

Vegetation Community D – Open Forest

Occurrence – The community occurs immediately west and south of the Sydney East Substation and at the terminal end of Ralston Avenue. It was extensive further north within the study area. The Open Forest vegetation could be a combination of either Sydney Sandstone Ridgetop Woodland or Duffys Forest (an EEC) as mapped by Smith and Smith (2000). Assessment of the vegetation within all 2008 and 2011 quadrats found the vegetation not to be representative of Duffys Forest (in accordance with P & J Smith's Duffys Forest Index).

Structure – Open Forest structure but taller than the Low Open Forest, generally above 10m tall. This vegetation community contains a mixture of healthy understorey species with a moderate dominance of sclerophyllous species. Taller Eucalypt species dominate such as *Eucalyptus punctata* and *Eucalyptus sieberi*. This vegetation community comprises a partially grassy understorey unlike the low heath and tall heath vegetation communities.

Disturbances – This vegetation community is impacted by walking / driving tracks, a communications tower and an electricity substation.

Common Species

Trees: *Eucalyptus punctata* (Grey Gum), *Corymbia gummifera* (Red Bloodwood), *Angophora costata* (Smooth-barked Apple), *Eucalyptus sieberi* (Silver-top Ash) and *Allocasuarina littoralis* (Black She-oak).

Shrubs: *Acacia terminalis* (Sunshine Wattle), *Melaleuca hypericifolia*, *Banksia ericifolia* var. *ericifolia* (Heath-leaved Banksia), *Platysace linearifolia* (Narrow-leaved Platysace), *Callistemon linearis* (Narrow-leaved Bottlebrush) and *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle).

Groundcovers: *Entolasia marginata* (Bordered Panic), *Entolasia stricta* (Wiry Panic), *Tetradlea ericifolia* (Black-eyed Susan), *Pimelea linifolia* subsp. *linifolia* (Slender Rice Flower), *Lomandra longifolia* (Spiky-headed Mat-rush), *Lindsaea microphylla* (Lacy Wedge-fern) and *Lomandra gracilis*.

Significance – This vegetation community provides some habitat for the recorded threatened or ROTAP species *Tetradlea glandulosa*, *Eucalyptus luehmanniana* and *Angophora crassifolia*.

Where vegetation within the canopy is dominated by *Eucalyptus sieberi* and *Corymbia gummifera*, this provides very good potential habitat for the threatened species *Grevillea caleyi*, particularly to the north and north east of the existing residence.



Photo 4 – Open Forest vegetation along the northern edge of Ralston Avenue

Vegetation Community E – Cleared, Managed, Landscaped or Weed Plume

Occurrence – In relation to the flora study area this community only occurs within the centre of the site adjacent to the intersection of some major tracks, the managed grounds and residential lot, other built structures and the weed plume along the edge of Ralston Avenue near the existing gate.

Structure – Contains shrub and heath vegetation with no trees and a grassy and annual understorey.

Disturbances – This vegetation community is impacted by walking / driving tracks, and a high proportion of annuals, exotic grasses and Pampas Grass.



Photo 5 – Disturbed area with weed plume near the centre of the site

Common Species

Cortaderia selloana (Pampas Grass), *Acacia saligna* (Orange Wattle), *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle), *Andropogon virginicus* (Whisky Grass), *Eragrostis curvula* (African Lovegrass), *Centella asiatica* (Swamp Pennywort), *Hakea teretifolia* (Dagger Hakea), *Cynodon dactylon* (Common Couch), *Seneca madagascariensis* (Fireweed), *Paspalum dilatatum* (Paspalum) and *Bidens pilosa* (Cobbler's Pegs).

Vegetation Community F – Coastal Upland Swamp

Occurrence – This vegetation community occurs in patches to the south of Ralston Avenue, varying in size up to 1.27 ha.

Structure – Sedge, heath or scrub usually under 2.5m tall with few emergents and few Eucalyptus / Angophora specimens.

Disturbances – Recent fire within the remnants, south of Ralston Avenue.

Common Species

Baekkea imbricata, *Banksia ericifolia* (Heath-leaved Banksia), *Bauera rubioides* (River Rose), *Dillwynia floribunda* var. *floribunda* (Parrot Pea), *Hakea teretifolia* (Dagger Hakea), *Leptospermum squarrosum*, *Viminaria juncea* (Native Broom), *Empodisma minus*, *Lepidosperma* spp., *Schoenus brevifolius* (Bog-rush), *Leptocarpus tenax* (Slender Twine-rush), *Lepyrodia scariosa* (Scale Rush), *Goodenia dimorpha* and *Xyris gracilis* (Slender Yellow-eye).

Significance – This community is regionally significant and falls under the EEC Coastal Upland Swamps of the Sydney Basin Bioregion. This community may provide good habitat for the threatened frog species, Red-crowned Toadlet and Giant Burrowing Frog.



Photo 6 – Coastal upland swamp vegetation with fringing low open forest or tall heath in the background

Vegetation Community G – Sandstone Gully Forest

Occurrence – This vegetation community occurs in steeper portions of land to the south of Ralston Avenue generally outside of the proposed development area and thus was not surveyed in much detail. It tends to occur on sheltered southerly facing slopes.

Structure – An Open Forest structure of Eucalypts, Angophoras and Corymbias with a moderately healthy understorey and some herbs, forbs and ferns in the ground layer. Trees are usually between 10-20m in height.

Disturbances – There has been recent fire within the remnant south of Ralston Avenue.

Common (Canopy) Species

Eucalyptus piperita (Sydney Peppermint), *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood).

3.2 Fauna results

To date, a total of ninety eight (98) fauna species were observed within the proposed development area during the survey. This number comprised fifty four (54) species of bird, 18 species of mammal, eighteen (18) species of reptile and eight (8) species of amphibian.

Fauna species observed throughout the duration of fauna surveys are listed in Table 3.2 below.

Table 3.2 – Fauna observations for the study area

Common name	Scientific name	Method observed		
Birds		May 2008	Dec 2011	Oct 2012+
Australian Magpie	<i>Gymnorhina tibicen</i>		O	O
Australian Owllet-nightjar	<i>Aegotheles cristatus</i>			C
Australian Raven	<i>Corvus coronoides</i>	O C	O C	O C
Bar-shouldered Dove	<i>Geopelia humeralis</i>		O	
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	O	O C	O C
Brown-headed Honeyeater	<i>Melithreptus validirostris</i>	O C		
Brown Thornbill	<i>Acanthiza pusilla</i>		O C	O C
Brown Quail	<i>Coturnix ypsilophora</i>	O	O	O T
Brush Bronzewing	<i>Phaps elegans</i>	O	C	
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>		C	C
Common Koel	<i>Eudynamys scolopacea</i>		C	C
Common Myna *	<i>Acridotheres tristis</i>	O		O
Crested Pigeon	<i>Ocyphaps lophotes</i>	O		
Crimson Rosella	<i>Platyceus elegans</i>			O C
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	O C	O C	O C
Eastern Whipbird	<i>Psophodes olivaceus</i>	O C	O C	O C
Eastern Yellow Robin	<i>Eopsaltria australis</i>	O	O C	O C
Fairy Martin	<i>Hirundo ariel</i>		O	
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>		C	C
Golden Whistler	<i>Pachycephala pectoralis</i>	O		C
Grey Butcherbird	<i>Cracticus torquatus</i>	O C	C	C
Grey Fantail	<i>Rhipidura fuliginosa</i>	O C	C	O C
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	O	O C	O C
Laughing Kookaburra	<i>Dacelo novaeguineae</i>		O C	O C
Little Lorikeet ^{TS}	<i>Glossopsitta pusilla</i>	C		
Little Wattlebird	<i>Anthochaera chrysoptera</i>	O C	O C	O C
Masked Lapwing	<i>Vanellus miles</i>		C	C
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	O C	O C	O C
Pied Currawong	<i>Strepera graculina</i>	C	O C	O C
Powerful Owl ^{TS}	<i>Ninox strenua</i>	Sp C P		
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	C	C	O C
Red-browed Finch	<i>Neochmia temporalis</i>	O C	O C	O C
Red Wattlebird	<i>Anthochaera carunculata</i>	O C		C
Red-whiskered Bulbul *	<i>Pycnonotus jocosus</i>		C	C
Rufous Whistler	<i>Pachycephala rufiventris</i>		C	O C
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>	C		
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidus</i>		C	
Silveryeye	<i>Zosterops lateralis</i>	O C	O C	O C
Southern Boobook	<i>Ninox novaeseelandiae</i>			C
Spotted Pardalote	<i>Pardalotus punctatus</i>	O C	C	O C
Spotted Quail-thrush	<i>Cinclosoma punctatum</i>			C ^{PR}
Striated Pardalote	<i>Pardalotus striatus</i>	O C		C
Striated Thornbill	<i>Acanthiza lineata</i>		O C	O C

Common name	Scientific name	Method observed		
Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	C	O C	O C
Superb Fairy-wren	<i>Malurus cyaneus</i>		O C	C
Tawny Frogmouth	<i>Podargus strigoides</i>	O		
Variegated Fairy-wren	<i>Malurus lamberti</i>		O C	O C
Welcome Swallow	<i>Hirundo neoxena</i>	O	O	O
White-browed Scrubwren	<i>Sericornis frontalis</i>	O C	O C	O C
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>			C ^{PR}
White-eared Honeyeater	<i>Lichenostomus leucotis</i>	O C	O C	O C
White-throated Nightjar	<i>Eurostopodus mystacalis</i>			O C
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	O C	O	C
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	C		O C
Mammals				
Brown Antechinus	<i>Antechinus stuartii</i>		T R	
Bush Rat	<i>Rattus fuscipes</i>		T R	T R
Common Brushtail Possum	<i>Trichosurus vulpecula</i>		S T R	T R
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>		S	
Dog *	<i>Canis familiaris</i>	O	O C	O R
Eastern Bentwing-bat ^{TS}	<i>Miniopterus orianae oceansis</i>			A
Eastern Pygmy Possum ^{TS}	<i>Cercartetus nanus</i>			H
Forest Bat	<i>Vespadelus sp</i>	A		
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		A	A
Grey-headed Flying-fox ^{TS}	<i>Pteropus poliocephalus</i>	S C	O	O
Horse *	<i>Equus caballus</i>	O	O	O
Little Bentwing-bat ^{TS}	<i>Miniopterus australis</i>			A
Little Forest Bat	<i>Vespadelus vulturnus</i>			A ^{PR}
Long-nosed Bandicoot	<i>Parameles nasuta</i>		T R	T R
Rabbit *	<i>Oryctolagus cuniculus</i>			O
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>		O	I
Sugar Glider	<i>Petaurus breviceps</i>		T	I C
Swamp Wallaby	<i>Wallabia bicolor</i>		O R	O T R
White-striped Freetail-bat	<i>Austronomus australis</i>			A
Reptiles				
Blackish Blind Snake	<i>Ramphotyphlops nigrecens</i>		H	
Burton's Legless Lizard	<i>Lialis burtonis</i>			T
Copper Tailed Skink	<i>Ctenotus taeniolatus</i>	O	H	T
Delicate Skink	<i>Lampropholis delicata</i>		O	O T
Diamond Python	<i>Morelia spilota</i>	O	O	O
Eastern Bearded Dragon	<i>Pogona barbata</i>	O		O R
Eastern Blue Tongue Lizard	<i>Tiliqua scincoides</i>		T	T
Eastern Brown Snake	<i>Pseudonaja textilis</i>			O
Eastern Tiger Snake	<i>Notechis scutatus</i>	O		
Eastern Water Dragon	<i>Physignathus lesueurii</i>			O
Eastern Water Skink	<i>Eulamprus quoyii</i>			O
Grass Skink	<i>Lampropholis guichenoti</i>			T
Rosenberg's Goanna ^{TS}	<i>Varanus rosenbergii</i>		T	O T
Lace Monitor	<i>Varanus varius</i>		O	O T
Mainland She-oak Skink	<i>Cyclodomorphus michaeli</i>			H
Red-throated Skink	<i>Pseudemoia platynota</i>	H		
Weasel Skink	<i>Saproscincus mustelina</i>		O ^{PR}	T
Yellow-faced Whip Snake	<i>Demansia psammophis</i>	H		T
Amphibians				
Broad-palmed Frog	<i>Litoria latopalmata</i>		C ^{PR}	
Common Eastern Froglet	<i>Crinia signifera</i>	C	O C	C T
Freyinet's Frog	<i>Litoria freycineti</i>			O
Giant Burrowing Frog ^{TS}	<i>Heleioporus australiacus</i>			T/DNA O

Common name		Scientific name	Method observed		
Leaf Green Tree Frog		<i>Litoria phyllochroa</i>			C
Peron's Tree Frog		<i>Litoria peronii</i>			C
Red-crowned Toadlet ^{TS}		<i>Pseudophryne australis</i>	O C	C	H
Striped Marsh Frog		<i>Limnodynastes peronii</i>		C	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 (<i>Elliott</i> , cage, etc)	H	-	Habitat search
S	-	Spotlight	I	-	Scat, track or sign identification
R	-	Surveillance camera	DNA	-	DNA Analysis

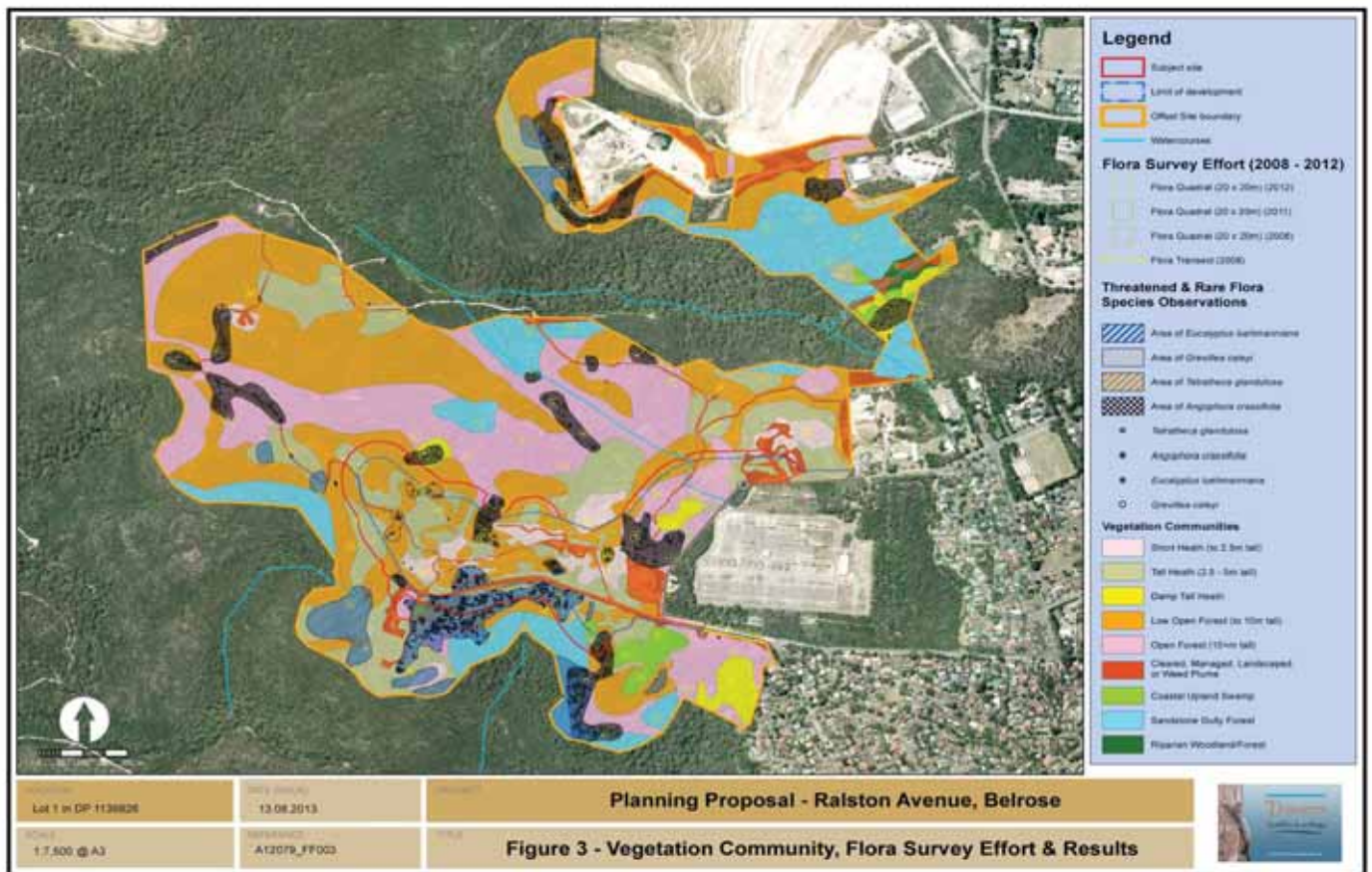


Figure 3 – Vegetation communities and flora survey results within Lot 1 DP1139826

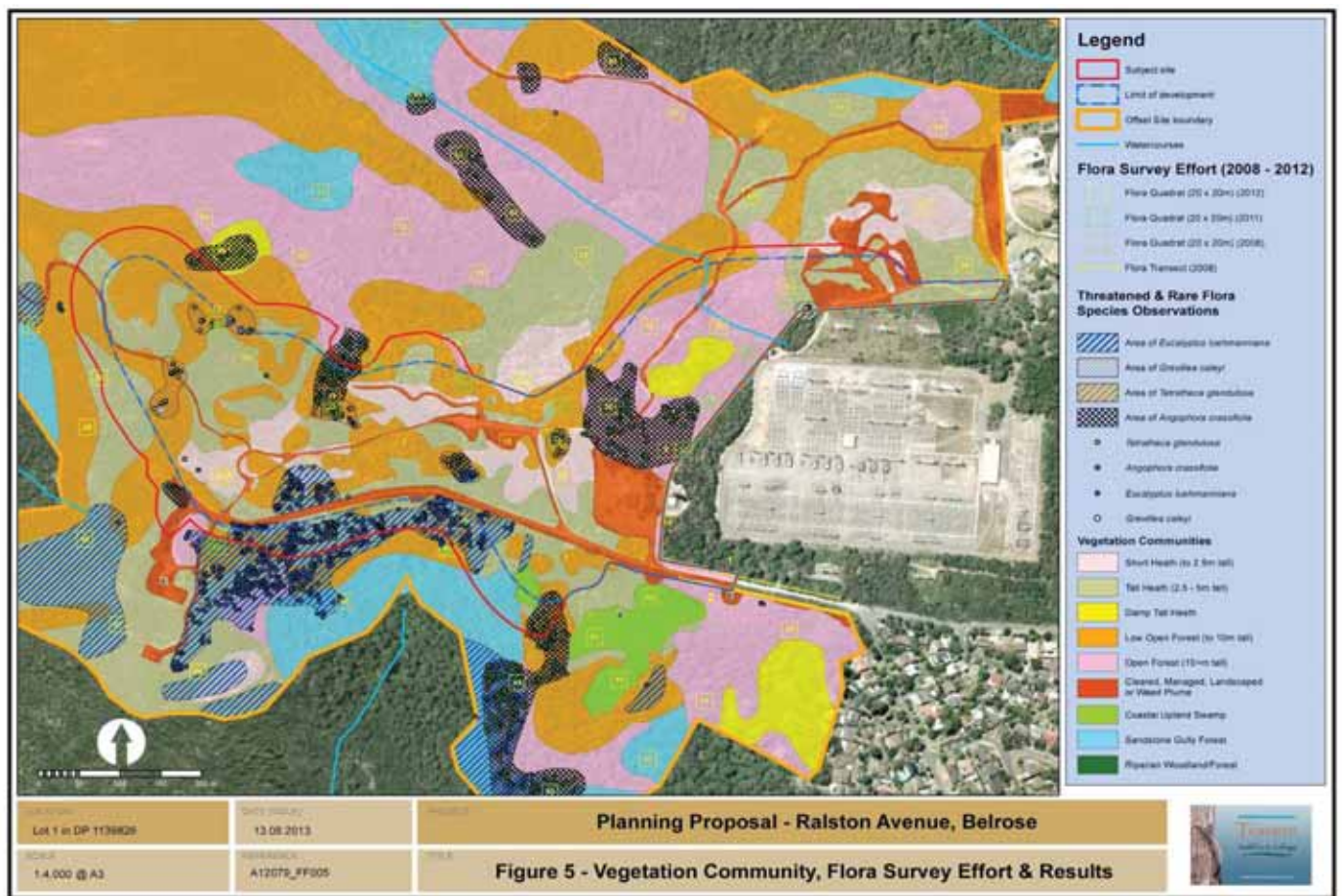


Figure 5 – Vegetation communities and flora survey results within the subject site (zoom in)



Ecological Assessment

4

4.1 Previous surveys reviewed

The following regional vegetation mapping was examined to identify the potential vegetation communities' onsite.

Ecological mapping of the local area was obtained from *Warringah Council* (Smith and Smith 2000) that identified much of the land near the centre of the subject site as Coastal Sandstone Heath. The vegetation nearer the perimeter of the subject site was recognised as Sydney Sandstone Ridgetop Woodland. The vegetation mapping performed by Smith and Smith (2000) did not identify any Duffys Forest EEC vegetation within the subdivision boundary area, however adjoining lands to the east and a small patch to the south of the adjoining Sydney East Substation were identified as containing Duffys Forest vegetation. Vegetation downslope of the proposed development area was largely mapped as Sydney Sandstone Gully Forest.

4.2 Flora

Generally, only species observed within the subject site are listed in Table 3.1. The number of observed native species is high indicating species richness is good. The number of exotic species observed is very low with only a few quadrats recording more than 5% exotic species make up. Largely, the exotic species are confined to the edges of roads and around existing infrastructure.

Two (2) endangered species were observed, including *Tetratheca glandulosa* and *Grevillea caleyi*. Two (2) ROTAP species were also observed, *Eucalyptus luehmanniana* and *Angophora crassifolia*. Both species were observed in both the development area and the offset area.

4.2.1 Local / regional flora matters

Eucalyptus luehmanniana is also a rare plant (ROTAP) species which was found in the tall heath and Low Open Forest on south east to south west facing slopes on or near sandstone benches near the top of the ridge. The population within the southern portion of the proposed development area continues to the south until the edge of the gully forest vegetation. All individual specimens within and immediately adjoining the proposed development were identified by GPS. All observed specimens are shown on Figure 1.

Large numbers of this species have been recorded within the proposed development area and within the proposed offset lands. The extent and size of the existing population was considered too large and too time consuming to map as individual records outside of the proposed development area. Therefore the exact population is unknown and the mapped distribution may not reflect the full extent of the species. However, observed habitat areas were mapped and the population size has been estimated on the basis of recorded densities. Approximately 80% of the estimated population will be retained within the proposed offset lands.

The proposed development will likely remove all specimens of *Eucalyptus luehmanniana* on the northern side of Ralston Avenue. Specimens located on the southern side of Ralston Avenue fall within a proposed APZ. Whilst there is no assurance of their retention, there are excellent opportunities to retain further trees and still comply with the standards for APZs. We recommend the fuel management plan aims to protect as many of them as possible.

Angophora crassifolia, listed as a rare Australian plant (ROTAP species) has been observed broadly across the proposed development area and continues into the broader study area. This is a rare species due to its geographical range, occurring primarily in the northern suburbs of Sydney in near coastal locations, predominantly within the Warringah LGA. This species was located sporadically in clumps throughout the proposed development area, typically more so on the outskirts in the taller vegetation communities such as Low Open Forest and Open Forest and occasionally in the Tall Heath. Some large clumps were also located within the offset area and it is likely that the population is more extensive than mapped. Approximately 80% of the estimated population will be retained within the proposed offset lands. All specimens observed within and immediately adjoining the proposed development have been identified by GPS. All observed specimens are shown on Figure 1.

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2012) indicated a list of species that have been recorded within a 10 km 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

<i>Scientific name</i>	<i>TSC Act</i>	<i>Potential to occur</i>
<i>Acacia bynoeana</i>	E1	Low
<i>Callistemon linearifolius</i>	V	Low
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	V	Low - Moderate
<i>Eucalyptus camfieldii</i>	V	Moderate
<i>Grevillea caleyi</i>	E1	Recorded
<i>Haloragodendron lucasii</i>	E1	Very low
<i>Lasiopetalum joyceae</i>	V	Low
<i>Melaleuca deanei</i>	V	Low-moderate
<i>Microtis angusii</i>	E1	Very low
<i>Persoonia hirsuta</i>	E1	Low
<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	Moderate
<i>Tetratheca glandulosa</i>	V	Recorded

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

Two (2) state listed threatened flora species, *Tetradlea glandulosa* and *Grevillea caleyi* were recorded during survey(s) undertaken. These species have been assessed in detail within Appendix 3.

The following is a summary of our current knowledge of the threatened flora populations within and surrounding the site and the estimated impacts as a result of the proposed development area.

Grevillea Caleyi – Only one (1) small area containing three (3) specimens has been recorded on the fence line between the Wyatt Avenue corridor and the substation which may or may not be impacted by a future road extension. A historical record is also located within the proposed offset lands within Open Forest vegetation but, due to the age and inaccuracy of the record (year 1892 – 10km accuracy), it is not a reliable position of the record and may no longer be present. The same applies for the second record within the proposed development area which was recorded in 1930 with 4km accuracy. The development proposal is not directly removing this population, however, the proposed Wyatt Avenue extension could potentially have a direct impact upon these specimens. It is unknown if the five (5) specimens form part of a larger population that continues into the substation lands although there is a good possibility that this might be the case based on existing *Atlas of NSW Wildlife* records and the vegetation types present (Figure 1). One (1) further individual was observed within the main development area approximately 150m from the existing residential dwelling and will be directly impacted.

Potential habitat areas for this species have been observed within the proposed development and offset areas. We note however that intensive target searches for *Grevillea caleyi* have not been undertaken within the offset areas, but have been recorded if found within quadrats, on the meander between quadrats and along existing walking track edges. There were no further observations of *Grevillea caleyi* within the proposed development area or offset lands. The taller vegetation communities including the Open Forest and parts of the Sandstone Gully Forest where *Eucalyptus sieberi* and *Corymbia gummifera* are dominant canopy species in association with laterite soils may be suitable. The threatened species profile also notes that *Grevillea caleyi* is known to occur at an altitude of between 170- 240m ASL. Given that parts of the development area and offset lands have appropriate topography, we expect that the ridge line areas with Open Forest provide the most likely habitat.

The Wyatt Avenue extension should aim to avoid impacting the stand of three (3) individuals by ensuring the road and proposed cut and fill do not impact on the recorded location.

On the assumption that the OEH database records are inaccurate or out dated, then the population within the study area is four (4) individuals. There will be a loss of one (1) individual.

Further survey on the substation lands has located thirty eight (38) specimens, all of which are approximately 400m away. As the hazard reduction burn has knocked out all pre-existing specimens, the count is considered to be low and not representative of the local population. Given a few additional months and some spring growth, the population is likely to rise.

The three (3) specimens observed before the hazard reduction burn now equates to seven (7). Recent self-propagation has seen the stems emerge in recent weeks.

As a concluding statement on *Grevillea caleyi*, the proposal is likely to remove just one (1) of the current forty six (46) new specimens present within the local population as surveyed by this firm.

Tetratheca glandulosa – Several clumps of this species have been recorded throughout the proposed development area during the ideal survey period of spring 2012. Some specimens were previously recorded in December 2011 at the very end of the flowering period, with many at that time holding on to senescing flowers or flowers that had recently fallen from the plant and were still visible on the ground.

The majority of observed clumps of *Tetratheca glandulosa* were located in the Low Open Forest vegetation community. It was thought that the dense nature of the short heath would be unlikely to host the species except on the edges as it intergrades with other taller vegetation types. The potential habitat within the Tall Heath is considered to be low overall (although variable) because of the dense nature of the Banksia / Leptospermum / Hakea / Allocasuarina association, so if it does occur, the density of *Tetratheca glandulosa* is not expected to be high. The Sandstone Gully Forest is likely to provide only marginal potential habitat or low potential habitat as the gully vegetation is not on the ridge line which the species favours.

The potential habitat of the species is moderate to high in the Low Open Forest and Open Forest communities. Throughout the proposed development area, large numbers of other *Tetratheca* species were sighted, notably *Tetratheca ericifolia* and *Tetratheca thymifolia*, however, there were not large numbers of *Tetratheca glandulosa* recorded despite the good habitat potential.

Intensive target searches for *Tetratheca glandulosa* have not been undertaken within the whole of the offset area. Target searches have been undertaken within the quadrats, on the meander between quadrats and along existing walking track edges, however, only one (1) additional patch has been identified outside of the proposed development area. High numbers of *Tetratheca ericifolia* and *Tetratheca thymifolia* were also observed in the offset areas and it is believed that if target survey was undertaken in the offset areas, many clumps of *Tetratheca glandulosa* would be observed.

On 6 August 2013, target survey was undertaken for this species within parts of the offset area. Given that the survey has been undertaken prior to the beginning of the known flowering period, it has only produced limited observations of thirteen (13) specimens. Of a total of one hundred and forty nine (149) observed specimens, only fifteen (15) in total have been observed within the offset area.

It is expected that the offset area would provide many more specimens but survey has not been conducted during the most appropriate time period (post September).

(b) Endangered flora populations (NSW)

No endangered flora populations occur within a 10km radius of the proposed development area.

(c) Endangered ecological communities (NSW)

The vegetation mapping performed by Smith and Smith (2000) did not identify any Duffys Forest EEC vegetation within the proposed development area, however, adjoining lands to the east and a small patch to the south of the adjoining Sydney East Substation were identified as containing Duffys Forest vegetation.

Duffys Forest

All 2008 and 2011 quadrats have been compared against the Scientific Committee's determination to assess whether or not Duffys Forest EEC is present or absent within the

study area. Whilst a number of quadrats appeared to have a number of Duffys Forest species present, when using the Duffys Forest Index as derived by *P & J Smith Ecological Consultants* (2000), the index was high for Sydney Sandstone Ridgetop Woodland as opposed to Duffys Forest. As such, the vegetation within the study area is not considered to be representative of the EEC, Duffys Forest. The Council mapped EEC, Duffys Forest is not present within the site. It was observed just outside of the proposed development area on the south eastern side of the substation.

Coastal Upland Swamp

The Coastal Upland Swamp is representative of the EEC, Coastal Upland Swamp of the Sydney Basin Bioregion. The Damp Tall Heath vegetation community has some floristic similarities compared to the listed indicative species described in the final determinations of the EEC. The presence of taller vegetation not typical of the described EEC, association with a drainage line, and the presence of less than 50% of species within the quadrat listed on the final determinations, indicates that the Damp Tall Heath is not consistent with the EEC, Coastal Upland Swamp in the Sydney Basin Bioregion.

These communities have been assessed in detail within Appendix 3.

(d) Significant ecological communities

The EEC, Coastal Upland Swamp occurs at locations within the proposed development area that are on the southern side of Ralston Avenue and to the north of Wyatt Avenue. Both areas are mostly within the proposed offset areas. In early due diligence studies, this community was identified as Sandstone Hanging Swamp over a smaller area. The EEC determination for Coastal Upland Swamp effectively expands the areas of this sensitive community, based on a broader floristic assemblage.

Coastal Upland Swamps are recognised groundwater dependent ecosystems which are generally to be protected under the NSW Groundwater Dependent Ecosystem Policy. The impact of surface and subsurface drainage within its catchment is also considered, typically resulting in an ecological buffer to be established. A buffer of 30m has been provided in addition to separation created by APZs.

The vegetation that contains *Eucalyptus luehmanniana* as a dominant species was considered by Smith and Smith (2005) to be a rare vegetation community in Australia. The current development concept protects all of this vegetation within the proposed offset area.

4.2.3 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

Scientific Name	EPBC Act	Potential to occur
<i>Acacia bynoeana</i>	V	Low
<i>Eucalyptus camfieldii</i>	V	Moderate
<i>Grevillea caleyi</i>	E	Recorded
<i>Haloragodendron lucasii</i>	E	Very low
<i>Lasiopetalum joyceae</i>	V	Low
<i>Melaleuca deanei</i>	V	Low-moderate
<i>Microtis angusii</i>	E	Very low
<i>Persoonia hirsuta</i>	E	Low
<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	Moderate
<i>Tetratheca glandulosa</i>	V	Recorded

Two (2) nationally listed threatened flora species, *Grevillea caleyi* and *Tetratheca glandulosa*, were recorded within the study area.

(b) Endangered ecological communities (national)

There are no nationally listed EECs present within the study area or affected by the proposal.

4.2.4 Flora and EEC assessment conclusions

In accordance with Section 5A of the *EPA Act* the 7 part test of significance (Appendix 3) concluded that the proposed development will not have a significant impact on any state listed threatened species, populations or EECs. Therefore, an SIS should not be required for the proposed development in respect to flora.

The proposed development was not considered to have a significant impact on matters of NES listed under the *EPBC Act*. As such, a referral to SEWPAC should not be required in respect to flora.

Mitigation measures and recommendations have been provided to reduce direct and indirect impacts in section 7.

4.3 Fauna

All fauna species recorded during survey(s) are listed in Table 3.2.

4.3.1 Fauna habitat

The extent of the offset area surrounding the proposed development area is the only locally undeveloped area of the Lambert soil type within the connective natural landscape to the south of Mona Vale Road and west of Forest Way. The proposed development area covers the plateau area within this soil landscape. Habitat features of the Lambert soil type include:

- Presence of greater than 50% rock outcrops
- Open and closed heathland and scrubland
- Broad ridges, wide benches with low broken scarps
- Small hanging valleys and poor drainage areas

Alternatively, the highly developed Somersby soil type is characterised by low open woodland and scrubland typically with less rock outcropping. The remaining surrounding, mostly uncleared, Hawkesbury sandstone to the north, west and south, whilst providing similar rocky features, provides slopes in excess of 25% and is characterised by open woodland and Tall Open Forest.

The fauna habitats present throughout the proposed development area include:

- Vegetated areas of Short Heath, Tall Heath, Wet Heath, Hanging Swamp and Low Open Forest with a healthy to scrub understorey
- Nectar producing *Eucalyptus* trees providing foraging resources for all seasons excluding winter
- Other nectar producing resources, principally *Angophora*, *Melaleuca*, *Banksia* and *Acacia* species
- Sandstone rock outcrops, crevices, overhangs and small caves at various aspects
- Sparse to dense shrub layers, ground covers and leaf litter.
- Small to medium sized hollows in low density only within the Low Open Forest Community
- Fallen branches
- Loose sandy soil suitable for digging, burrowing and foraging
- Moist soil within hanging swamps
- Depressions providing temporary soaks after heavy rainfall
- Ephemeral drainage lines off a heath-land plateau into sandstone rocky slopes
- Artificial debris and refuse

4.3.2 Habitat trees

A complete assessment of hollows for hollow dependent threatened fauna species within any proposed development area would typically be required for assessment purposes. This comprehensive survey has not been undertaken to date. However the available size, range and quality of hollows were noted during site visits with no large (30cm+), and limited medium (10-30cm), hollows present. Powerful Owls utilise large tree hollows for nesting and Rosenberg's Goanna may occasionally utilise terrestrial / fallen hollows for shelter.

Generally, eucalypt tree species present within the proposed development area are of a low, stunted or mallee type growth nature. This means that they have multiple growth stems from a base root. Some small hollows providing quality refuge were noted within vegetation communities C and D with two (2) trees found to be utilised by Eastern Pygmy Possum.

4.3.3 Local fauna matters

The Warringah Council website was reviewed for a list of non-threatened fauna species of local significance. The rare and endangered animals page only provides links to lists of threatened species of concern. Therefore, no locally or regionally significant fauna species have been identified.

4.3.4 State legislative fauna matters

(a) Threatened species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (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. Strictly estuarine and oceanic threatened species found within 10km have not been included as no marine / aquatic habitats occur 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. Nine (9) threatened fauna species have been recorded to date with potential for others to occur as indicated below. Such potential is also based on the presence of nearby recent records in similar habitat.

Table 4.3 – State listed threatened fauna species with suitable habitat present

COMMON NAME	TSC Act	Potential to occur
Giant Burrowing Frog	V	recorded
Red-crowned Toadlet	V	recorded
Rosenberg's Goanna	V	recorded
Little Lorikeet	V	recorded
Powerful Owl	V	recorded
Grey-headed Flying-fox	V	recorded
Little Bentwing-bat	V	recorded
Eastern Bentwing-bat	V	recorded
Eastern Pygmy Possum	V	recorded
Swift Parrot	E	possible
Barking Owl	V	possible
Spotted-tailed Quoll	V	possible
Southern Brown Bandicoot	E	possible
Little Eagle	V	low
Glossy Black-Cockatoo	V	low
Varied Sittella	V	low
Scarlet Robin	V	low
East-coast Freetail Bat	V	low
Greater Broad-nosed Bat	V	low
Gang-gang Cockatoo	V	unlikely
Masked Owl	V	unlikely
Koala	V	unlikely
Yellow-bellied Sheath-tail-bat	V	unlikely
Eastern Falsistrelle	V	unlikely

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

Threatened species recorded or with considered potential to occur have been assessed in detail within Appendix 3.

FM Act – No habitats suitable for threatened aquatic species were observed within the subject site and, as such, the provisions of this act do not require any further consideration.

(b) Endangered populations (NSW)

There is no listed endangered fauna population within the Warringah LGA.

There is an endangered Gang-gang Cockatoo population listed in the Hornsby and Ku-ring-gai LGAs and a Koala population is located in the Pittwater LGA. The geographical extent of these populations does not include the study area or suburbs immediately adjacent, therefore, this matter requires no further consideration.

(c) SEPP 44 Koala Habitat Protection

SEPP 44 Koala Habitat Protection applies to land within 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 Warringah 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.

Potential Koala Habitat (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. Core Koala habitat (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 (*Eucalyptus punctata* and *Eucalyptus haemastoma*) listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection, were observed within the proposed development area. These trees comprised of greater than 15% of the total number of trees within the Low Open Forest (Sydney Sandstone Ridge-top Woodland) and Open Forest (Sydney Sandstone Ridge-top Woodland) vegetation communities and therefore are classified under SEPP 44 as PKH.

Step 2 – Is the land CKH?

Despite the presence of PKH, Koala habitation of the Open Forest habitat of the proposed development area is considered unlikely based on existing records. A search of the *Atlas of NSW Wildlife* (OEH 2012) found fifty nine (59) records of Koala habitation within a 10km radius from the proposed development area since 1940. The majority of these records are located within Ku-ring-gai National Park and Berowra Valley and Berowra Valley Regional Park, further north.

Only four (4) Koala records exist in the nearby locality. Three (3) of these records are located on the other side of Forest Way from 1940, 1994 and 1997. The only likely route of passage from these areas to the site is across the northern portion of Forest Way, north of Bundaleer Street. Roadside signage indicating possible Koala passage along this road portion is present, however, there are no Koala records within 3km of this road section. The

only remaining Koala record is located within the connective bushland areas to the site approximately 5km to the south of Davidson in 1940.

Call playback techniques did not evoke a male response and spotlighting did not observe any Koalas present within or surrounding the subject site during surveys to date. No scat searches, however, have been conducted within the Open Forest vegetation communities to date. The proposed development area is not considered to comprise CKH as defined under SEPP 44.

4.3.5 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), and those with potential habitat within the subject site are considered in the 7 part test of significance within Appendix 3.

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 4.4 – Nationally listed threatened fauna species with suitable habitat present

COMMON NAME	EPBC Act	Potential to occur
Giant Burrowing Frog	V	recorded
Grey-headed Flying-fox	V	recorded
Swift Parrot	E	possible
Spotted-tailed Quoll	E	possible
Southern Brown Bandicoot	E	possible
New Holland Mouse	V	possible

Two (2) nationally listed threatened fauna species, Giant Burrowing Frog (*Heliophorus australiacus*) Grey-headed Flying-fox (*Pteropus poliocephalus*), were recorded within the subject site during surveys undertaken. These are also state listed fauna species and a detailed assessment under state legislation (*EPA Act*) is undertaken within the 7 part test of significance (Appendix 3).

The significant impact criteria for vulnerable species listed under the *EPBC Act* (Appendix 4) was reviewed to assess the impacts on these species as a result of the proposed subdivision layout within the subject site. Following site review by specialist Prof Michael Mahony, (see Appendix 6), it is concluded that there will not be any significant impact on The Giant Burrowing Frog as a result of the subdivision proposal.

Further survey is recommended for Southern Brown Bandicoot, and to a lesser extent New Holland Mouse, to ensure that these species are not utilising the subject site as part of important habitat areas. The Southern Brown Bandicoot is listed as endangered under national legislation and, as such, a significant impact may be concluded if there is a real chance or possibility that the proposal will result in any one of the following potentially relevant assessment criteria:

- Lead to a long term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

In the absence of survey effort recommended within the *Draft Referral Guidelines for Southern Brown Bandicoot* (SEWPAC 2011) a referral to SEWPAC will be required. No referral will be required for any remaining threatened fauna species recorded or with potential to occur.

(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 for habitat suitability in Table A2.3 (Appendix 2). Threatened migratory species are assessed for habitat suitability in Table A2.2 (Appendix 2). No nationally protected

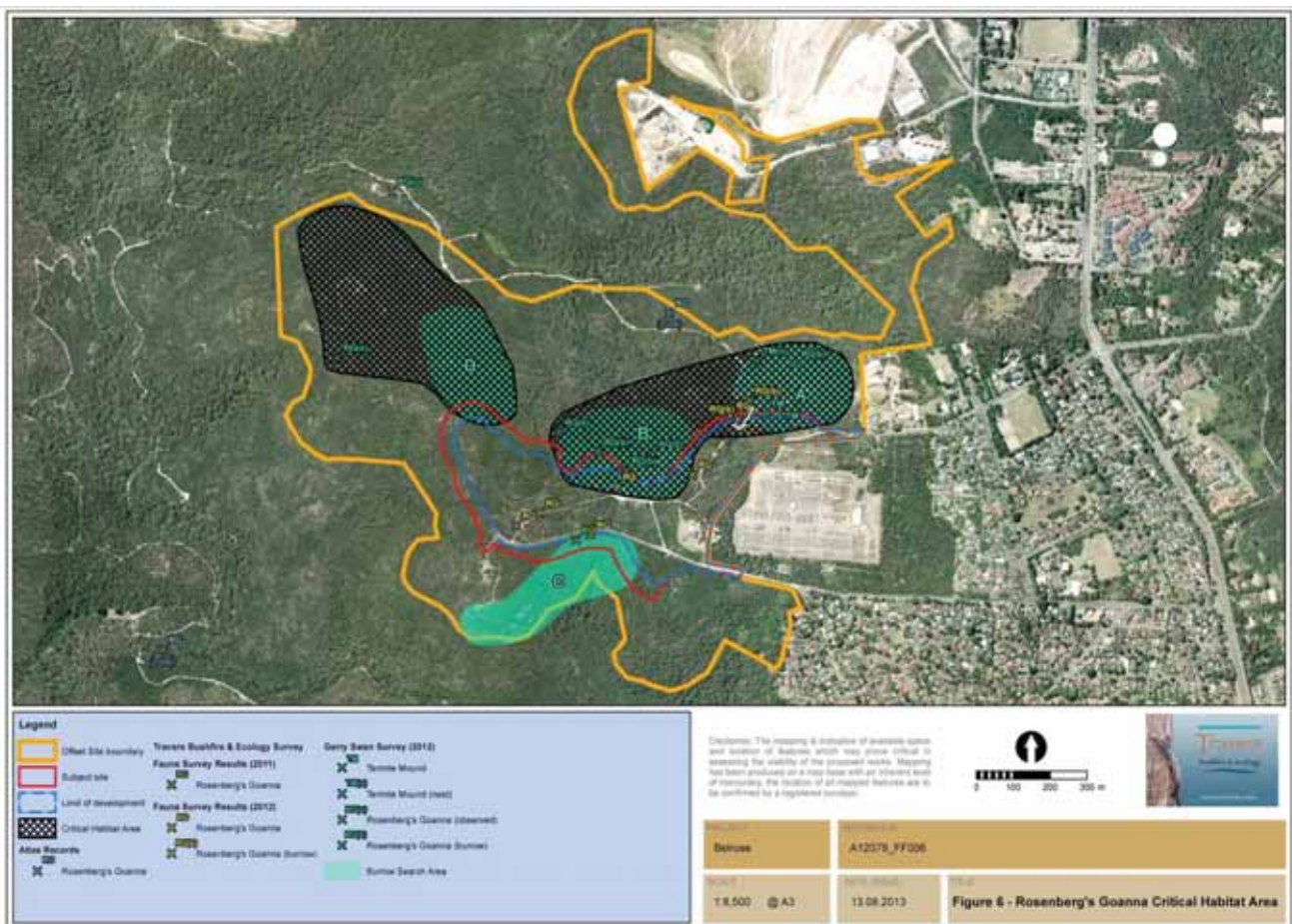


Figure 6 - Rosenberg's Goanna – Important habitat and observations (Gerry Swan)

4.4 Vegetation connectivity

To the north, west and south there is extensive bushland that adjoins Garigal National Park and Middle Harbour Creek catchment (Figure 4). This extensive area of bushland covers no less than 500ha and is fragmented further north only by Mona Vale Road before heading into Ku-ring-gai National Park towards Berowra and north of Terrey Hills. There is additional connectivity to the north east towards Narrabeen Lakes and the Warriewood-Ingleside escarpment, however, this is fragmented by Forest Way.

Both Mona Vale Road and Forest Way are very busy roads that would provide a potential barrier for movement for terrestrial fauna species. However, it is noted that these roads are not fenced in all locations and wildlife is likely to attempt to cross, at risk of being hit by traffic, at night, or at sunrise when traffic is low.

The majority of the directly connective landscape to the site provides open forest, open woodland and heath habitat associated with steeper gully Hawkesbury soils and exposed slopes.

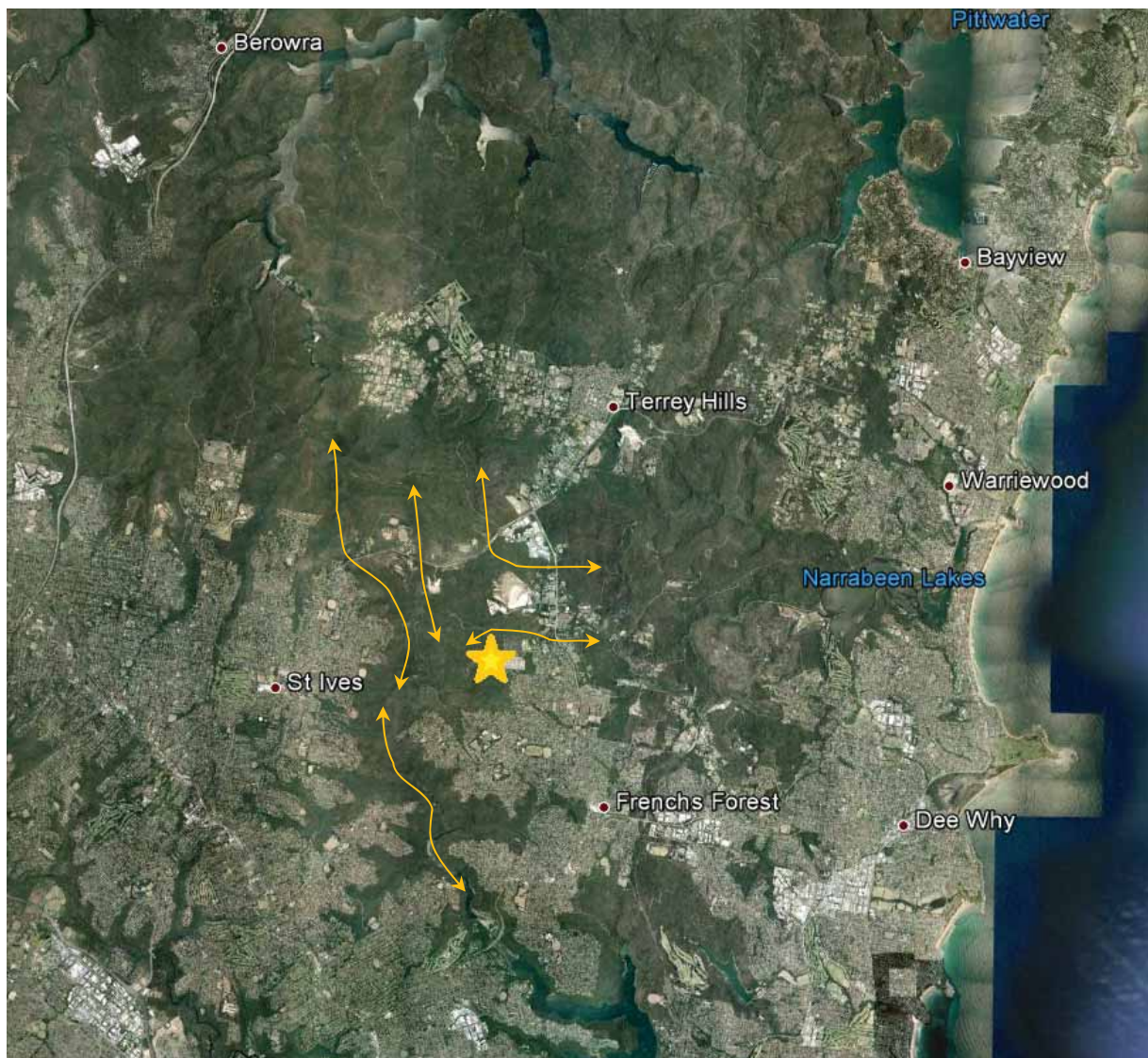


Figure 8 – Vegetation connectivity



Ecological Impacts & Constraints

5

5.1 Recorded threatened species and endangered ecological community

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *TSC Act*;

- Nine (9) threatened fauna species occur, being Giant Burrowing Frog (*Helioporus australiacus*), Red-crowned Toadlet (*Pseudophryne australis*), Rosenberg's Goanna (*Varanus rosenbergii*), Powerful Owl (*Ninox strenua*), Little Lorikeet (*Glossopsitta pusilla*), Eastern Pygmy Possum (*Cercartetus nanus*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Little Bentwing-bat (*Miniopterus australis*) and Eastern Bentwing-bat (*Miniopterus orianae oceanensis*) were recorded during surveys;
- Two (2) threatened flora species were recorded, *Tetratheca glandulosa* and *Grevillea caleyi*; and
- One (1) EEC, Coastal Upland Swamp of the Sydney Basin Bioregion was recorded within the study area.

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

- Two (2) threatened fauna species occur, being Giant Burrowing Frog (*Helioporus australiacus*) and Grey-headed Flying-fox (*Pteropus poliocephalus*);
- No protected migratory bird species were recorded;
- Two (2) threatened flora species occur, being *Tetratheca glandulosa* (listed as vulnerable) and *Grevillea caleyi* (listed as endangered); and
- No EECs listed under this act were recorded within the study area.

In respect of matters relative to the *FM Act* no suitable habitat for threatened marine or aquatic species was observed within the proposed development area and there are no matters requiring further consideration under this Act.

5.2 Ecological Impacts of the proposed planning scheme

The planning proposal results in a potential loss of one hundred and thirty four (134) *Tetratheca glandulosa* plants, and a potential loss of one (1) *Grevillea caleyi* specimen within the areas proposed for residential rezoning, including road corridors. Significant areas of potential *Tetratheca glandulosa* habitat exist within the offset lands and more extensive populations are likely to be present. However, limited *Grevillea caleyi* habitat is present within the proposed development area and either protection or restoration mitigation

measures are recommended for the small population present within the disturbed northern reaches of the total land parcel.

An estimated 80% of both populations of *Eucalyptus luehmanniana* and *Angophora crassifolia* will be conserved. There are an estimated three thousand and sixty-two (3,062) *Eucalyptus luehmanniana* and nine hundred and seventy eight (978) *Angophora crassifolia* being protected within the proposed offset lands.

The planning proposal directly impacts on 0.13ha of the EEC, Coastal Upland Swamp but conserves a larger contiguous area of 1.27ha to the south of Ralston Avenue, plus a further 0.54ha in the northern portion of the land parcel proposed as offset lands. The retention of the 0.13ha patch is not feasible within the current planning scheme and represents a 6.7% loss of this community.

The habitat of the proposed development area is being utilised as foraging habitat for Rosenberg's Goanna (*Varanus rosenbergi*). Peripheral areas of the planning proposal also provide suitable breeding habitat for Red-crowned Toadlet (*Pseudophryne australis*), and suitable burrowing and foraging habitat for Giant Burrowing Frog (*Heleioporus australiacus*). These recorded threatened fauna species were considered as potentially significantly impacted and were therefore subject to further investigation. The Eastern Pygmy Possum was more recently opportunistically observed by Council and subsequently is now known to utilise the site for denning and foraging. The other recorded threatened species are not considered to be site dependent and will not be adversely affected by the proposed planning scheme.

Based on the advice of Mr Gerry Swan, the Rosenberg's Goanna population is expected not to be significantly impacted and a viable population can be maintained in the presence of the proposed development. The nearest most likely breeding areas for Rosenberg's Goanna are in the north and north east portion of the study area as confirmed by Mr Gerry Swan, inclusive of lands north of the substation site. Other areas also exist to the southern, south western, eastern, and north eastern aspects of the proposed residential areas.

Based on the survey outcomes by Prof Michael Mahony, no nearby breeding habitat has been identified within 350m of the proposed development precinct for the recorded Giant Burrowing Frog. Prof Mahony indicates that it is most unlikely that habitats on the plateau are used routinely for shelter or foraging and indirect impacts on hydrology are unlikely to impact on breeding habitat. Prof Mahony has concluded that based on separation distance from the recorded breeding location and availability of suitable habitat within the proposed offset lands that this species will not likely be significantly impacted.

Red-crowned Toadlet on the other hand has been recorded at several locations surrounding the subject site in the majority where suitable ephemeral breeding areas exist. Four (4) recorded locations were within the proposed development area and will be directly impacted along with surrounding shelter and foraging locations. Prof Mahony concluded that the majority of the recorded breeding sites will not be directly impacted by the proposal and movement will mostly be within the escarpment and mid-slope areas. The potential for impact on the population of the Red-crowned Toadlet is assessed to be related mostly to indirect impacts on the hydrology of the breeding habitat (rate, volume, and water quality of discharge). Prof Mahony states that specific mitigation measures are required to ensure that the hydrology of these sites is not altered by the proposal.

The Eastern Pygmy Possum was observed within a low hollow in a Scribbly Gum within the western portions of the subject site by Council's ecologist during a site inspection in 2013. Habitat for this species is considered suitable at this location, given the high density of *Banksia ericifolia* which occurs at highest densities at the outer plateau areas and along the

escarpment areas, particularly towards the north where Lambert soils types continue in lower contours extending well into the proposed offset areas. This observation and the presence of young as well as a second hollow containing nesting material located during site investigations with Dr Ross Goldingay, confirms the use of the subject site for denning and breeding. The proposal will therefore impact on denning, breeding and foraging habitat.

The extent of site utilisation has not been determined in survey, particularly in the absence of the most current survey methods using nest boxes, however, this is not considered necessary as the species is present on site (see Dr Goldingay's report - Appendix 7). Most local records are located on the other side of Forest Way which potentially represents a separate population, however, one (1) 2003 record existed 700m to the west.

The use of the site and the offset areas by Eastern Pygmy Possum is predicted based on the presence of *Banksia ericifolia*, presence of other associated *Banksia sp.* and *Eucalypt sp.* and particularly locations where hollows are available. Such habitat, particularly the availability of hollows is less suitable across the upper central plateau areas as well as off the edge of steeper escarpments to the south. Habitat for this species however continues beyond the lower plateau areas and well into the proposed offset areas to the north and as such these areas are expected to be similarly utilised by the Eastern Pygmy Possum.

Dr Ross Goldingay was engaged to provide a habitat assessment for the Eastern Pygmy Possum. In the areas inspected within the offset lands by Dr Goldingay, hollows were found less frequently. Dr Goldingay identified the following considerations:

- Foraging habitat for the Eastern Pygmy Possum appears to encompass almost all vegetation communities in the study area. Tall heathland with higher densities of various banksia species will be most influential and is likely to drive breeding in the local population.
- The brief field examination suggests that scribbly gums within the low open forest may be the primary source of tree hollows to be used for breeding.
- That important areas of foraging habitat and breeding habitat will therefore be affected by the proposed development.
- There is no current data to indicate that there are sufficient hollows for breeding in the offset areas (subject to target survey for hollow resources).
- There are potential indirect impacts of the proposal, particularly the impact of increased domestic cat predation adjacent to habitat areas.

Significant areas of potential breeding and important habitat are available within the proposed offset lands for Rosenberg's Goanna, Giant Burrowing Frog and the Red-crowned Toadlet and Eastern Pygmy Possum. All of the frog species recorded during surveys are indirectly impacted by stormwater drainage and hence the integrated management of stormwater will be important, particularly in maintaining viable threatened species populations.

5.3 Ecological constraints

The ecological constraints are a combination of the insitu EEC, Coastal Upland Swamp, and threatened species constraints. The flora and fauna survey results to date indicate that the threatened flora populations, whilst present on site, are not likely to form a significant constraint to development and are subject to additional target survey for *Tetratheca glandulosa* and *Grevillea caleyi* within the adjoining offset lands and surrounding landscape.

The site and surrounding landscape provide important habitat for rare threatened flora species including insitu populations of *Eucalyptus luehmanniana* and *Angophora crassifolia*.

5.3.1 Flora constraints

Vegetation community survey has been undertaken throughout the total land parcel owned by MLALC (including the offset lands), whilst target threatened flora searches have been undertaken within the proposed residential areas and the immediate surrounding landscape.

Target flora survey has not been undertaken in the entire offset lands, except for the purposes of identifying the presence or absence of threatened flora species. Therefore individual records as mapped are not considered to be the full extent of the threatened or rare plant populations within the offset lands.

The MLALC land parcel and associated road corridors provide known habitat for the following threatened flora species and an EEC:

- *Tetradlea glandulosa* (one hundred and forty nine (149) plants mostly within proposed residential zone)
- *Grevillea caleyi* (eight (8) plants within proposed residential zone, one (1) specimen to be impacted)
- EEC, Coastal Upland Swamp (1.94ha)

The land parcel (study area) also contains two (2) populations of the following rare ROTAP listed threatened species:

- *Eucalyptus luehmanniana* (estimated three thousand and sixty two (3,062) plants within study area including offset lands)
- *Angophora crassifolia* (estimated nine hundred and seventy eight (978) plants within study area including offset lands)

The EEC, Coastal Upland Swamp occurs in several patches covering a total of 1.8ha. All of the Coastal Upland Swamp will be retained as part of the proposed planning scheme. Based on the floristic survey results, the EEC, Coastal Upland Swamp of the Sydney Basin Bioregion provides a vegetation constraint to development of the land. Coastal Upland Swamp occurs on the southern aspect of Ralston Avenue and in the northern portion of the land parcel. The Coastal Upland Swamp is also a protected groundwater dependent ecosystem under the NSW Groundwater Dependent Ecosystem Policy.

Ralston Avenue, which currently extends through to the south western boundary, provides a physical barrier for the existing Coastal Upland Swamp. The planning proposal provides a natural vegetation buffer of 30m to the north west of the largest patch of Coastal Upland Swamp. An APZ provides additional separation.

Following surveys in May 2008 and December 2011, target survey for potential threatened flora species was undertaken in October (spring) 2012, in particular for *Pimelea curviflora* var. *curviflora* which has not been detected within the proposed residential zone to date. *Tetradlea glandulosa* and *Grevillea caleyi* were also resurveyed in October 2012 to ascertain their full coverage across the development area.

Based upon the floristic survey, the current potential botanical constraints are;

- *Tetradlea glandulosa* and *Grevillea caleyi*, threatened plant species under both the TSC Act and EPBC Act
- EEC, Coastal Upland Swamp

- *Angophora crassifolia*, a rare (ROTAP) species found within the taller vegetation stratas and occasionally in Tall Heath / Damp Tall Heath
- *Eucalyptus luehmanniana*, a rare (ROTAP) species has been observed, usually within Tall Heath or Low Open Forest in close proximity to Ralston Avenue, mostly on the southern side of the road on south west to south east facing slopes

Based on the vegetation community mapping, the Low Open Forest and Open Forest communities appear to provide the best potential threatened flora habitat. However, the recorded number and densities of threatened species are low.

The offset lands provide extensive areas of habitat for these species, as demonstrated by target survey for *Eucalyptus luehmanniana* and *Angophora crassifolia*. The offset lands are also expected to provide habitat for *Tetratheca glandulosa* and *Pimelea curviflora* var. *curviflora* and *Grevillea caleyi*.

Given the estimated large numbers of *Eucalyptus luehmanniana* and *Angophora crassifolia* in the offset lands, approximately 80% of the estimated *Eucalyptus luehmanniana* population (three thousand and sixty two (3,062) records) and 80% *Angophora crassifolia* of the population (nine hundred and seventy eight (978) records) will be retained.

Due to the lack of target survey for *Tetratheca glandulosa* within the offset lands, the total loss of the population cannot currently be estimated. Significant areas of habitat are present within the offset lands, therefore, it is expected that the loss of these plants within the proposed development area is not likely to lead to significant impact.

A very small population of *Grevillea caleyi* (eight (8) plants) are potentially directly affected by road works and the development area. There is further suitable habitat within adjoining lands to the east of the proposed residential area surrounding the electricity substation and Open Forest communities within the proposed offset lands. Based on the proposed plans, on site protective measures can potentially be implemented to protect seven (7) of the existing small population within and adjoining the road corridor. It is also likely that this species can be propagated and restored to an appropriate protected location.

5.3.2 Fauna constraints

Nine (9) threatened fauna species have been recorded within, or in close proximity to, the development area during surveys to date. The recorded species include:

- Powerful Owl (*Ninox strenua*),
- Eastern Pygmy Possum (*Cercartetus nanus*),
- Grey-headed Flying-fox (*Pteropus poliocephalus*),
- Eastern Bentwing-bat (*Miniopterus orianae oceanensis*),
- Little Bentwing-bat (*Miniopterus australis*),
- Little Lorikeet (*Glossopsitta pusilla*),
- Rosenberg's Goanna (*Varanus rosenbergi*),
- Red-crowned Toadlet (*Pseudophryne australis*), and
- Giant Burrowing Frog (*Heleioporus australiacus*).

Of these species, the Eastern Pygmy Possum, Rosenberg's Goanna, Red-crowned Toadlet and Giant Burrowing Frog were considered to offer potential constraints to development and thus required specialist review.

It is considered that the development area also has potential for the following additional threatened fauna species to occur which have not been recorded within the proposed development area:

- Southern Brown Bandicoot (*Isoodon obesulus*),
- Spotted-tailed Quoll (*Dasyurus maculatus*), and
- New Holland Mouse (*Pseudomys novaehollandiae*)

The Southern Brown Bandicoot and New Holland Mouse are known to recolonise areas of burnt heath during regrowth stages and, therefore, the site offers available habitat that may be colonised by these species at such a future stage. The Spotted-tailed Quoll has large home ranges and would not occupy the study areas exclusively.

Fauna surveys to date have revealed that the proposed residential area is utilised by Rosenberg's Goanna for foraging purposes, however, locations of burrows within the proposed area have not been fully located. No terrestrial termite mounds suitable for nesting have been observed to date within the proposed development area, but proposed burns may provide better access for further investigation. We expect to find potential termite mounds in the more wooded areas below the escarpment edge. Further investigation on this species by specialist Gerry Swan determined that the planning scheme is not considered a likely significant impact based on the habitat utilisation and surrounding known habitat of this species.

Mr Swan, a recognised reptile specialist, located a termite mound with a juvenile exit point and several more burrows. The termite nest and observed burrows are located outside of the proposed development area. Mr Swan has concluded that the proposed development site is not critical to the survival of the population, that there is adequate habitat surrounding the proposed residential development site to maintain a viable population, and the proposed residential development is not likely to result in a significant movement of connectivity restriction to the local population. Mr Swan also states that the proposed development is not likely to have a significant impact on the Rosenberg's Goanna population. Mr Swan has identified a critical habitat area for this species which may require further investigation to refine the extent to which development can encroach to the northern aspect of the site.

Recognised frog specialist, Prof Michael Mahony, with field assistance by TBE, undertook targeted surveys for Red-crowned Toadlet and Giant Burrowing Frog (GBF). A GBF breeding location was recorded within the far northern fringe of the offset area, over 300m from the north western tip of the proposed development. Prof Mahony concluded that:

- The density of GBF at the site is low, and that it is most unlikely that habitats on the plateau are used routinely for shelter and foraging. Furthermore, it is not likely that development will break a corridor that connects breeding habitat with foraging and shelter sites since there are no identified breeding sites close to the plateau.
- The considerable distance of the identified breeding habitat from the plateau and the relatively large area of surrounding habitat indicate that indirect impacts on hydrology are unlikely to impact on the GBF breeding habitat.
- It is not likely that the proposal will impact on the local viable population of the GBF.
- There is no need for the placement of buffer zones around habitat on the escarpment since there is no identified breeding, sheltering or foraging habitat.

Following additional site surveys for Red-crowned Toadlet in 2013, Prof Mahony concluded that:

- Additional breeding habitats of the Red-crowned Toadlet were detected and twelve (12) breeding locations were identified within the study area outside the subject site. It is concluded that the local population occurs along most of the semi-permanent drainages and soaks that occur near the escarpment and down slope from the plateau. None of these breeding locations will be directly impacted by the proposed development. There are four (4) identified breeding locations within the subject site; one (1) on the western end of the plateau (human made pit), two (2) on the rock face seepage in the north east, and one (1) at the head of the drainage line to the south.
- Movement of the Red-crowned Toadlet will mostly be in the escarpment and mid-slope areas and development of the plateau will not have a significant effect on the local population due to the removal of habitat or the breaking of corridors.
- The potential for impact on the population of the Red-crowned Toadlet is assessed to be related mostly to indirect impacts on the hydrology of the breeding habitat (rate, volume, and water quality of discharge). Specific mitigation measures are required to ensure that the hydrology of these sites is not altered by the proposal.
- Protection of the considerable area of Red-crowned Toadlet habitat below the escarpment and at mid-slope should protect the local viable population.

Following surveys and engagement of specialists for species of concern, the Eastern Pygmy Possum was recorded opportunistically during a site inspection by Council. Dr Ross Goldingay was engaged to undertake a site inspection and habitat assessment for this species. During field inspection, a second hollow showing evidence of nesting material was found within the subject site (see Figure 4). The subject site subsequently provides recorded denning, breeding and foraging habitat for the Eastern Pygmy Possum. Key constraints identified by Dr Goldingay included:

- The tall heathland with higher densities of various banksia species will be most influential and is likely to drive breeding in the local population.
- Many scribbly gums (*E. haemastoma*) within the low open forest of the proposed development area contained small hollows; however relatively few of the trees that were inspected within the offset areas contained hollows.
- Important areas of foraging habitat and breeding habitat will be affected by the proposed development.
- Impacts on the Eastern Pygmy Possum from the proposed residential development could be direct and indirect. The loss of habitat from clearing for the residential development would have a direct impact. The most serious indirect impact from the development would be if residents in the area keep house cats. This indirect impact of the development could be removed by proposing that cat ownership be disallowed in the residential development.
- Foraging habitat for the Eastern Pygmy Possum appears to encompass almost all vegetation communities in the study area (proposed residential area, APZ and offset lands) with the exception of the modified community (Community E) and possibly the riparian woodland-forest (not examined). The most important community would be the Tall Heath (Community B) due to the high density of *B. ericifolia*.
- Brief examination of the area bounded by the proposed residential area and APZ suggest that scribbly gums within the low open forest may be the primary source of tree hollows to be used for breeding.

Dr Goldingay concluded in particular that further surveys are required to determine the adequacy of the offset as providing sufficient breeding habitat.

Therefore, of the recorded fauna species to date, the Red-crowned Toadlet (*Pseudophryne australis*) and Eastern Pygmy Possum (*Cercartetus nanus*) have been found to offer a

constraint to development due to the recorded presence of breeding locations within and the nearby surrounds to the proposed residential area.



Biodiversity Offsets

6

6.1 Background

Biometric vegetation survey within the proposed offset area has been undertaken to confirm the vegetation communities present (Figure 3). The biometric survey of vegetation communities has been used to provide a preliminary analysis as to whether the offset lands are likely to meet typically acceptable offset targets.

It is important to note that for approval purposes of a potential site for biodiversity offsets, OEH typically requires the sites to be assessed using a maintain or improve test such as under the bio certification assessment methodology or the biobanking assessment method as used for biobanking applications.

A basic component of any offset analysis is the calculation of losses and gains (typically in hectares) of each vegetation community which identifies the offset ratios for each vegetation community. This process by itself does not adequately assess the conservation value of the landscape due to the need to take into account the typical lifecycle and habitat requirements of known and potential threatened species in the locality. Factors such as the size of the impacted remnants, the amount of habitat loss and the degree of connectivity to surrounding habitat areas also affect the conservation and offset value of lands. The maintain or improve test and the biobanking method, predicts the conservation values based on a comprehensive data set of species records and habitat requirements which are too complex to consider simply as a loss and gain of vegetation communities.

However, the loss and gain of each vegetation community enables the determination of the available offset ratios of each community which may be used to support an application for development and the provision of an offset in accordance with the OEH *Principles for the use of Biodiversity Offsets in NSW* (OEH 2010). The adequacy of the offsets will need to be determined through the use of the maintain or improve test for *TSC Act* listed matters and the offset calculator as provided by SEWPAC for *EPBC Act* listed matters.

Notwithstanding the principles of use for biodiversity offsets in NSW (OEH 2012) the key objectives of a biodiversity offset strategy for a proposed development include:

- to achieve a maintain or improve outcome of total native vegetation cover including protection and restoration offsets,
- to secure sites with suitable habitats to compensate for the loss of onsite habitats and which contain suitable habitat for the threatened flora and fauna species previously observed within the development area, and
- to enable long-term management of conserved bushland areas in accordance with an approved vegetation management plan or equivalent.

A maintain or improve test is determined on the basis of acceptable methodologies that estimate the expected loss and gain in flora and fauna habitat and is a calculation process that provides offset ratios. Any offset ratio of 3:1 or greater is generally considered to meet

minimum offset ratios, however, typical ratios of 5:1 or greater are more acceptable subject to the presence or absence of threatened species and EECs.

6.2 Offset security

A key principle of the offsetting guidelines is to provide security in perpetuity for the offset outcomes. As such, the offset areas can be protected in a number of ways including:

- Rezoned as E2 (environmental protection) usually in combination with a voluntary conservation agreement (VCA),
- Protection and management as public reserve under the *Local Government Act*
- Protected under a conservation covenant or equivalent
- Transferred into national park estate
- Established as a biobanking site

The method of protection is to be resolved in consultation with OEH. Please note that an environmental zoning without another form of legislative protection such as a VCA is not considered to be adequate security.

The type of security provided must also consider the ability to effectively manage the proposed offset lands for biodiversity conservation purposes and whether the offset lands remain under private or public ownership. It is current policy that if the offset lands are to remain in private ownership then either the site is offered as a biobanking site or a VCA is established.

Section 6.2 identifies the principles that must be met in order to provide a viable offset site.

6.3 Principles for use of biodiversity offsets in NSW

The following principles have been defined by OEH for the use of biodiversity offsets in NSW. The proposed offset sites are considered in the context of these principles.

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

The proposal must demonstrate avoidance of impact using prevention and mitigation measures. Subject to the assessment process, the development concept should be able to demonstrate avoidance of significant impacts.

2. *All regulatory requirements must be met*

All other existing legislative requirements must be met. This principle will be addressed as part of the gateway determination of the planning proposal and subsequent development applications.

3. *Offsets must never reward ongoing poor performance*

The proponents must demonstrate satisfactory performance in managing, protecting and maintaining the conservation values of the landscape subject to the approved development application. Current and ongoing land management practices demonstrate that the land is currently being managed in an appropriate manner but will require resources in the future to maintain the lands for biodiversity conservation purposes.

4. *Offsets will complement other government programs*

In this case, the offset lands have significant strategic conservation value, being located adjoining Garigal National Park.

5. *Offsets must be underpinned by sound ecological principles*

The ecological survey, biodiversity offset analysis and subsequent assessment process is intended to flesh out the ecological implications of the proposed development and the offset arrangements. Consultation with OEH, Warringah Council and SEWPAC are critical to this process to ensure that the offsets are ecologically sound.

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

The provision of the offset site is a major part of the process of seeking a net improvement in biodiversity but its protection and future management must be based on best practice conservation management practices. Future monitoring of the offset site must demonstrate a net improvement in biodiversity values as a result of land management practices including target weed control, revegetation or regeneration works and / or changes in land practices such as ecological or hazard reduction burns.

7. *Offsets must be enduring – they must offset the impact of the development for the period that the impact occurs*

The offset site must clearly demonstrate that it adequately offsets the impact of the development throughout the entire development process.

8. *Offsets should be agreed to prior to the impact occurring*

The offsets are required to be approved by the Director General prior to commencement of any actions related to current development applications.

9. *Offsets must be quantifiable – the impacts and benefits must be reliably estimated*

The offset analysis needs to determine the following parameters:

- The area of Impact,
- The types of ecological communities affected,
- The condition of habitat,
- The conservation status and / or scarcity / rarity of ecological communities,
- The Level of security afforded to the site.

These are key issues to resolve as part of the assessment process in consultation with OEH.

10. *Offsets must be targeted*

The offsets must demonstrate that they target the biodiversity values impacted by the proposed development. Where it does not offset specific ecological impacts, either alternative offsets may need to be provided such as through restoration on other lands.

11. Offsets must be located appropriately

The offset sites must be large enough to be of conservation value and must also be located to support other conservation areas or ecological corridors. Access must also be available for management purposes.

12. Offsets must be supplementary

The proposed offset areas are not to be under any other conservation agreement and must not be offered as biodiversity offset under any other scheme.

13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conserving agreements or a contract

The proposed offset must be enforceable through the development consent. Considerations to the transfer of ownership of the land to a public authority, provision of long term funding for the management of the offset site and / or entering into a VCA are important matters to be resolved.

6.4 Vegetation offsets

The following sections provide a summary of the offset outcomes that can potentially be achieved by the planning proposal.

6.4.1 Offset calculations

The offset calculations provided below are a qualitative assessment of the offset areas being provided and whether they meet typically acceptable offset ranges. These results should not be used to identify whether the offsets are adequate to achieve a *maintain or improve* outcome. This is more appropriately assessed using the bio certification or biobanking assessment methods.

Floristic quadrat sampling (using the biometric field assessment method) has been undertaken within the existing vegetation communities to provide a baseline data set upon which offset analysis is undertaken. Floristic quadrats undertaken on site are directly comparable to the Catchment Management Authority (CMA) benchmark figures and have enabled the vegetation mapping to be more accurately defined within the study area.

Tables 6.1 - 6.3 provide qualitative results based on the vegetation survey to date. Please note that the impact of all works including the clearance of vegetation within existing road corridors has been estimated within the following tables.

Table 6.1 - Vegetation offset outcomes

Veg code	Vegetation community	Vegetation within offset lands (ha) (Note 5)	Vegetation within APZ (ha)	Vegetation within development area (ha)	Total vegetation loss (ha)	Total vegetation in study area (ha)	Protection offset ratios	Potential restoration offsets (ha)	Combined restoration & protection offset ratios
A	Short Heath (to 2.5m tall)	2.21	0.05	2.24	2.29	4.5	0.97:1	Nil	0.97:1
B	Tall Heath (2.5 - 5m tall)	18.13	1.97	4.95	6.92	25.05	2.62:1	Nil	2.62:1
B2	Damp Tall Heath	2.65	0.01	0.44	0.45	3.10	5.89:1	Nil	5.89:1
C	Low Open Forest (to 10m tall)	38.71	2.66	5.74	8.40	47.11	4.61:1	2.83	4.95:1
D	Open Forest (10+m tall)	27.55	0.26	3.56	3.82	31.37	7.21:1	Nil	7.21:1
E	Cleared, Managed, Landscaped or Weed Plume	5.48	0.26	2.85	3.11	8.59	N/A	Nil	N/A
F	Coastal Upland Swamp	1.81	0.05	0.08	0.13	1.94	13.9:1	Nil	13.9:1
G	Sandstone Gully Forest	17.33	0.26	0	0.26	17.59	66.6:1	Nil	66.6:1
H	Riparian Woodland / Forest	0.34	0	0	0	0.34	Nil Loss	0.47	gain (0.47 ha)
Total		114.21	5.52	19.86	25.38	139.59	4.78:1	3.30	4.93:1

Table 6.2 - Estimated loss and gain of rare or threatened flora populations in study area

Species code	Threatened flora	Estimated population in offset lands	Recorded population in APZ	Recorded population in residential zone	Estimated total population loss	Estimated total population in study area	Estimated % loss of population	Significance of loss
El	<i>Eucalyptus leuhmanniana</i>	3,062	713	21	734	3,796	19 %	Not significant
Dc	<i>Grevillea caleyi</i>	45	0	8 (7 protected)	1	46	2%	Not significant
Tg	<i>Tetradlea glandulosa</i>	13	0	136	136	149	91 %	Potentially significant - subject to seasonal target survey in offset lands
Ac	<i>Angophora crassifolia</i>	978	38	192	230	1,208	19 %	
Total		4,098	751	349	1,101	5,199		

Table 6.3 - Potential rare or threatened flora habitat offset outcomes

Species code	Threatened flora	Potential habitat within offset lands (ha) (Note 5)	Potential habitat within APZ (ha)	Habitat within development area (ha)	Total habitat loss (ha)	Total habitat in study area (ha)	% Loss of habitat	Protection offset ratios	Potential restoration offsets (ha)	Combined restoration & protection offset ratios
El	<i>Eucalyptus luehmanniana</i> (Note 1)	6.61	1.36	0.54	1.90	8.51	22%	3.48:1	0.00	3.48:1
Gc	<i>Grevillea caleyi</i> (Note 2)	9.19	0.6	4.53	5.13	14.32	36%	1.79:1	2.83	2.34:1
Tg	<i>Tetradlea glandulosa</i> (Note 3 & 5)	68.91	3.04	9.61	12.65	81.56	16%	4.42:1	2.83	4.65:1
Ac	<i>Angophora crassifolia</i> (Note 4)	68.91	3.33	10.08	13.41	83.96	16%	5.26:1	0.47	5.30:1

Note 1 – Potential habitat for *Eucalyptus luehmanniana* consists of selected lands on the south and south west aspects

Note 2 – Potential habitat for *Grevillea caleyi* consists of Low Open Forest areas and Open Forest vegetation within study area on Somersby derived soils (laterites)

Note 3 – Potential habitat for *Tetradlea glandulosa* consists of all Low Open Forest and Open Forest vegetation within study area

Note 4 – Potential habitat for *Angophora crassifolia* consists of all Damp Tall Heath, Low Open Forest and Open Forest vegetation

Note 5 – Habitat areas based on known occurrences, target survey for *Tetradlea glandulosa* has not been comprehensively completed for the offset areas (out of season survey has been undertaken), all population and habitat estimates may change subject to completion of target flora survey within the offset lands.

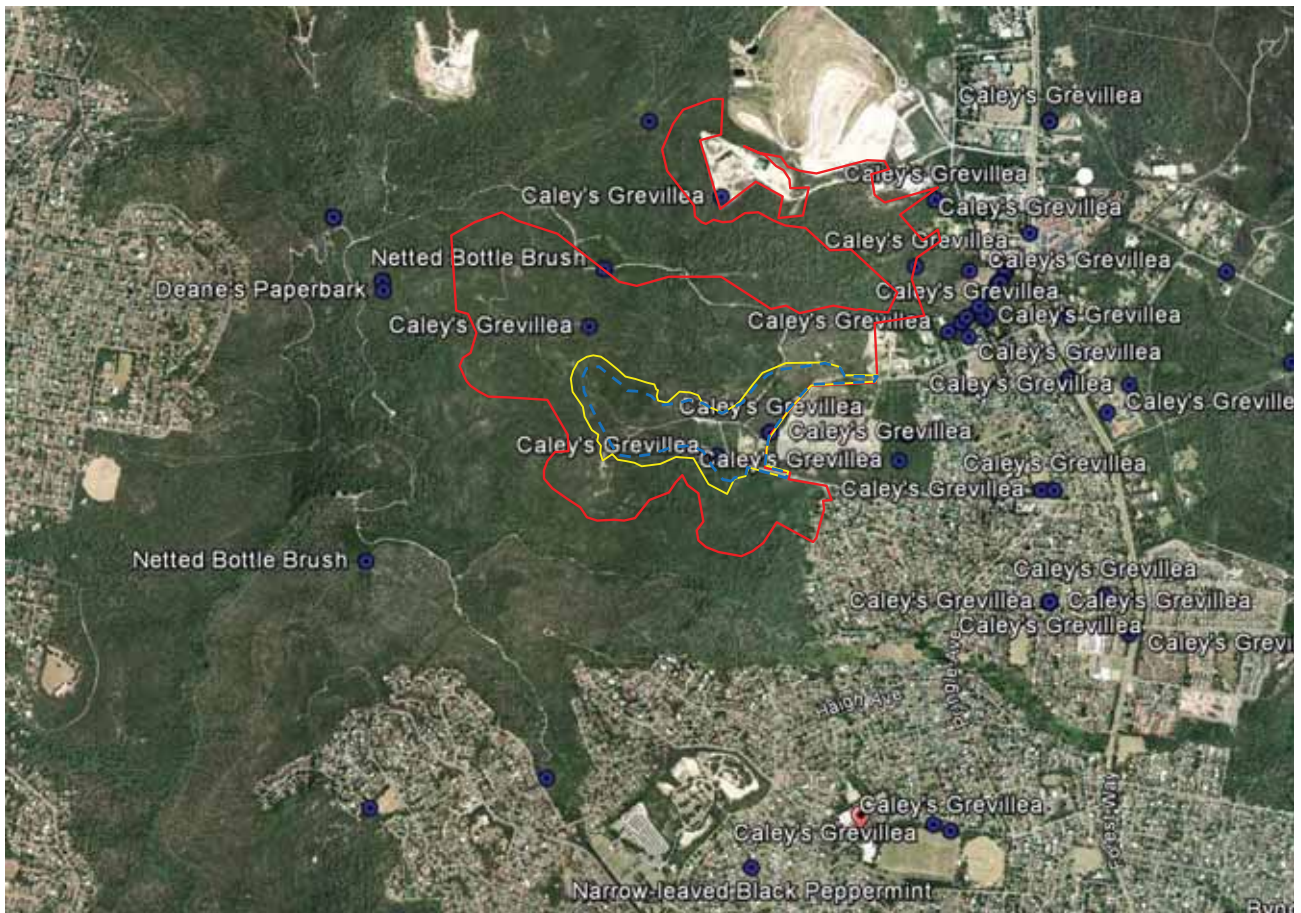


Figure 9 – Threatened flora records within and adjoining the offset area



Figure 10 – Threatened fauna records within and adjoining the offset area

6.4.2 Concluding offset comments

The offset ratios provided by the proposed conservation area are within typically acceptable ranges for all vegetation communities, with the exception of Short Heath (offset ratio of 0.97:1) and, to a lesser extent, Damp Tall Heath (offset ratio of 2.62:1). In some cases, offset ratios of less than 3:1 are acceptable provided it is supported by a biobanking assessment or bio certification, maintain or improve test. The proposed conservation area provides a favourable offset for the recorded EEC, Coastal Upland Swamp. The offset ratios for Short Heath and Tall Heath are low or marginal and may potentially require an offset external to the site.

The available offsets of suitable habitat for the recorded rare and threatened flora including *Angophora crassifolia*, *Eucalyptus luehmanniana*, and *Tetratheca glandulosa* are also within typically acceptable offset ranges (Table 6.3). *Grevillea caleyi* has a marginal offset ratio of 2.83:1 including the potential restoration areas.

Despite the loss of the current recorded population of *Grevillea caleyi*, Tables 6.1-6.3 indicate favourable offset outcomes for *Grevillea caleyi* based on the recorded habitat areas and potential habitat areas within the offset area.

Based on the combined soil landscape and vegetation distributions, the habitat for *Grevillea caleyi* is not limited to the site. Based on the distribution of Open Forest vegetation (Figure 9), existing records, laterite soils and the presence of *Eucalyptus sieberi*, there are further areas of potential habitat within the offset lands and to the east of the site in the substation lands.

Mitigation measures such as protection of the existing plants insitu by modification of the proposed Wyatt Avenue extension, or provision of an on site or off site restoration offset, are approaches to addressing the loss of this species. However, subject to the completion of target *Grevillea caleyi* survey in September-October, the total habitat areas and total population size can be more accurately determined.

Although not assessed in the above tables, the offset lands also provide potential offsets for Red-crowned Toadlet, Southern Brown Bandicoot, Eastern Pygmy Possum, New Holland Mouse, Spotted-tail Quoll, Little Lorikeet, Little Bentwing-bat, Giant Burrowing Frog, Eastern Bentwing-bat, Grey-headed Flying-fox, Powerful Owl and Rosenberg's Goanna.

For those recorded site dependent threatened species, it is important to identify possible foraging and breeding areas within the local landscape as a means of identifying whether the proposal directly impacts on critical habitat areas for the recorded threatened fauna species.

The potential offset value of the proposed conservation area needs to be assessed for threatened fauna species and investigation are required to establish whether sufficient land to maintain viable populations is available (Figure 10). The offset area provides significant habitat for Red-crowned Toadlet which is also likely to give a favourable offset outcome. The habitat for Giant Burrowing Frog within the study area has not been defined as yet and is subject to further investigation.

The proposed offset lands provide a significant contribution to securely conserved areas and provide benefit to Garigal National Park as existing extended habitat. It is current OEH advice that the method of calculation of offsets and their adequacy should not be based on the loss and gain of vegetation communities only, as habitat preferences for threatened flora and fauna species do not correlate to floristic assemblage alone but are also dependent on the habitat attributes. In addition, it is important that the offset calculation process should be transparent and comparable to other sites. Accordingly, a specific offset analysis using the

biobanking assessment method or the biodiversity certification assessment method is recommended to determine the *adequacy* of the proposed lands for biodiversity offsetting purposes.



Conclusions & Recommendations

7

7.1 Conclusions

The document forms the basis of assessment required under Section 5A of the *EPA Act* and matters of national significance under the *EPBC Act*. These assessments determine if the proposed residential development of the site is likely to have a significant effect on threatened species, populations and / or EECs.

Survey to date has indicated that in particular for threatened flora species, there are likely to be adequate populations conserved within the proposed offset lands and adjoining landscapes to not result in a significant impact. Target survey for *Tetratheca glandulosa* is recommended to confirm this conclusion. The impacts on the recorded EEC, Coastal Upland Swamp is low and only impacts on small areas resulting in 93% conservation of this EEC.

With regard to threatened fauna species, the Eastern Pygmy Possum may offer additional constraints to the proposal and in this case will require further survey and specialist advice.

Of the recorded fauna species to date, the Red-crowned Toadlet (*Pseudophryne australis*) has been found to offer a constraint to development due to the recorded presence of breeding locations within and the nearby surrounds of the proposed residential area. The development design should minimise impacts on breeding locations and ensure that adverse indirect impacts on the hydrology of the surrounding breeding habitat areas are avoided.

The proposed offset areas provide a major contribution to the adjoining national park estate and appear to provide typically acceptable offsets based on the loss and gain of vegetation communities. Adequacy of the offsets will need to be determined through the application of the biodiversity certification assessment methodology or the biobanking assessment methodology. Development redesign and additional offsets, including restoration of habitat, may be required to adequately offset the loss of threatened flora and fauna habitat.

EPA Act and TSC Act

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *TSC Act*.

- Nine (9) threatened fauna species have been recorded within and immediately surrounding the proposed development area. Giant Burrowing Frog (*Heliophorus australiacus*), Red-crowned Toadlet (*Pseudophryne australis*), Rosenberg's Goanna (*Varanus rosenbergii*), Powerful Owl (*Ninox strenua*), Little Lorikeet (*Glossopsitta pusilla*), Eastern Pygmy Possum (*Cercartetus nanus*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Little Bentwing-bat (*Miniopterus australis*) and Eastern Bentwing-bat (*Miniopterus orianae oceansis*).
- Two (2) threatened flora species, *Tetratheca glandulosa* and *Grevillea caleyi*, were recorded.

- One (1) EEC, Coastal Upland Swamp of the Sydney Basin Bioregion, was recorded.
- No endangered populations listed under this act were recorded within the total land parcel.

The proposed residential development has potential to have an undetermined impact on Eastern Pygmy Possum. Further target survey of the offset lands is proposed to occur in accordance with the requirements of Dr Goldingay in terms of establishing additional foraging, breeding and nesting habitat.

In light of the current planning proposal there is no requirement to undertake an assessment of threatened species in accordance with Section 5A of the EPA Act. Such an assessment will be undertaken at the appropriate time which is during the preparation of a Part 4 development application. Alternatively should the proponent and the Council determine that the best route is for a biocertification approach, then the matter of threatened species, endangered ecological communities and populations will be given appropriate assessment under the biocertification legislation.

Of the threatened species with potential to occur, the endangered Southern Brown Bandicoot may also be impacted by habitat loss but is not currently considered as being significantly affected based on the absence of detection in survey. There is no likely significant impact for any remaining threatened species recorded present, or with potential to occur, populations or EECs.

EPBC Act

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

- Two (2) threatened fauna species, Giant Burrowing Frog (*Heliophorus australiacus*) and Grey-headed Flying-fox (*Pteropus poliocephalus*), were recorded
- No protected migratory bird species were recorded
- Two (2) threatened flora species, *Tetratheca glandulosa* (listed as vulnerable) and *Grevillea caleyi* (listed as endangered), were recorded
- No EECs or endangered populations listed under this act were recorded within the total land parcel.

The proposed subdivision development is not currently considered to have a potential significant impact on any nationally listed threatened or protected species. Primary surveys for Southern Brown Bandicoot to national standards, however, have not been completed and therefore in the absence of these recommended extensive surveys, a referral to SEWPAC should be required in respect to this species. The proposed subdivision development is not expected to have a significant impact on any remaining matters of NES, particularly based on the advice of Prof Michael Mahony in respect to the Giant Burrowing Frog.

FM Act

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.

7.2 Recommendations

This report has identified the following threatening processes and potential ecological impacts as a result of the proposed rezoning:

- Minor loss of *Grevillea caleyi* (2% population loss, 36% habitat loss) and moderate to high loss of *Tetratheca glandulosa* (91% population loss subject to target seasonal survey in offset lands and 16% habitat loss)
- 19% loss of rare flora specimens of *Eucalyptus leuhmanniana* (22% habitat loss) and *Angophora crassifolia* (16% habitat loss)
- 6.7% loss of the EEC, Coastal Upland Swamp
- Increased risk of weed invasion and possibly fungal mobilisation or infections
- Alteration to the natural overland flow regimes Direct or indirect impacts on important habitat areas for Eastern Pygmy Possum and Rosenberg's Goanna and Red-crowned Toadlet
- Increased potential for predation on native species by feral pests
- Hollow dependent threatened species habitat
- Potential impacts on burrows and removal of bushrock

The following survey and mitigation measures are recommended to avoid and mitigate the loss of threatened flora and fauna habitat and to minimise the adverse impacts on the surrounding terrestrial and aquatic ecosystems:

- Undertake target surveys to determine if hollow resources are sufficiently available for Eastern Pygmy Possum in offset lands as well as further targeted survey for Southern Brown Bandicoot for purposes of an *EPBC Act* referral to ensure the recommended national draft referral guidelines for this species are addressed.
- Open space areas typically provide a buffer against potential negative impacts associated with the development. In this case, open space areas surrounding the proposed residential lands provide a managed buffer including APZs, a partially vegetated landscape for wildlife and a managed interface with the surrounding conserved lands. It is expected that pathways, fire trails and stormwater drainage and treatment measures would feasibly be located within the open space areas. These are not intended to be fully cleared zones but are to maintain a visual and ecological buffer with selective retention of healthy trees in accordance with APZs management requirements.
- Stormwater management is recommended to achieve a performance standard that will protect the surrounding conservation areas and associated threatened species habitat in the long term. Consequently, the target quality should be equivalent to the receiving water quality (similar pre and post development). Ensure all stormwater inputs are treated to a receiving waters standard commensurate with MUSIC modelling for water quality and quantity model in pre and post development conditions. In addition, the presence of groundwater dependent ecosystems means that groundwater discharges need to be maintained (similar pre and post development) through the careful management of surface runoff, permeable surfaces and to maintain the current quantity and peak discharges from site.
- Ensure protection of important habitat areas within the offset lands and minimise losses of habitat for threatened flora and fauna.
- Maximise retention of habitat within APZs.

- Provide adequate buffers to all sensitive watercourse and upland swamp areas such as the north eastern drainage line to conserve Red-crowned Toadlet habitat.
- Minimise impacts of domestic cats on wildlife such as the Eastern Pygmy Possum.
- Ensure wildlife passage across Forest Way to permit broader connectivity for species such as the Eastern Pygmy Possum.
- Provide a comprehensive fuel management plan that integrates ecological, bushfire, stormwater and open space requirements.
- Strategically place road and fence barriers to minimise access to sensitive habitat areas.
- Provide on site and off site restoration areas that can offset the loss of threatened species habitat and provide an overall net benefit to local threatened species populations or existing conservation areas.
- Ensure best practice landscape and bushland management is in place to minimise the establishment and spread of weed species and the control of waste disposal.
- Undertake target survey for *Grevillea caleyi* and *Tetratheca glandulosa* to understand the potential extent of threatened flora populations within the proposed adjoining lands.
- Up to 25% of understorey vegetation is to be retained within APZs to provide on ground refugia and habitat linkages without compromising the effectiveness of the APZs.
- Up to 75% of all overstorey vegetation should be retained within APZs to provide habitat linkages.
- Where possible, revegetation using locally occurring native plant species is to be re-established on stabilised road batters or within clear areas of the corridor to maintain native vegetation cover. Clearance for maintenance purposes is to be maintained for road safety reasons.
- Target weed control is to be undertaken within 10m of any works to control the invasion or spread of noxious or invasive environmental weed species.
- 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 onsite found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal herbicides.
- Erosion control measures are to be in place to reduce temporary erosion and sedimentation risks to adjacent EEC vegetation and any nearby drainage channel.
- Where possible, the existing EEC, Coastal Upland Swamp, should be restored or regenerated in offset lands (north eastern portions) to mitigate impacts of the proposed residential zone

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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 as well as 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 outlined 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 if 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 with 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 five minute periods with five 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 Phascogales are 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 in the 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 presences 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 five 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 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 spot assessment technique (SAT) described below but may only be an initial survey effort to determine presence / absence.

Where any Koala activity is recorded, the complete 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 has 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 road kill 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* 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, search 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 4.2m² 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 microchiropteran bat species and are sourced from 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* (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 <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <small>Notes 1,2 & 3</small>	Record(s) from recent years (✓) <small>Notes 1,2 & 3</small>	Potential to occur	
<i>Acacia bynoeana</i> <small>OEH EPBC</small>	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	✓ mostly near existing tracks	✓	x	Low	✓
<i>Acacia gordonii</i> <small>OEH</small>	E1	E	Erect or spreading shrub 0.5-1.5m high growing in heath and dry sclerophyll forest on sandstone outcrops. Distribution limits N-Bilpin S-Faulconbridge.	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				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					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	
<i>Acacia terminalis</i> ssp <i>terminalis</i> OEH EPBC	E1	E	Erect shrub to 2m tall, flowers from March to July. Occurs in eucalypt woodland or forest, usually in sandy soil on creek banks, hill slopes or in shallow soil in rock crevices and sandstone platforms on cliffs. Typically restricted to the Port Jackson and eastern suburbs of Sydney.	x	x	-	-	x	x
<i>Asterolasia elegans</i> EPBC	E1	E	Erect shrub 1-3m high growing in moist sclerophyll forests on Hawkesbury sandstone slopes hillsides. Distribution limits Maroota region.	x	x	-	-	x	x
<i>Caladenia tessellata</i> OEH EPBC	E1	V	Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S-south of Eden.	x	x	-	-	x	x
<i>Callistemon linearifolius</i> OEH	V	-	Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. Distribution limits N-Nelson Bay S-Georges River.	x	✓ very limited to drainage line areas	✓	✓	Low	✓
<i>Chamaesyce psammogeton</i> OEH	E1	-	Prostrate herb. Coastal dunes. Distribution limits N-Tweed Heads S-Jervis Bay	x	x	-	-	x	x
<i>Cryptostylis hunteriana</i> 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

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					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	
<i>Darwinia biflora</i> OEH EPBC	V	V	Erect or spreading shrub to 0.8m high. Grows in heath or understorey of woodland on or near shale-capped ridges underlain by Hawkesbury sandstone. Distribution limits N-Gosford S-Cheltenham.	x	x	-	-	x	x
<i>Darwinia peduncularis</i> OEH	V	-	Divaricate shrub to 1.5m high. Grows in dry sclerophyll forest on sandstone hillsides and ridges. Distribution limits N-Glen Davis S-Hornsby.	x	x	-	-	x	x
<i>Deyeuxia appressa</i> OEH EPBC	E1	E	Erect grass to 0.9m high. Grows on wet ground. Distribution limits N-Hornsby S-Bankstown.	x	x	-	-	x	x
<i>Diuris bracteata</i> OEH	E1	Extinct	An orchid that grows in dry sclerophyll woodland. Was thought to be extinct until approximately 10yrs ago. Found in the Sydney Basin Bioregion. Flowers in September.	x	x	-	-	x	x
<i>Epacris purpurascens</i> var. <i>purpurascens</i> 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	✓ limited to the edge of drainage lines	✓	✓	Low - Moderate	✓
<i>Eucalyptus camfieldii</i> OEH EPBC	V	V	Stringybark to 10m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. Distribution limits N-Norah Head S-Royal NP.	x	✓ most of the central plateau area	✓	✓	Moderate	✓

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					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	
<i>Eucalyptus nicholii</i> OEH	V	-	This species is widely planted as an urban street tree and in gardens but is quite rare in the wild. It is confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield, largely on private property.	x	x	-	-	x	x
<i>Eucalyptus scoparia</i> OEH	E1	V	Smooth-barked tree only known from vicinity of Bald Rock.	x	x	-	-	x	x
<i>Genoplesium baueri</i> OEH	E1	-	A terrestrial orchid that grows in sparse sclerophyll forest and moss gardens over sandstone. Distribution limits N – Hunter Valley S – Nowra	x	x	-	-	x	x
<i>Genoplesium plumosum</i> OEH	E4A	-	Terrestrial Orchid that grows in mallee scrubland and Callitris Woodland. Distribution south from Griffith	x	x	-	-	x	x
<i>Grammitis stenophylla</i> OEH	E1	-	A small lithophytic fern with fronds generally <5cm. Occurs in rainforest and wet sclerophyll forest in the coastal divisions of NSW.	x	x	-	-	x	x
<i>Grevillea caleyi</i> OEH EPBC	E1	E	Shrub mostly 1-3m high. Grows in laterite. Distribution limits Terrey Hills-Belrose area.	x	✓ ideal habitat to the north and north-east of the existing residence	✓	✓	Recorded	✓

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					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	
<i>Grevillea shiressii</i> OEH	V	V	Shrub 2-5m high. Flowers mainly spring. Grows along creek banks in wet sclerophyll forest. Sandy soil on Hawkesbury sandstone. Restricted to the Gosford area. CC.	x	x	-	-	x	x
<i>Haloragodendron lucasii</i> OEH EPBC	E1	E	Straggling shrub to 1.5m high. Grows in open forest on sheltered slopes near creeks. Distribution limits Ku-ring-gai Plateau and Mt Wilson.	x	✓ marginal habitat near drainage lines around the fringes of the proposed development area	✓	x	Very low	✓
<i>Hibbertia puberula</i> OEH	E1	-	Shrublets with branches up to 30cm long. Not been seen for 40 years however early records are from Hawkesbury River area in Sydney and the Blue Mountains.	x	x	-	-	x	x
<i>Hibbertia superans</i> OEH	E1	-	Small spreading shrub to 0.3m high. Grows on sandstone, usually in or near SSTF. Distribution limits N-Glenorie S-Kellyville disjunct Mt Boss.	x	x	-	-	x	x
<i>Kunzea rupestris</i> EPBC	V	V	Shrub to 1.5m high. Grows in cracks and fissures on Hawkesbury sandstone rock platforms. Distribution limits N-Maroota S-Glenorie.	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				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					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	
<i>Lasiopetalum joyceae</i> OEH EPBC	V	V	Erect shrub to 2m high. Grows in heath and open forest on Hawkesbury sandstone. Distribution limits Hornsby Plateau.	x	✓ Limited by geographic range. Nearest record 5km away	x	✓	Low	✓
<i>Leptospermum deanei</i> OEH EPBC	V	V	Shrub to 5m high. Grows on forested slopes. Distribution limits Near watershed of Lane Cove River.	x	x	-	-	x	x
<i>Melaleuca biconvexa</i> OEH EPBC	V	V	Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. Distribution limits N-Port Macquarie S-Jervis Bay.	x	x	-	-	x	x
<i>Melaleuca deanei</i> OEH EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. Distribution limits N-Gosford S-Nowra.	x	✓ limited to the low open woodland and open woodland vegetation communities	✓	✓	Low-moderate	✓

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					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	
Report Authors:	Michael Sheather-Reid, Lindsay Holmes & Corey Mead	Report Authors:	Michael Sheather-Reid, Lindsay Holmes & Corey Mead	Report Authors:	Michael Sheather-Reid, Lindsay Holmes & Corey Mead	Report Authors:	Michael Sheather-Reid, Lindsay Holmes & Corey Mead	Report Authors:	Michael Sheather-Reid, Lindsay Holmes & Corey Mead
<i>Persoonia hirsuta</i> 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	✓ limited to the open woodland vegetation community	x	✓	Low	✓
<i>Persoonia laxa</i> OEH	E4	Ext.	Decumbent or prostrate shrub. Not been seen since 1908. Once recorded in Newport and Manly.	x	x	-	-	x	x
<i>Persoonia mollis</i> <i>ssp. maxima</i> OEH EPBC	E1	E	Erect to prostrate shrub. Grows in moist to wet sclerophyll forests on Hawkesbury sandstone. Distribution limits N-Cowan S-Hornsby.	x	x	-	-	x	x
<i>Pimelea curviflora</i> <i>var. curviflora</i> 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	✓ limited to the low open woodland and open woodland vegetation communities and some tall heath	✓	✓	Moderate	✓

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					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	
<i>Pimelea spicata</i> 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	x	-	-	x	x
<i>Prostanthera junonis</i> OEH	E1	E	Small shrub. Grows in sclerophyll forest and heath in shallow soil on sandstone. Distribution limits Somersby region.	x	x	-	-	x	x
<i>Prostanthera marifolia</i> OEH	E4a	Critic . E	Erect shrub to 0.3m high. Woodland dominated by Eucalyptus sieberi and Corymbia gummifera. In deeply weathered clay soil with ironstone nodules. Has been recorded previously in the Sydney Harbour region.	x	x	-	-	x	x
<i>Sarcochilus hartmannii</i> OEH	V	V	An orchid which grows on volcanic rocks, often in shallow soil in sclerophyll forest or exposed sites usually at an elevation above 500m. Distribution – north from the Richmond River in the far north of NSW.	x	x	-	-	x	x
<i>Senecio spathulatus</i> OEH	E	-	A low growing daisy that prefers primary dunes. Known to occur at Cape Howe and between Kurnell north to Myall Lakes National Park. Also occurs in coastal locations in eastern Victoria.	x	x	-	-	x	x
<i>Syzygium paniculatum</i> OEH	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				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
<i>Tetratheca glandulosa</i> OEH EPBC	V	V	Spreading shrub to 0.2m high. Sandy or rocky heath or scrub. Distribution limits N-Mangrove Mountain S-Port Jackson.	✓	✓ most vegetation communities have some potential habitat but away from the damper areas	✓	✓	Recorded	✓
OEH	- Denotes species listed within 10km of the subject site on the <i>Atlas of NSW Wildlife</i> database								
EPBC	- Denotes species listed within 10km of the subject site in the <i>EPBC Act</i> 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 <i>Atlas of NSW Wildlife</i> database. Updated 1:100,000 database map sheet requests to OEH are undertaken every 3 months as recommended. 3. 'Nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.								

A detailed assessment in accordance with Section 5A of the *EPA Act* will be completed for these species in Appendix 3 of this report.

Table A2.2 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) or indicated to have potential habitat present within 10km on the *EPBC Protected Matters Tool*.

Table A2.2 – Threatened fauna habitat assessment

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <small>Notes 1,2 & 3</small>	Record (s) from recent years (✓) <small>Notes 1,2 & 3</small>	Potential to occur	
Giant Burrowing Frog <i>Heleioporus australiacus</i> <small>OEH EPBC</small>	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. <i>Distribution Limit: N-Near Singleton S-South of Eden.</i>	✓	-	-	-	-	✓
Stuttering Frog <i>Mixophyes balbus</i> <small>EPBC</small>	E	V	Terrestrial inhabitant of rainforest and wet sclerophyll forests. <i>Distribution Limit: N-near Tenterfield S-South of Bombala.</i>	x	x	-	-	x	x
Giant Barred Frog <i>Mixophyes iteratus</i> <small>EPBC</small>	E	E	Terrestrial inhabitant of rainforest and open forests. <i>Distribution Limit: N-Border Ranges National Park. S-Narooma.</i>	x	x	-	-	x	x
Red-crowned Toadlet <i>Pseudophryne australis</i> <small>OEH</small>	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. <i>Distribution Limit: N-Pokolbin. S-near Wollongong.</i>	✓	-	-	-	-	✓

COMMON NAME <i>Scientific name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Green and Golden Bell Frog <i>Litoria aurea</i> OEH EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. <i>Distribution Limit: N-Byron Bay S-South of Eden.</i>	x	x	-	-	x	x
Littlejohn's Tree Frog <i>Litoria littlejohnii</i> 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. <i>Distribution Limit: N-Hunter River S-Eden.</i>	x	✓	x	x	x	x
Rosenberg's Goanna <i>Varanus rosenbergi</i> OEH	V	-	Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. <i>Distribution Limit: N-Nr Broke. S-Nowra Located in scattered patches near Sydney, Nowra and Goulburn.</i>	✓	-	-	-	-	✓
Broad-headed Snake <i>Hoplocephalus bungaroides</i> EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. <i>Distribution Limit: N-Mudgee Park. S-Nowra.</i>	x	✓	x	x	x	x

COMMON NAME <i>Scientific name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Cotton Pygmy-goose <i>Nettapus coromandelianus</i> OEH	E	-	An aquatic species found in tropical to subtropical coastal lagoons, swamps and large bodies of calm fresh water with abundant vegetation. <i>Distribution Limit: N-Tweed Heads. S-Pambula.</i>	x	x	-	-	x	x
Superb Fruit-dove <i>Ptilinopus superbus</i> OEH	V	-	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. <i>Distribution Limit: N-Border Ranges National Park. S-Bateman's Bay.</i>	x	x	-	-	x	x
Black-necked Stork <i>Ephippiorhynchus asiaticus</i> 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. <i>Distribution Limit: N-Tweed Heads. S-Nowra.</i>	x	x	-	-	x	x
Australasian Bittern <i>Botaurus poiciloptilus</i> OEH EPBC	V	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. <i>Distribution Limit: N-North of Lismore. S- Eden.</i>	x	x	-	-	x	x

COMMON NAME <i>Scientific name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Black Bittern <i>Ixobrychus flavicollis</i> OEH	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams & ponds, sheltered mudflats and oyster slats. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x
Little Eagle <i>Hieraaetus morphnoides</i> OEH	V	-	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. <i>Distribution Limit - N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	low	✓
Osprey <i>Pandion haliaetus</i> OEH	V	-	Utilises water bodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x
Bush Stone-curlew <i>Burhinus grallarius</i> OEH	E	-	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. <i>Distribution Limit: N-Border Ranges National Park. S-Near Nowra.</i>	x	x	-	-	x	x

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Australian Painted Snipe <i>Rostratula australis</i> <small>EPBC</small>	V	V	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i> <small>OEH</small>	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. <i>Distribution Limit: mid north coast of NSW to western Victoria.</i>	x	Sub-optimal	x	x	unlikely	✓
Glossy Black-Cockatoo <i>Calyptorhynchus lathamii</i> <small>OEH</small>	V	-	Open forests with <i>Allocasuarina</i> species and hollows for nesting. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓ Foraging only	x	✓	low	✓
Little Lorikeet <i>Glossopsitta pusilla</i> <small>OEH</small>	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelter beds, and street trees. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	✓	-	-	-	-	✓
Swift Parrot <i>Lathamus discolor</i> <small>OEH EPBC</small>	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	marginal	✓	✓	✓	✓

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Turquoise Parrot <i>Neophema pulchella</i> OEH	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. <i>Distribution Limit: N-Near Tenterfield. S-South of Eden.</i>	x	✓	x	x	Not likely	x
Superb Parrot <i>Polytelis swainsonii</i> OEH	V	V	Inhabits open woodland and riverine forests of inland NSW. <i>Distribution Limit: N-Near Walgett. S-South of Deniliquin.</i>	x	x	-	-	x	x
Barking Owl <i>Ninox connivens</i> OEH	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. <i>Distribution Limits: N-Border Ranges National Park. S-Eden.</i>	x	✓	✓	2003	✓	✓
Powerful Owl <i>Ninox strenua</i> OEH	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. <i>Distribution Limits: N-Border Ranges National Park. S-Eden.</i>	✓	-	-	-	-	✓
Masked Owl <i>Tyto novaehollandiae</i> OEH	V	-	Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. <i>Distribution Limit: N-Border Ranges National Park. S-Eden.</i>	x	✓	x	-	unlikely	✓

COMMON NAME <i>Scientific name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Sooty Owl <i>Tyto tenebrosa</i> OEH	V	-	Tall, dense, wet forests containing trees with very large hollows. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	x	-	-	x	x
Eastern Bristlebird <i>Dasyornis brachypterus</i> EPBC	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	x	x
Black-chinned Honeyeater <i>Melithreptus gularis</i> 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. <i>Distribution Limit: N-Cape York pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.</i>	x	marginal	x	x	x	x
Regent Honeyeater <i>Xanthomyza Phrygia</i> OEH EPBC	E4A	E	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. <i>Distribution Limit: N-Urbanville. S-Eden.</i>	x	x	✓	x	Not likely	x

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Grey-crowned Babbler <i>Pomatostomus temporalis temporalis</i> <small>OEH</small>	V	-	Found in dry open forests, woodland scrubland, farmland with isolated trees. Distribution Limit mostly west of Great Dividing Range except Hunter Valley. <i>Distribution Limit: N-Qld widespread. S-Mornington Pen. E-se SA.</i>	x	x	-	-	x	x
Varied Sittella <i>Daphoenositta chrysoptera</i> <small>OEH</small>	V	-	Open eucalypt woodlands/forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	✓	x	x	low	✓
Scarlet Robin <i>Petroica boodang</i> <small>OEH</small>	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	low	✓
Spotted-tailed Quoll <i>Dasyurus maculatus</i> <small>OEH EPBC</small>	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. <i>Distribution Limit: N-Mt Warning National Park. S-South of Eden.</i>	x	✓	✓	✓	✓	✓

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <small>Notes 1,2 & 3</small>	Record (s) from recent years (✓) <small>Notes 1,2 & 3</small>	Potential to occur	
Southern Brown Bandicoot <i>Isodon obesulus</i> <small>OEH EPBC</small>	E	E	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. <i>Distribution Limit: N-Kempsey. S-South of Eden.</i>	x	✓	✓	✓	✓	✓
Koala <i>Phascolarctos cinereus</i> <small>OEH</small>	V	-	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	✓	x	unlikely	✓
Eastern Pygmy Possum <i>Cercatus nanus</i> <small>OEH</small>	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. <i>Distribution Limit: N-Tweed Heads. S-Eden.</i>	x	✓	x	✓	✓	✓
Yellow-bellied Glider <i>Petaurus australis</i> <small>OEH</small>	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. <i>Distribution Limit- N-Border Ranges National Park. S-South of Eden.</i>	x	✓	x	x	x	x
Long-nosed Potoroo <i>Potorous tridactylus</i> <small>EPBC</small>	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. <i>Distribution Limit: N-Mt Warning National Park. S-South of Eden.</i>	x	✓	x	x	x	x

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <small>Notes 1,2 & 3</small>	Record (s) from recent years (✓) <small>Notes 1,2 & 3</small>	Potential to occur	
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i> EPBC	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. <i>Distribution Limit: N-North of Tenterfield. S-Bombala.</i>	x	✓	x	x	x	x
Grey-headed Flying-fox <i>Pteropus poliocephalus</i> 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. <i>Distribution Limit: N-Tweed Heads. S-Eden.</i>	✓	-	-	-	-	✓
Yellow-bellied Sheathtail-bat <i>Saccolaimus flaviventris</i> OEH	V	-	Rainforests, sclerophyll forests and woodlands. <i>Distribution Limit: N-North of Walgett. S-Sydney.</i>	x	✓	x	x	unlikely	✓
East-coast Freetail Bat <i>Micronomus norfolkensis</i> 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. <i>Distribution Limit: N-Woodenbong. S-Pambula.</i>	x	✓	✓	✓	low	✓

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Large-eared Pied Bat <i>Chalinolobus dwyeri</i> <small>OEH EPBC</small>	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. <i>Distribution Limit: N-Border Ranges National Park. S-Wollongong.</i>	x	✓	x	x	x	x
Little Bentwing-bat <i>Miniopterus australis</i> <small>OEH</small>	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. <i>Distribution Limit: N-Border Ranges National Park. S-Sydney.</i>	✓	-	-	-	-	✓
Eastern Bentwing-bat <i>Miniopterus orianae oceansis</i> <small>OEH</small>	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well timbered areas. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	✓	-	-	-	-	✓
Eastern Falsistrelle <i>Falsistrellus tasmaniensis</i> <small>OEH</small>	V	-	Recorded roosting in caves, old buildings and tree hollows. <i>Distribution Limit: N-Border Ranges National Park. S-Pambula.</i>	x	Sub-optimal	x	x	unlikely	✓

COMMON NAME <i>Scientific name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Large-footed Myotis <i>Myotis macropus</i> OEH	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. <i>Distribution limits: N-Border Ranges National Park. S-South of Eden.</i>	x	x	-	-	x	x
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> OEH	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. <i>Distribution Limit: N-Border Ranges National Park. S-Pambula.</i>	x	✓	x	✓	low	✓
New Holland Mouse <i>Pseudomys novaehollandiae</i> 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. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	✓	✓	x	✓	✓

COMMON NAME <i>Scientific name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Macquarie Perch <i>Macquaria australasica</i> EPBC	V	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.	x	x	-	-	x	x
Australian Greyling <i>Prototroctes maraena</i> EPBC	Part 2, Section 19 – Protected Fish	V	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1,000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (e.g. weirs, waterfalls).	x	x	-	-	x	x
OEH	- Denotes species listed within 10km of the subject site on the <i>Atlas of NSW Wildlife</i>								
EPBC	- Denotes species listed within 10km of the subject site in the <i>EPBC Act</i> habitat search								
V	- Denotes vulnerable listed species under the relevant Act								
E	- Denotes endangered listed species under the relevant Act								

COMMON NAME <i>Scientific name</i> <small>DATABASE SOURCE</small>	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record (s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
NOTE:	<div>1. This field is not considered if no suitable habitat is present within the subject site</div> <div>2. 'Records' refer to those provided by the <i>Atlas of NSW Wildlife</i>. Updated 1:100,000 database map sheet requests to OEH are undertaken every 3 months as recommended.</div> <div>3. 'Nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.</div>								

A detailed assessment in accordance with Section 5A of the *EPA Act* will be completed for these species in Appendix 3 of this report.

Table A2.3 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 <i>Scientific name</i>	PREFERRED HABITAT <i>Migratory breeding</i>	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
White-bellied Sea Eagle (<i>Haliaeetus leucogaster</i>)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. <i>Sedentary; dispersive.</i>	x	-	-
White-throated Needletail (<i>Hirundapus caudacutus</i>)	Air space over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. <i>Breeds Siberia, Himalayas, and east to Japan. Summer migrant to eastern Australia.</i>	✓	x	-
Rainbow Bee-eater (<i>Merops ornatus</i>)	Open woodlands with sandy, loamy soil; sand ridges, sand spits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. <i>Breeding resident in northern Australia. Summer breeding migrant to south-east and south west Australia.</i>	Sub-optimal	x	-
Black-faced Monarch (<i>Monarcha melanopsis</i>)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. <i>Summer breeding migrant to coastal south east Australia, otherwise uncommon.</i>	Sub-optimal	x	-
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. <i>Breeds mostly south east Australia and Tasmania over warmer months, winters in north east Qld.</i>	Sub-optimal	x	-
Rufous Fantail (<i>Rhipidura rufifrons</i>)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. <i>Breeding migrant to south east Australia over warmer months. Altitudinal migrant in north east NSW in mountain forests during warmer months.</i>	✓	x	-
Great Egret (<i>Ardea alba</i>)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. <i>Dispersive; cosmopolitan.</i>	x	-	-
Cattle Egret (<i>Ardea ibis</i>)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. <i>Breeds in summer in warmer parts of range including NSW.</i>	x	-	-

COMMON NAME <i>Scientific name</i>	PREFERRED HABITAT <i>Migratory breeding</i>	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
Latham's Snipe (<i>Gallinago hardwickii</i>)	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. <i>Breeds Japan. Regular summer migrant to Australia. Some overwinter.</i>	x	-	-
Fork-tailed Swift (<i>Apus pacificus</i>)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. <i>Breeds Siberia, Himalayas, and 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.</i>	✓	x	-



7 Part Test of Significance

A3

In light of the current planning proposal there is no requirement to undertake an assessment of threatened species in accordance with Section 5A of the EPA Act. Such an assessment will be undertaken at the appropriate time which is during the preparation of a Part 4 development application. Alternatively should the proponent and the Council determine that the best route is for a biocertification approach, then the matter of threatened species, endangered ecological communities and populations will be given appropriate assessment under the biocertification legislation.

The impacts of the rezoning proposal relates to a proposed development area of 23.32ha including APZs and proposed road extensions of the total 135.3ha land within the study area. The development area excluding APZs represents 17.79ha.

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***

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*
- *Callistemon linearifolius*
- *Epacris purpurascens* var. *purpurascens*
- *Eucalyptus camfieldii*
- *Grevillea caleyi* *
- *Haloragodendron lucasii*
- *Lasiopetalum joyceae*
- *Melaleuca deanei*
- *Microtis angusii*
- *Persoonia hirsuta*
- *Pimelea curviflora* var. *curviflora*
- *Tetratheca glandulosa* *

Endangered ecological communities

- Coastal Upland Swamp in the Sydney Basin Bioregion *

Threatened fauna

- | | |
|--------------------------|----------------------------|
| • Giant Burrowing Frog * | • Scarlet Robin |
| • Red-crowned Toadlet * | • Spotted-tailed Quoll |
| • Rosenberg's Goanna * | • Southern Brown Bandicoot |
| • Little Eagle | • Koala |
| • Gang-gang Cockatoo | • Eastern Pygmy Possum * |

- Glossy Black-Cockatoo
- Little Lorikeet *
- Swift Parrot
- Barking Owl
- Powerful Owl *
- Masked Owl
- Varied Sittella
- Grey-headed Flying-fox *
- Yellow-bellied Sheath-tail-bat
- East-coast Freetail Bat
- Little Bentwing-bat *
- Eastern Bentwing-bat *
- Greater Broad-nosed Bat

Endangered populations

- No endangered populations are known to the Warringah LGA.

Species indicated with a “*” have been recorded within the subject site during surveys or field investigations. These species, as well as other species known or considered with potential to occur, are discussed in detail below. For those remaining threatened flora and fauna species which were not recorded with limited, marginal or variable potential habitat, 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.

THREATENED SPECIES RECORDED PRESENT

Grevillea caleyi

The potential habitat for *Grevillea caleyi* is restricted within the subject site to those areas which have taller vegetation and a regular composition of *Eucalyptus sieberi* and *Corymbia gummifera* on laterite soil on ridge tops. This vegetation is present surrounding the electrical substation and incorporates vegetation in the far north east of the subject site. A total of eight (8) specimens were located in this area and it likely that one (1) specimen would be lost as part of the subdivision proposal. The other seven (7) specimens were located on the fence line between the Wyatt Road road corridor and the electrical substation. Suitable design of a future road could avoid impacting those specimens as the road corridor is 20m wide and the likely road pavement and sides for cut and fill would not likely exceed 10m in width.

In late 2012 a burn was put through this area and within the substation lands. *Grevillea caleyi* has a positive response to fire and that was noted when an inspection of the known *Grevillea* area was undertaken in July 2013 with seven (7) stems located along the Wyatt Road fence line (where three (3) semi-mature plants were previously).

The hazard reduction burn continued on to the electrical substation lands. Consequently, mature specimens have been burnt out and there are new seedlings underneath them. Survey conducted in August 2013 located thirty eight (38) juvenile specimens. It is likely that after the spring season, more will emerge, increasing the local population further.

The proposed rezoning is not expected to have a significant impact on this species (loss of one (1) specimen) through the loss of habitat, altered fire regimes or altered surface runoff conditions subject to defining an appropriate fire management regime for the conserved lands and implementation on performance based stormwater quality and quantity measures.

On the provision that the specimens on the fence line in the Wyatt Road corridor are retained, and given the extent of habitat on adjoining lands and known specimens comprising a local population, 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.

Tetratheca glandulosa

The potential habitat areas within the subject site and broader offset area for *Tetratheca glandulosa* are extensive. The one hundred and thirty four (134) specimens observed thus far within the subject site are largely within the low open forest and open forest vegetation communities, and seldom within the tall heath as these areas are typically very dense and do not allow enough penetration of light to the ground layer for *Tetratheca glandulosa* to thrive.

Throughout the subject site, large numbers of other *Tetratheca* species were sighted, notably *Tetratheca ericifolia* and *Tetratheca thymifolia*, however there were not large numbers of *Tetratheca glandulosa* recorded, despite the good habitat potential. In areas where *Tetratheca glandulosa* was observed, they were typically found in clumps of 10-50 individuals.

Intensive target searches for *Tetratheca glandulosa* have not been undertaken within the offset areas. There have been searches undertaken within the quadrats, on the meander between quadrats and along existing walking track edges, however only fifteen (15) specimens have been identified outside of the subject site. High numbers of *Tetratheca ericifolia* and *Tetratheca thymifolia* were observed in the offset areas and it is believed that if adequate target survey was undertaken in the offset areas, many clumps of *Tetratheca glandulosa* would be observed. The upper slopes in non-sheltered localities are likely to provide the more likely potential habitats. It is estimated that ~25% of the offset area would provide variable levels of suitable habitat for this species.

A number of specimens (approximately ten (10)) also occur within APZ lands that may be retained in situ in the north western part of the subject site.

The proposed rezoning is not expected to have a significant impact on this species through the loss of habitat, altered fire regimes or altered surface runoff conditions subject to defining an appropriate fire management regime for the conserved lands and implementation on performance based stormwater quality and quantity measures.

As there are significant areas of potential habitat within the offset area, along with known recorded locations in the nearby locality from the *Atlas of NSW Wildlife* (OEH 2012), it is expected that the population within the local area is large and that the loss or modification of most species from within the subject site is unlikely to disrupt the life cycle such that a viable local population would be placed at risk of extinction.

Giant Burrowing Frog (*Heleioporus australiacus*)

Giant Burrowing Frog was previously recorded in 1996 to the north near Fireclay Gully on outer edge of the offset area (possibly adjacent to the Heath Trail). This species was also recorded to the south west in 2010 along French's Creek, near the intersection of Middle Harbour Creek (again possibly adjacent to the French's Creek Trail).

This species is typically known to breed in drainages that flow from natural sandstone habitats. Whilst this may suggest that adults would utilise mostly the north eastern and south eastern extents of the proposed development area, the species has been found to burrow, forage and generally occupy territories hundreds of metres from riparian areas (Webb 1983; Lemckert et al. 1998). As with other frog species, the young also have wide dispersal ranges as a natural behaviour to colonise new suitable habitats in the locality.

The individual recorded during the 2012 surveys was found desiccated in a funnel trap and identified in the hand to a probable level of certainty. The specimen was later confirmed by DNA analysis by The Australian Museum to be Giant Burrowing Frog. The captured Giant

Burrowing Frog was a juvenile and therefore may have been in dispersal at the time of capture. The capture point was in the middle of the proposed development area.

Further targeted surveys were undertaken by specialist Prof Michael Mahony with *Travers bushfire & ecology* during the late autumn peak breeding period along all major drainages, perched swamps and roadside gutters surrounding the subject site. A breeding location was identified within a made-made scrape next to the Heath Track which continues into Garigal National Park. This breeding location identified many tadpoles in a small number of perennial pools along the edge of the fire trail. The main larger pool contained a typical sandy substrate with a few surrounding yabby burrows and appeared to be continuously fed by ground water and not a defined drainage line. Numerous Giant Burrowing Frog tadpoles were present with no adults recorded by call or observation. This location is close to the nearest Atlas record of this species from 1996. No tadpoles or activity were recorded close to the subject site in locations previously identified as having potential.

The recorded breeding location is located more than 300m from the north western tip of the proposed development landscape. Prof Mahony concluded that:

- The density of GBF at the site is low, and that it is most unlikely that habitats on the plateau are used routinely for shelter and foraging. Furthermore, it is not likely that development will break a corridor that connects breeding habitat with foraging and shelter sites since there are no identified breeding sites close to the plateau.
- The considerable distance of the identified breeding habitat from the plateau and the relatively large area of surrounding habitat indicate that indirect impacts on hydrology are unlikely to impact on the GBF breeding habitat.
- It is not likely that the proposal will impact on the local viable population of the GBF.
- There is no need for the placement of buffer zones around habitat on the escarpment since there are no identified breeding, sheltering or foraging habitat.

This species is potentially restricted by Mona Vale Road to the north and urban development in the remaining surrounds. The extent of the local population is not known but existing records suggest that suitable habitat continues within the broader catchment area within the offset lands and the surrounding Garigal National Park.

Given the assessment provided by Prof Mahony, it is concluded that the proposed subdivision is not likely to significantly impact on the local population of Giant Burrowing Frog.

Red-crowned Toadlet (*Pseudophryne australis*)

Red-crowned Toadlets use small ephemeral drainage lines, which feed water from the top of ridges to perennial creeks below. This species is confined to the Hawkesbury sandstone formation and is not usually found in the vicinity of permanent water (Ehmann, 1997). Breeding habitat is small puddles or depressions where rock or leaf litter holds back water temporarily (Ehmann, 1997; State Forests Threatened Species Protocol, 1997). Breeding congregations can occur deep in grass and debris beside such non-perennial creeks, gutters etc. They have also been noted to be very partial to damp shelves and cracks in sandstone where they have been observed emerging at dusk (NPWS 1997). At other times, individuals disperse and are found under rocks, logs etc. on sandstone ridges (Cogger, H. G. 2000).

The Red-crowned Toadlet was initially recorded to the central north of the proposed development area in both 2008 and 2011. In 2011 it was also recorded north of the western endpoint of Ralston Avenue. Both of these recorded locations were found to be dry during 2012 survey. This 2012 survey session was undertaken following a dry spring period and other potential breeding locations were also dry at this time, particularly the ephemeral

drainages along the northern aspects of the escarpment. This restricted identification of further breeding locations.

Prof Michael Mahony was engaged to undertake additional survey, habitat assessment and specialist review of the impacts on Red-crowned Toadlet during the late autumn and early winter of 2013. *Travers bushfire & ecology* provided assistance in target surveys at this time where the majority of drainages that run off the plateau area surrounding the proposal were searched. Search transects undertaken by *Travers bushfire & ecology* is shown in Figure 7 of the Ecological Assessment Report (*Travers bushfire & ecology* 2013) and searches undertaken by Prof Mahony are depicted within his attached report (Appendix 6).

The 2013 target surveys were undertaken during suitable weather conditions predominantly following rain events which included heavy mid autumn falls. Several new breeding locations were identified across the study area and surrounding the proposed development layout. This survey revealed that all ephemeral drainage lines from the plateau and perched swamp areas provide potential breeding habitat for this species.

The Red-crowned Toadlet has also been recorded at various locations in the surrounding connective habitats into Garigal National Park. Given that Red-crowned Toadlet is never found far from breeding areas and it typically displays limited movement, this species is assumed to have a reduced capacity to disperse however results from the study area would suggest dispersal is likely possible between the recorded breeding areas.

The potential impacts on this species from the proposed development include:

- Removal of four (4) recorded breeding areas
- Indirect impacts of altered water quality and / or quantity onto other recorded breeding areas as well as other potential breeding located just off the escarpment.

The proposed rezoning is not expected to have a significant impact on this species through the loss of habitat, altered fire regimes or altered surface runoff conditions subject to defining an appropriate fire management regime for the conserved lands, integrated interface management of the bushland / APZ zone and implementation on performance based stormwater quality and quantity measures.

Following additional site surveys for Red-crowned Toadlet in 2013, Prof Mahony concluded that:

- Additional breeding habitats of the Red-crowned Toadlet were detected and twelve (12) breeding locations were identified within the study area outside the subject site. It is concluded that the local population occurs along most of the semi-permanent drainages and soaks that occur near the escarpment and down slope from the plateau. None of these breeding locations will be directly impacted by the proposed development. There are four (4) identified breeding locations within the subject site; one (1) on the western end of the plateau (human made pit), two (2) on the rock face seepage in the north east, and one (1) at the head of the drainage line to the south.
- Movement of the Red-crowned Toadlet will mostly be in the escarpment and mid-slope areas and development of the plateau will not have a significant effect on the local population due to the removal of habitat or the breaking of corridors.
- The potential for impact on the population of the Red-crowned Toadlet is assessed to be related mostly to indirect impacts on the hydrology of the breeding habitat (rate, volume, and water quality of discharge). Specific mitigation measures are required to ensure that the hydrology of these sites is not altered by the proposal.

- Protection of the considerable area of Red-crowned Toadlet habitat below the escarpment and at mid-slope should protect the local viable population.

Therefore, the proposed subdivision will impact on four recorded breeding locations. One of these is constructed and a second receives modified flows from roadside runoff. Based on the recorded and available breeding habitat within the proposed offset areas and the available and likely passages for movement between these along the escarpment breaks, the removal of these breeding locations is not considered to be a significant impact on the local population.

Rosenberg's Goanna (*Varanus rosenbergi*)

On the east coast of NSW, the Rosenberg's Goanna (also known as Heath Monitor) is a Hawkesbury / Narrabeen sandstone outcrop specialist (State Forests of NSW, 1995). The Rosenberg's Goanna is largely restricted to heath (NPWS 1997); inhabiting humid woodlands, dry hardwood forests and heathland where it shelters in self-dug burrows, hollow logs, rock crevices and sandstone outcrops (Cogger 1992), usually with a sandy substrate (State Forests of NSW, 1997). Eggs are generally laid within a terrestrial termite mound but they are unlikely to use termite mounds exclusively for nesting purposes.

Rosenberg's Goanna is a mobile species and is a lot more versatile than currently reported (Gerry Swan pers. com. 2012). For example, the species has been observed in the Rylstone area utilising grassland areas for foraging purposes (entering burrows and preying on a young rabbit) and has been observed entering backyards with little native vegetation.

Rosenberg's Goanna was initially recorded only from cage trapping of a juvenile in 2011. More recent 2012 surveys in more suitable, warmer weather conditions observed the species at a number of locations throughout the proposed development area as well as trapping of an individual in a cage trap in the north eastern proposed development area. The trapped monitor had a cotton spool taped to the tail with biodegradable sticky tape (a method suggested by reptile specialist Gerry Swan). The cotton line was later followed with GPS to two (2) burrow locations, one (1) located just within the development area and the other located just outside of the north eastern portion of the proposed development area extent (see Figure 2).

Based on the age of the trapped goannas we estimate that there is a minimum of three (3) Rosenberg's Goannas utilising the site's habitats. Rosenberg's Goanna was observed using the edge of tracks for basking and presumably can move around more easily using walking trails.

The rocky escarpment edge surrounding the proposed development area extent are important for this species providing a number of burrowing opportunities particularly where termite mounds are found (see Figure 6 of the Ecological Assessment 2013).

Rosenberg's Goanna has also been observed using a wide range of vegetation types in the Shoalhaven area using Shale Sandstone Transition Forest, Turpentine Forest, Sandstone Forest, Heath Woodland and Mallee Heath (Gerry Swan pers.com. 2012). Therefore, this species may be more of a generalist than currently believed and may utilise most habitat areas within its home range for foraging.

No terrestrial termite mounds have been recorded present within the development area to date. Termite mounds may also be present further abroad and foraging opportunities are still present in the locality.

Recognised reptile specialist, Mr Gerry Swan, was engaged to undertake a site study on Rosenberg's Goanna which has resulted in the observation of one (1) termite mound with a

juvenile exit point and several more burrows (see Appendix 5 for *Cygnets Surveys and Consultancy Report*, November 2012). This termite mound and recorded burrows are located outside of the proposed development area. Further burrows have been identified in suitable habitat areas to the north and north-west of the proposed development area.

Mr Swan has concluded that the proposed development site is not critical to the survival of the population, that there is adequate habitat surrounding the proposed residential development site to maintain a viable population, and the proposed residential development is not likely to result in a significant restriction on the movement of the local population. Mr Swan states that the proposed development is not likely to have a significant impact on the Rosenberg's Goanna population. Interface management between the development area and mapped critical habitat areas as identified by Mr Swan needs to be investigated.

A 1,500m fire trail is proposed to run along a lower contour approximately 100m to the north of the proposed subdivision area boundary. Some of this trail will utilise the existing Heath Trail. It is recommended that this constructed trail will need to be accurately located by land survey in association with targeted habitat searches to ensure that no Rosenberg's Goanna burrows or potential nesting mounds will be impacted by this clearance.

This species may be restricted by Mona Vale Road to the north and urban development in the remaining surrounds. However as this species is capable of and has been previously observed crossing roads (despite the risk of collisions), the home ranges are likely to be large and capable of extending beyond existing unfenced road corridors (Gerry Swan pers.com. 2012). Home ranges for this species (at least on Kangaroo Island) for thirteen (13) studied animals ranged from 1.71ha to 43.7ha with a mean of 19.44ha. The proposed residential area is quite small compared to the total available habitat in the locality (Gerry Swan pers.com. 2012).

Little Lorikeet (*Glossopsitta pusilla*)

Little Lorikeets mostly occur 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).

The proposed development area provides sub-optimal foraging habitat for the Little Lorikeet. This species was recorded during initial surveys in 2008, however the location of the recording was not documented as the species was not listed as threatened at this time. No Little Lorikeets were recorded during 2011 or during recent 2012 surveys over two (2) weeks during the breeding period, suggesting that breeding is not taking place within the proposed development area or nearby. Development within the proposed development area would remove seasonally available foraging resources (excluding winter), however, would not be considered likely to significantly impact on this species.

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 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 proposed development area provides no suitable breeding hollows for the Powerful Owl. No suitable hollows were observed in the nearby surrounds. The proposed development area also provides unlikely roosting habitat. Powerful Owl may utilise the site

for foraging, given the presence of arboreal prey species, however, these are present in low density given the low density of available hollow resources.

The Powerful Owl was recorded responding to call playback during 2008 surveys. Call playback may call owls away from core foraging and roosting areas. No sign of owl activity but evidence of whitewash below roosting locations was found evident in the low Open Forest areas during extensive surveys to date. This species is therefore not likely to be significantly impacted by development within the proposed development area.

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.

The proposed development area provides no suitable roosting or breeding habitat for the Grey-headed Flying-fox. A nearby large camp is located at Gordon over 3.5km from the proposed development area and individuals observed during surveys were likely foraging out from this camp site. The proposed development area provides seasonal foraging opportunity for the Grey-headed Flying-fox (excluding winter) within the low Open Forest areas. Loss of habitat within the development area will reduce foraging resources within the locality, however, this is not likely to cause a significant impact on this species.

Little Bentwing-bat (*Miniopterus australis*) and Eastern Bentwing-bat (*Miniopterus orianae oceanensis*)

These species are considered here together due to similar habitat requirements.

The Little Bentwing-bat forages below the canopy and the Eastern Bentwing-bat forages above and below the canopy within Open Forests and woodlands, feeding on small insects. The 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 for both species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer 1995).

Both of these species were recorded during recent 2012 surveys by only one or two call sequence (passes) on the *Anabat* recorder. Neither species were recorded during previous *Anabat* surveys. This suggests only low use of the proposed development area, which is understandable due to the predominant heath structure within the site.

Whilst suitable caves for roosting and breeding may be present in the surrounding locality, and perhaps the nearby central south of the proposed development area, there are no such opportunities within the proposed development area itself. Therefore, development within the proposed development area will impact only on suitable foraging habitat for both species. Such removal of foraging habitat will not likely result in a significant impact for either of these species.

Eastern Pygmy Possum (*Cercartetus nanus*)

The Eastern Pygmy Possum is found from rainforest through sclerophyll forest to heath. Banksia and myrtaceous shrubs and trees are favoured (Turner and Ward, 2008). An important determinant of habitat quality may be the proportion of the year in which pollen is

available and the species is usually associated with floristically diverse shrub community, especially those including *Banksia* species.

The proposed development area provides suitable habitat for the Eastern Pygmy Possum based on the floristic diversity within the Heath and Open Forest communities due to the presence of several *Banksia* species. Most local records are located on the other side of Forest Way, however one record exists within 700m to the west in 2003 suggesting that a population is present in the surrounding connective landscape.

This species was not recorded during initial surveys by *Travers bushfire & ecology*. Warringah Council recently recorded this species by observation of an adult and two juveniles in a Scribbly Gum hollow on 5 June 2013 inside the north western portion of the development footprint. Following this recording specialist Dr Ross Goldingay was engaged to undertake a site visit and review impacts on this species. During the site walkover with Dr Goldingay a second low hollow was found in an *Angophora crassifolia* with bedding material consistent with the species (see Figure 4 for locations).

At the recorded locations habitat for this species is considered highly suitable given the high density of *Banksia ericifolia* which occurs at highest densities at the outer plateau areas and the surrounding moderate escarpments particularly towards the north where Lambert soils types continue in lower gradual contours extending well into the proposed offset areas. This recording and the presence of young confirms the use of the site for denning and breeding. The proposal will therefore impact on denning, breeding and foraging habitat.

Dr Goldingay's report on habitat of the Eastern Pygmy Possum on land near Ralston Avenue, Belrose (August 2013) is provided in Appendix 7. Dr Goldingay concluded the following key points:

- The main point of interest is that the tall heathland with higher densities of various banksia species will be most influential and is likely to drive breeding in the local population.
- Many scribbly gums (*E. haemastoma*) within the low open forest of the proposed development area contained small hollows; however relatively few of the trees that were inspected within the offset areas contained hollows.
- Important areas of foraging habitat and breeding habitat will be affected by the proposed development.
- Impacts on the Eastern Pygmy Possum from the proposed residential development could be direct and indirect. The loss of habitat from clearing for the residential development would have a direct impact. The most serious indirect impact from the development would be if residents in the area keep house cats. This indirect impact of the development could be removed by proposing that cat ownership be disallowed in the residential development.
- Foraging habitat for the Eastern Pygmy Possum appears to encompass almost all vegetation communities in the study area (proposed residential area, APZ and Offset lands) with the exception of the modified community (Community E) and possibly the riparian woodland-forest (not examined). The most important community would be the Tall Heath (Community B) due to the high density of *B. ericifolia*
- Brief examination of the area bounded by the proposed residential area and APZ suggest that scribbly gums within the low open forest may be the primary source of tree hollows to be used for breeding.
- It is difficult to estimate the overall impact of the proposed development on the local population of the Eastern Pygmy Possum because population studies on this species are difficult to conduct and none with sufficient detail has been published. The impact of the loss of 6.9ha of high quality foraging habitat (Tall Heath) may be sustainable when offset by 20.1ha in the Offset Lands. The loss of breeding habitat

if defined by the Low Open Forest in the development area (9.0ha) may be sustainable if offset by 38.8ha of Low Open Forest in the offset lands and it provides equivalent breeding habitat. Further surveys are required to determine the adequacy of the offset.

- Further surveys to detect presence are not warranted. However, what is required is more detailed information on the distribution and abundance of tree hollows that potentially provide breeding sites for the Eastern Pygmy Possum. This would provide more confidence in determining whether the offset lands provide important areas of breeding habitat in comparison to what may be lost in the development area. Someone with specialist knowledge of tree hollows used by Eastern Pygmy Possums would be desirable.
- Another key point with having confidence that the proposal will not have a significant impact on the local population is knowing whether there are opportunities for individuals to disperse east and west across the Forest Way between the adjoining National Parks. This should be investigated. If none are present rope-bridges could also be useful for this species. Ultimately, broader connectivity will provide greater confidence that the loss of habitat will not threaten a local population.
- There is no separation of important habitat areas from the proposed residential zone.
- The spatial location of the proposed development will not pose a particular restriction on movements by the local population.

In the absence of the further information as recommended by Dr Goldingay, it is currently concluded that the proposal has potential to impact on the local population of Eastern Pygmy Possum.

THREATENED SPECIES WITH CONSIDERED POTENTIAL TO OCCUR

Swift Parrot (*Lathamus discolor*)

The Swift Parrot is a migratory species that breeds in Tasmania and its offshore islands in summer. In late March, almost the entire population migrates to mainland Australia spreading from Victoria through to central and coastal NSW and south east Queensland (Schodde and Tidemann, 1986). Winter flowering trees are an important resource for this species.

The recorded eucalypt trees present within the proposed development area are not recognised winter flowering species. The potential presence of Swift Parrot is based on a very close record to the north of the proposed development area in 2009. However, this species is not likely to be significantly impacted by the proposal.

Barking Owl (*Ninox connivens*)

The Barking Owl utilises dry sclerophyll forests and woodlands containing many large trees suitable for roosting or breeding and will utilise adjacent cleared areas for foraging. The Barking Owl utilises large hollows for nesting (Schodde & Tidemann 1986).

The Barking Owl has been recorded nearby to the south west in 1999, as well as a recording of the (likely) same pair in 2003 further south in the same connective forest area. Given the expected lifespan and home range of this species, there is potential utilisation of the site.

The proposed development area provides sub-optimal habitat for this species which may be utilised for foraging but will unlikely be utilised for roosting and contains no suitable hollows for breeding. There were no signs of owl activity within the proposed development area

during recent extensive field investigations. Therefore, this species is not likely to be significantly impacted by the proposal.

Spotted-tailed Quoll (*Dasyurus maculatus*)

The southern subspecies of Spotted-tailed Quoll *D. m. maculatus* inhabits a range of treed habitats including rainforests, wet and dry sclerophyll forests, woodland and coastal heathland, scrub and dunes, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas (Belcher et al. 2008, Long & Nelson 2010).

Quolls favour areas with dense over storey and understorey and use hollow bearing trees, hollow tree buttresses, fallen logs, small caves, rock crevices, boulder fields, rocky cliff faces and underground burrows as den sites for shelter / breeding (Long & Nelson 2010). Multiple dens are used and movement between these is every 1-4 days. It appears to prefer moist forest types and inland riparian habitat for movement. Despite its occurrence in inland riparian areas, it also ranges over dry ridges (NPWS 1999).

Female home ranges are generally non-overlapping and 88-1,515ha in size. Male home ranges are much larger, from 359-5,512ha in size, and overlap and encompass multiple female home ranges. The species is capable of covering large distances in a short period of time, with animals recorded moving at least 8km in a day and 19km in a week (Long & Nelson 2010). Habitat that is critical to the survival of the Spotted-tailed Quoll includes large patches of forest with adequate denning resources and relatively high densities of medium sized mammalian prey.

The proposed development area provides suitable habitat for the Spotted-tailed Quoll and utilisation of the site on occasion is expected, based on records, the large home range of the species and preference for a range of habitats. Three (3) records along the urban interface of Belrose and Davidson from 1993 were taken on successive days and may have been the same individual or part of a single study. The species is likely to be utilising the nearby connective habitats given a record to the nearby west in 2009. The habitat attributes of the site make it a potential foraging area and the rocky escarpment, particularly the cave system to the immediate south, may be utilised for denning.

The Spotted-tailed Quoll has not been recorded during targeted trapping effort to date. However, given the species difficulty in capture, and large home ranges, the site may still prove part of this species range. However this species is not likely to be significantly affected by the proposed development based on the extent of suitable habitat in the local surrounds, the presence of better denning opportunities below the escarpment and the absence of recorded activity within the site to date.

Southern Brown Bandicoot (*Isodon obesulus*)

The Southern Brown Bandicoot has been detected in a range of habitats including Open Forest, woodland, heaths, agricultural land and urban areas, preferring areas with thick ground cover which provide protection from predators (Braithwaite, 1988). Environment Australia (2000) recorded this species from a range of habitat types, though it was more typically found in heathland environments on sandy friable soils. When located in forests and woodlands there is generally a healthy or shrubby understorey characterised by *Acacia*, *Banksia*, *Daviesia*, *Epacris*, *Hakea*, *Leptospermum*, *Melaleuca* and *Platylobium* species.

Distribution is patchy along the NSW coast and foothills with current information suggesting only two population strongholds, one in the far south eastern corner and the other within the Northern Sydney Metropolitan Area. Research undertaken by Macquarie University indicates that the sub-populations within Ku-ring-gai and Garigal National Parks may have been genetically different (DEC 2006). Additionally, this species is found to display a

preference for newly regenerating natural heathland habitat following fire or clearing (Menkhorst & Seebeck (1990); Braithwaite and Gullan (1978); Stoddart and Braithwaite (1979); Opie 1980).

The proposed development area provides suitable habitat for the Southern Brown Bandicoot. The species was expected to occur, based on nearby records, in similar habitat to the north, west and south of the proposed development area (see Figure 10 of the Ecological Assessment 2013).

Recent 2012 cage trapping effort was undertaken extensively throughout the proposed development area for ten (10) consecutive nights for one (1) session. Prior to this, cage trapping effort in 2011 was undertaken less extensively for four (4) consecutive nights. Supplementary survey effort using hair tubes and use of infra-red cameras have also been undertaken such that effort is considered sufficient in consideration to suggested methods outlined within the *Working Draft Threatened Species Survey and Assessment Guidelines* (DEC 2004).

The proposal is not considered to have a significant impact on the South Brown Bandicoot in the absence of the species to date within the subject site.

New Holland Mouse (*Pseudomys novaehollandiae*)

Across the species' range, the New Holland Mouse is known to inhabit open heathland, open woodland with a heathland understorey and vegetated sand dunes (Fox & Fox (1978); Fox & McKay (1981); Hocking (1980); Keith & Calaby (1968); Lazenby et al. (2008); Norton (1987); Posamentier & Recher (1974); Pye (1991); Wilson (1991)). Sites where the New Holland Mouse is found are often high in floristic diversity, especially leguminous perennials (Haering & Fox (1997); Kemper & Wilson (2008)). The species has been found to peak in abundance during the early to mid-stages of vegetation succession three to five years after fire (Braithwaite & Gullan (1978); Fox & Fox (1978); Fox & McKay (1981); Posamentier & Recher (1974)).

The proposed development area provides suitable habitat for the New Holland Mouse based on the sandy substrate, presence of heath and high floristic diversity. Not many records are known of this species in Northern Sydney, however, one (1) record exists to the nearby south west in 2001.

This species has not been recorded present during survey undertaken to date. The proposal is not considered to have a significant impact on the New Holland Mouse in the absence of the species to date within the subject site.

Acacia bynoeana

There are only a few localised records of *Acacia bynoeana*. The vegetation near to disturbance area such as the existing trails may provide low potential habitat for the species.

No specimens have been observed and there is similar and ample habitat within the offset areas. This species will not be significantly impacted by the proposed development.

Callistemon linearifolius

The possible habitat is likely to be in close proximity to drainage lines. The majority of the drainage lines will be within offset areas. No specimens have been observed. This species will not be significantly impacted by the proposed development.

Epacris purpurascens* var. *purpurascens

The possible habitat is likely to be in close proximity to drainage lines. The majority of the drainage lines will be within offset areas. No specimens have been observed. This species will not be significantly impacted by the proposed development.

Eucalyptus camfieldii

The plateau area would provide the most suitable potential habitat for this species. No specimens have been noted during any of the botanical surveys to date. Some potential habitat exists within the offset areas also but only a small percentage. This species will not be significantly impacted by the proposed development.

Haloragodendron lucasii

The possible habitat is likely to be in close proximity to drainage lines. The majority of the drainage lines will be within offset areas. No specimens have been observed. This species will not be significantly impacted by the proposed development.

Lasiopetalum joyceae

Some vegetation types within the subject site may provide suitable habitat but the known geographic distribution of the species does not cover Belrose, making the subject site only contain low level suitability. The same vegetation types for which it prefers also occur within the offset area. No specimens have been observed. This species will not be significantly impacted by the proposed development.

Melaleuca deanei

This species often grows on or near plateau areas within woodland/open forest with a heathy understorey. The taller vegetation units on site may provide some suitable habitat. These vegetation units are extensive within the offset area and no specimens have been observed. This species will not be significantly impacted by the proposed development.

Microtus angusii

This species only has marginal habitat present as there are no records within a 5km radius. Surveys have been undertaken during its known flowering period of May to October and no specimens have been observed. Similar extensive habitat is also present within the offset area. This species will not be significantly impacted by the proposed development.

Persoonia hirsuta

This species often grows on plateau areas or upper slopes within woodland/open forest with a heathy understorey. The taller vegetation units on site may provide some suitable habitat. These vegetation units are extensive within the offset area and no specimens have been observed. This species will not be significantly impacted by the proposed development.

Pimelea curviflora* var. *curviflora

This species often grows on or near plateau areas within woodland/open forest with a heathy understorey. The taller vegetation units on site may provide some suitable habitat. The species also responds well to fire and has been noted to occur in large numbers a few years post fire in the area of Duffys Forest. The more likely potential locations for this species is towards the electrical substation or in the far north-east of the subject site. These vegetation units are extensive within the offset area and no specimens have been observed. This species will not be significantly impacted by the proposed development.

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 identified specifically to the Warringah LGA.

The site does fall within the Sydney Metropolitan Catchment Management Authority area. An endangered population of White-fronted Chat (*Epthianura albifrons*) is also identified to the Sydney Metropolitan Catchment Management Authority area. This is made up of two known isolated sub-populations; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. This species was not recorded present during surveys and the subject site provides unlikely habitat for this species.

Therefore, it is considered that the action proposed is not likely to have an adverse effect on the life cycle of these species that constitute the endangered populations such that a viable local population of these species is likely to be placed at risk of extinction.

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*

One EEC, Coastal Upland Swamp in the Sydney Basin Bioregion, was observed within the subject site. The EEC occurs on the southern side of Ralston Avenue and continues further south into the offset area. The proposal currently impacts no EEC, all of which shall be conserved within the proposed offset. The development has been modified to achieve this level of conservation. There may be further small and isolated patches within the broader offset area that were not observed due to time constraints and limited access. Indeed, adjoining areas within the substation lands would be considered as part of the local occurrence as well as Garigal National Park within the Fireclay Gully catchment as they are both within a 500m radius of the proposed development area.

The protection of the higher quality and larger remnants within the development area through the provision of a buffer system and stormwater treatment, as well as conservation of those known areas outside of the development area would see only a low level impact upon the EEC within the locality.

The development proposal is not 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.

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

The proposed subdivision will not substantially and adversely modify the composition of this EEC such that the local occurrence is likely to be placed at risk of 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, *Callistemon linearifolius*, *Epacris purpurascens* var. *purpurascens*, *Eucalyptus camfieldii*, *Grevillea caleyi*, *Haloragodendron lucasii*, *Lasiopetalum joyceae*, *Melaleuca*

deanei, *Microtis angusii*, *Persoonia hirsuta*, *Pimelea curviflora* var. *curviflora*, *Tetratheca glandulosa*, Coastal Upland Swamp, Giant Burrowing Frog, Red-crowned Toadlet, Rosenberg's Goanna, Little Eagle, Gang-gang Cockatoo, Glossy Black-Cockatoo, Little Lorikeet, Swift Parrot, Barking Owl, Powerful Owl, Masked Owl, Varied Sittella, Scarlet Robin, Spotted-tailed Quoll, Southern Brown Bandicoot, Koala, Eastern Pygmy Possum, Grey-headed Flying-fox, Yellow-bellied Sheath-tail-bat, East-coast Freetail Bat, Little Bentwing-bat, Eastern Bentwing-bat and Greater Broad-nosed Bat.

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

The total area of impact (to the outer edge of the APZ) is estimated to be approximately 23.32ha.

- EEC – 0.13 ha loss.
- *Acacia bynoeana* - edges of vegetation only and low potential, less than 3ha.
- *Callistemon linearifolius* and *Epacris purpurascens* var. *purpurascens* – moist areas near drainages, less than 1ha.
- *Eucalyptus camfieldii* and *Pimelea curviflora* var. *curviflora* - approximately 25-50% of the subject site, 6-13ha.
- *Grevillea caleyi* and *Persoonia hirsuta* - approximately 3.5ha of the taller vegetation units.
- *Haloragodendron lucasii* - sheltered slopes only, less than 3ha with more habitat conserved in the offset portion.
- *Lasiopetalum joyceae* and *Tetratheca glandulosa* - maximum of 22ha, with little to no habitat expected in vegetation communities B2, E, F and G. Of the 22ha, there would also be very limited habitat in vegetation community A which represents a further 2.44ha.
- *Melaleuca deanei* & *Microtis angusii* - less than 1ha.
- Red-crowned Toadlet - four (4) identified local breeding locations and surrounding habitat for shelter, foraging and dispersal.
- Giant Burrowing Frog - potential foraging and dispersal areas will be affected but is unable to be quantified.
- Rosenberg's Goanna - loss of foraging habitat within the subject site. All seven (7) recorded burrow locations are all just outside of the subject site area to the north.
- Eastern Pygmy Possum - Heath and low open forest within the subject site may be utilised for foraging, potential denning and breeding habitat.
- Little Lorikeet - All areas mapped as Low Open Forest, Open Forest or Riparian Woodland / Forest.
- Powerful Owl - All areas mapped as Open Forest or Riparian Woodland / Forest within the subject site may be utilised for foraging only.

- Grey-headed Flying-fox - All areas mapped as Low Open Forest, Open Forest or Riparian Woodland / Forest within the subject site may be utilised for foraging only.
- Eastern Bentwing-bat and Little Bentwing-bat - The total subject site area may be used for foraging only. Roosting and unlikely breeding habitat may be present within any suitable caves that may be present in the surrounding escarpment to the south.

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 subject site is located on a plateau area extending west from the existing Belrose residential area and electrical substation. The steeper slopes surrounding the proposed subdivision will be retained and form part of an extensive vegetated corridor comprising of Garigal National Park. The narrowest point, if the subdivision was to be approved, would remain over 1.5km wide.

For all fauna threatened species recorded or with potential to occur, connectivity will remain through the local landscape and no isolation and fragmentation of habitat will result. This is given that the development extends off the Belrose urban landscape and movement pathways will remain around the naturally vegetated perimeter.

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 habitat present within the subject contains short heath and hanging swamp type communities that are poorly represented in the local area. These types of communities are generally considered the most important for particular threatened fauna in the local area such as Rosenberg's Goanna and Red-crowned Toadlet.

Following the recorded presence of a number of threatened species, there was particular concern of the importance of the subject site for Giant Burrowing Frog, Rosenberg's Goanna and Red-crowned Toadlet. The frog specialist Prof Michael Mahony and reptile specialist Gerry Swan were engaged to undertake further surveys, habitat assessment and review of impacts of the proposal. Both of these specialists provided report which are attached in Appendix 5 & 6 of the Ecological Assessment (*Travers bushfire & ecology* 2013).

Whilst a juvenile Giant Burrowing Frog was recorded within the subject site during 2012 and the site contains a number of suitable burrowing habitat areas, the site is not important habitat for this species given that the nearest breeding location found was over 300m from the development edge. The subject site, at best, represents dispersal habitat for juvenile Giant Burrowing Frog.

The site is utilised for foraging by the Rosenberg's Goanna. However, Mr Swan identified three (3) areas to the nearby north as the important habitat areas based on habitat and rock structures, aspect, recorded burrows, observed activity, recorded presence of termite mounds. Remaining portions of the subject site are not considered important due to the absence of termite mounds for nesting and burrows within the site.

In summary, the natural habitat within the subject site and surrounding offset areas offers habitat for a range of threatened species. The habitat to be removed or modified is in a minor part important as breeding habitat for Red-crowned Toadlet and Eastern Pygmy Possum.

For the Red-crowned Toadlet, breeding habitat is well represented within the nearby surrounding locality.

For the Eastern Pygmy Possum, the importance of the habitat within the subject site is yet to be determined by further survey on the availability of sufficient breeding habitat within the offset areas. Extensive areas of suitable foraging habitat are well represented in the surrounding habitats within the offset area. The removal of habitat for this species has potential to impact on the long-term survival of the species in the locality.

For threatened flora species, the variable habitats and vegetation communities are represented both within the development area and offset area. Sandstone gully forest has a much higher representation within offset lands and on the other hand, the short heath has limited representation within the offset lands. EEC vegetation is represented in both the development and offset area with no more than an 8% loss of the known habitat.

Rare or threatened flora species and associated habitat are both represented within the development and offset areas.

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:

- *Darwinia biflora* (DEC 2004)
- *Grevillea caleyi* (DEC 2004)
- Large Forest Owls ((Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*)) (DEC 2006)
- *Microtis angusii* (DECCW 2010)
- Southern Brown Bandicoot (*Isodon obesulus*) (DEC 2006)

In the absence of recording the Southern Brown Bandicoot, 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 (<i>Oryctolagus cuniculus</i>)	✓		
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 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 <i>Psittacine circoviral</i> (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 <i>Phytophthora cinnamomi</i>		✓	
Introduction of the large earth bumblebee (<i>Bombus terrestris</i>)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch Broom (<i>Cytisus scoparius</i>)			✓
Invasion and establishment of the Cane Toad (<i>Bufo marinus</i>)			✓
Invasion, establishment and spread of <i>Lantana camara</i>		✓	
Invasion of native plant communities by bitou bush and boneseed <i>Chrysanthemoides monilifera</i>			✓
Invasion of native plant communities by exotic perennial grasses	✓		
Invasion of native plant communities by African Olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>)			✓
Invasion of the Yellow Crazy Ant (<i>Anoplolepis gracilipes</i>)			✓
Loss of hollow bearing trees	✓		
Loss and/or degradation of sites used for hill-topping by butterflies	✓		
Predation and hybridisation by feral dogs (<i>Canis lupus</i>)		✓	

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
<i>familiaris</i>)			
Predation by the European Red Fox (<i>Vulpes vulpes</i>)			✓
Predation by the Feral Cat (<i>Felis catus</i>)		✓	
Predation by Plague Minnow or Mosquito Fish (<i>Gambusia holbrooki</i>)		✓	
Predation by the Ship Rat (<i>Rattus rattus</i>) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease transmission from Feral pigs (<i>Sus scrofa</i>)			✓
Removal of dead wood and dead trees	✓		

Summary of “likely” or “possible” Key Threatening Processes

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The proposal is likely to modify and re-divert stormwater runoff from development areas (impermeable road and property surfaces) and concentrate this increased flow into surrounding selected drainages.

The existing Sydney-east substation adjacent to the subject site provides a case study of such drainage alterations. Runoff from the substation is directed to a drainage that flows south as well as the major drainage line that flows north west from the plateau. Both of these drainages have been modified from an ephemeral drainage likely suitable for use by local occurring threatened frog species to more permanent drainages more suited to common frog species. Due to the more consistent presence of water these drainages are noticeably subject to higher weed incursion and low frog species diversity, particularly in the upper reaches. Both of these drainages, as with the other drainages from the plateau surrounding the proposed development, flow into Garigal National Park.

Consideration is to be given to the impact of the proposed action on local watercourses and native vegetation riparian buffers and stormwater measures will need to be implemented. The proposal will need to achieve high level performance targets for water quality and quantity into the surrounding natural drainages, particularly where threatened frogs species have been recorded.

Human-caused Climate Change

The proposal will require the removal of native vegetation 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 is part of a cumulative effect of vegetation clearance and thus should be considered as contributing to this threatening process.

Bushrock removal

The proposal will remove naturally occurring bushrock outcroppings 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 within the outer extent of the development area extends into the upper escarpment area of outcroppings surrounding the plateau. Such areas are utilised by a diversity of reptile species including the recorded threatened Rosenberg's Goanna.

In respect to the Rosenberg's Goanna alone, specialist Gerry Swan has determined that the important areas for this species are located outside of the development landscape and as such extensive suitable rocky habitats for burrows exist in the remaining landscape.

Clearing of native vegetation

The proposal will remove or modify up to 23.32ha of native vegetation area for residential lots, access roads, services and asset protection zones. Therefore, the proposal in this regard is a class of development recognised as a threatening process. The proposed fire trail to the north of the development will be approximately 4m wide and being in the vicinity of 1.5km in length, this would equate to the removal of a further 0.6ha of vegetation / habitat.

Competition and grazing by the feral European rabbit

European Rabbits were recorded present within the managed lawn areas of the residence located to the west of the substation and at the entry to the subject site. It is expected that the proposed development will increase the potential for rabbit invasion through clearance of natural bushland and replacement with large areas of managed grasses. Therefore the proposal is likely to contribute to this threatening process if appropriate rabbit management is not undertaken. Rabbit management and control such as through exclusion fencing, destruction of warrens and target *Pindone* baiting is recommended as a standard protocol.

High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition

The proposal will result in increased human presence surrounding the local bushland interface which is a vegetation structure susceptible to fire. Increased human presence results in increased potential for ignition points for fires into the surrounding landscape.

The use of fire to remove fuels in asset protection zones may affect all known threatened species that are known to occur or have potential habitat. It may be considered too frequent for some species which have low germination rates in post-fire events (or are killed by fire) or for fauna species that are not able to move away or burrow (or protect) themselves.

Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis

The proposal will result in the increased possibility of *chytrid* fungus cross-contamination from pedestrian and vehicle activity during the construction phase as well as potential through increase presence of human activity post development. It would be recommended to ensure that equipment working within wet areas on other sites are appropriately cleaned and left to dry before entering the subject site for use.

All natural drainages outside of the development area are to be appropriately fenced and strictly managed to ensure minimal impact during development.

*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 particularly during land clearance and construction. 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

The '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, establishment and spread of Lantana camara

The site currently contains this species and ineffective management can result in spread during and following land clearance and development. It is expected that the proposed development will provide an opportunity to remove, control and manage this species throughout the whole of the site by the application of a bushland management plan.

Invasion of native plant communities by exotic perennial grasses

The proposal is of a class of development recognised as a threatening process due to possible incursions of grasses such as *Pennisetum clandestinum* (Kikuyu) into natural bushland fringes following development. The proposal is a likely threatening process in this regard.

Loss of hollow bearing trees

Hollow bearing tree surveys have not been undertaken across the proposed development area. It may however be stated, based on field observations and vegetation structure, that no large hollows suitable for owls, parrots or cockatoos are present within this landscape. Hollows are present in small sizes classes and in low density with highest densities expected in the Scribbly Gum fringes in the central northern portions of the subject site.

The proposal will require the removal of hollow bearing trees and as such is of a class of development recognised as a threatening process. Threatened species with suitable habitat within the site and dependant on hollows of this nature include Spotted-tailed Quoll, Eastern Pygmy Possum, East-coast Freetail Bat and Greater Broad-nosed Bat. Eastern Pygmy Possum has been recorded utilising hollows present within the proposed development landscape. The replacement of hollows within the surrounding conservation areas is recommended to supplement the loss of hollows within the development landscape. Such boxes or relocated hollows would need to be suitable for use by Eastern Pygmy Possum.

Loss and degradation of sites used for hill-topping by butterflies

Many butterfly species, appear to be obligatory hill-toppers and tend to congregate on hill or ridge tops that are usually higher than the surrounding countryside as a focus area for mating. The nature of the sites varies and a site may be as small as a few square metres or may cover several hectares, or display minor or very marked topographic relief. The same sites are used year after year, whilst apparently similar nearby sites may not be used. Sites do not necessarily provide nectar food sources for the butterflies or food plants for the next generation of caterpillars.

Hill-top aggregations are essential for continuity of the reproductive cycle of some butterfly species, and hill-top sites may constitute vital focal points for such aggregations. The

importance of hill-topping sites is out of proportion to their extent, so that a small area can be important to the survival of species over a larger area. Hill-topping is often found in species which seasonally or habitually have low density populations and which have a greater need to facilitate male - female encounters (NSW Scientific Committee)

The proposal will require the removal and modification of up to 23.32ha of vegetation located on an undeveloped plateau. The importance of the site for hill topping has not been investigated however butterfly species have been observed present along the plateau areas during survey. In this regard the proposal is of a class of development recognised as a threatening process due to human alterations and increased presence within site hilltop areas which are the main areas designated for development.

Predation and hybridisation by feral dogs (Canis lupus familiaris)

The proposed development may alter impacts on adjoining lands by increasing the numbers of domestic dog ownership and as such the action proposed may increase the potential of this threatening process.

Predation by feral cat (Felis catus)

The proposed development may alter impacts on adjoining lands by increasing the numbers of domestic cat ownership and as such the action proposed may increase the impact of this threatening process.

Predation by Plague Minnow or Mosquito Fish (Gambusia holbrooki)

The proposal will require the implementation of stormwater management methods which may include open water swales. Such areas will be susceptible to invasion by Plague Minnow if of a permanent nature. The *Threat Abatement Plan for Predation by The Plague Minnow* (NPWS 2003) states that the only effective control measures to achieve effective control of Gambusia is to drain and dry out the basin. This process will kill all fish species present and often other fauna species.

Removal of dead wood and dead trees

The proposal will require the removal of deadwood and dead trees through the naturally vegetated landscape and as such is of a class of development recognised as a threatening process. Threatened fauna species with potential habitat within the subject site and with varying dependence on dead wood or dead trees include Red-crowned Toadlet, Varied Sittella, Scarlet Robin and Eastern Pygmy Possum.



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.



Rosenberg's Goanna Advice - Gerry Swan

A5

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19th November 2012

To:
Michael Sheather-Reid,
Travers bushfire & ecology,
38A The Avenue, Mt Penang Parklands,
Central Coast Highway,
Kariong, NSW 2250

Dear Michael,

**Belrose Planning Proposal
– Preliminary Report on Rosenberg Goanna**

Between the 17th and 20th November I carried out an extensive survey of areas adjacent to the proposed subdivision for the purpose of evaluating whether or not the population of Heath Monitors (Rosenberg Goanna) at the site would be significantly impacted. The survey concentrated on locating termite mounds, possible monitor burrows and other evidence of their presence. While not deliberately looking for the monitors themselves, one was seen and the co-ordinates noted.

In total 25 person hours of survey effort were undertaken by myself and another competent herpetologist familiar with the species. Apart from visual inspections while walking through the subdivision site no detailed searching was carried out there as my understanding is that members of the *Travers bushfire and ecology* staff have been in the subdivision area extensively as part of the environmental assessment and have not sighted any mounds to date.

Four areas, labelled A-D on the attached map were inspected in detail for burrows (Figure 1). The white outline (Figure 1) gives the approximate areas we covered during the inspections. We also briefly inspected some adjacent areas of Garigal National Park. Sites A and B were selected because they have rock outcrops and faced north. They could therefore be used by Heath Monitors for shelter in the form of burrows or rock crevices, and for basking. We also wanted to establish if Termite mounds were present. Site C was selected because of rock ledges, low open forest and because it had a different (southerly) aspect. Site D was selected because of the extensive tall heath, open forest and rock outcrops. As it had already been established that Heath Monitors were using the area, the question was, in what capacity was this area being used for such as shelter, basking, foraging and or egg deposition.

Site A Search Area

Three termite mounds were located by GPS in this area (Figure 2). Two were suitable for deposition of eggs by Heath Monitors, the third was very small and unsuitable for that purpose. The location of the termite mounds are shown on figure 2.

You will notice that the photographed mound (mapped as TM (n) for a nest site) has a small hole near the top (Photo 1). This is consistent with the exit hole made by hatchling heath monitors when they leave the mound.

A burrow that could be utilised by Heath monitors was noted at two locations (Figure 2).

A Diamond Python (*Morelia spilota spilota*), and a nest in a rock outcrop, probably that of the Brown Antechinus (*Antechinus stuartii*), an eggshell of the Broad-tailed Gecko (*Phyllurus platurus*), and a snake eggshell, possibly a Common Tree Snake (*Dendrelaphis punctulata*) were also noted.

Site B Search Area

Dense heath, low open forest with scattered rock outcrops and ledges. No termite mounds were located.

Burrows that could be utilised by Heath monitors were noted at 4 locations (Figure 2).

Site C Search Area

Extensive rock outcrops and ledges, heath, low open forest and sandstone gully forest. No termite mounds or burrows were located.

A Blackish Blind Snake (*Ramphotyphlops nigrescens*) was uncovered.

Site D Search Area

NOTE- we accessed this site to the north, outside the range of this map .Our entry point was from the track to a high tension pylon on a trail bordering the site boundary. Dense tall heath with scattered rock outcrops, open forest with extensive outcrops and ledges. No termite mounds were located. A Heath Monitor was observed adjacent to a track (probably in Garigal NP) 0332902 x 6267644 (33°43.081 x 151°11.796). The tracks of a Heath Monitor and of a Diamond Python were seen in the sand beneath a large rock overhang at 0332754 x 6267202 (33°43.321 x 151°11.696). A Cunninghams Skink (*Egernia cunninghami*) was also observed in a rock outcrop.

Discussion

The lack of termite mounds throughout the site is surprising, although I profess to have no expertise regarding termites. Nevertheless we expected to find some in the low open forest, low heath and open tall heath. No doubt some could be present on the ridgetop and surrounding slopes but the possibility is that they may be quite low and small, and unsuitable for egg deposition and extremely difficult to locate. Much

of the heath in the area is very dense and in my experience would have few if any mounds. Similarly open forest is sometimes too shady or moist for mounds.

The ridgeline itself has shallow soils and few exposed rock shelves. Heath Monitor burrows are usually under rock slabs or at the base of outcrops and ledges. Often there is sufficient soft soil in these situations to create burrows. This animal will also utilise crevices under overhangs for shelter. These too sometimes have sufficient soil or fractured rock to enable a burrow to be created. On this site the surrounding slopes and the north east area (Site A) provide such opportunities.

In conclusion I think that at this site the monitors do not limit themselves to heath but make use of all the habitats available within their territory including rock ledges for burrows and basking, tracks for moving about between habitats, heath, woodlands, hanging swamps and watercourses for foraging. Any termite mounds are likely to be in the low woodlands although we did not locate any.

Responses to the four key matters raised in project brief.

Whether the proposed site (sandstone plateau) is critical to the survival of the population and which parts of the landscape are likely to be more important for breeding purposes.

I do not believe the proposed residential site is critical to the survival of the population as it is only part of a much larger area encompassing the offset zone, the rest of the site, Garigal NP, and Ku-ring-gai NP on the other side of Mona Vale Road. The individuals utilising the site are only part of a larger population extending north west across Garigal NP to St Ives, and north into Ku-ring-gai NP and Terry Hills.

Heath Monitors use active termite mounds of a suitable size in which to lay eggs. There are very few such mounds on the proposed residential site therefore it is unlikely to be important for breeding purposes.

Whether there is adequate habitat surrounding the proposed residential zone to support a viable population.

Yes. The local population extends well beyond the residential site. I have observed 5-6 in Garigal NP adjacent to St Ives. I have also recorded them on the streets of St Ives. There is a good population in and around the Wildflower Garden on Mona Vale Road and they are well known from Ku-ring-gai NP.

Whether the planning proposal is likely to result in a significant movement or connectivity restriction on the local population.

No. The proposal would not fragment or isolate areas of habitat and accordingly the local population would not be restricted by the proposed development.

The significance of impact of the proposed rezoning.

Some individual animals may be affected, but there would not be a significant impact because the site does not appear to be important for breeding purposes, and the local population extends well beyond the direct area of impact.

Gerry Swan, Principal
Cygnet Surveys & Consultancy.



Photo 1 - Termite mound at Site A showing the exit hole.

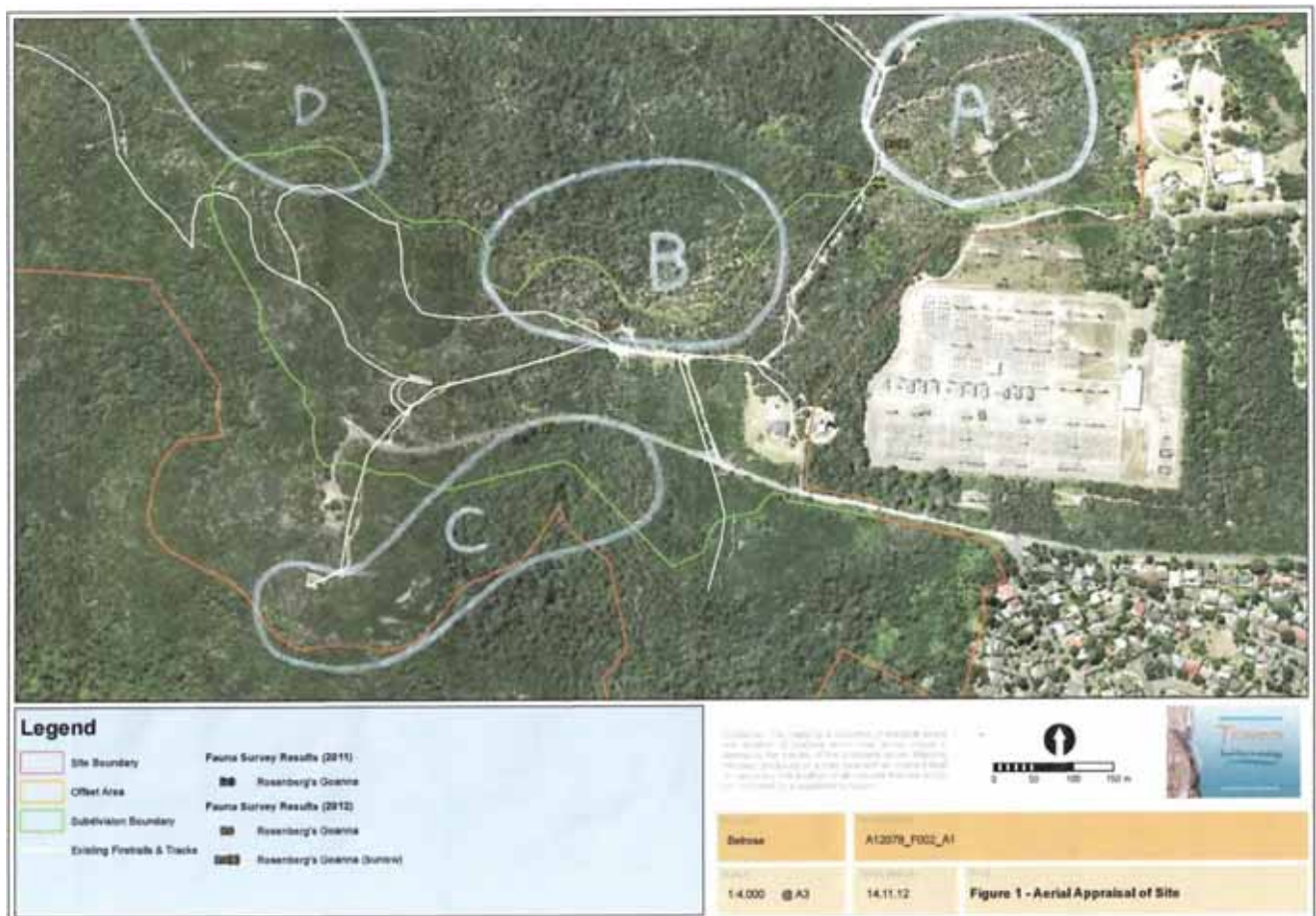


Figure 1 - Map of region showing the four selected survey sites.



Threatened Frog Advice - Prof Michael Mahony

A6

Assessment of the distribution and habitat use by the Giant Burrowing Frog and Red Crowned Toadlet at Ralston Ave Belrose

**Prof Michael Mahony
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June 2013

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EXECUTIVE SUMMARY

In January 2013 a brief was accepted to undertake habitat searches for potential breeding areas of the Giant Burrowing Frog (GBF) at a site at Ralston Avenue Belrose where a planning proposal for a residential subdivision (=subject site) was prepared. In earlier fauna studies conducted at the subject site by Travers Bushfire and Ecology a juvenile GBF had been collected in a trap line on the sandstone plateau at the site within the proposed residential subdivision footprint. The objective of the investigation was to address the significance of impact of the proposal on the GBF; 1) whether habitat on the plateau is critical to the survival of the GBF population and which parts of the landscape (subject site = residential zone, and surrounding areas) are likely to be important for breeding; 2) whether there is adequate habitat surrounding the proposed residential zone to support a viable population; and 3) whether the proposal is likely to result in significant restriction of movement or connectivity for the local population. An assessment of the potential impact of the proposal on the local population of the Red Crowned Toadlet (RCT) which was known from the area was also sought. Advice was also sought on relevant mitigation measures for these two threatened frog species. Habitat assessments at the subject site were conducted in February 2013.

- The outcome of habitat assessment was that there was no identified breeding habitat for the GBF within the subdivision boundary with the possible exception of a small drainage line on the north eastern edge of the subdivision boundary.
- Several breeding locations for the RCT were detected with only one on the plateau, one at the head of a drainage line to the south, and two in a seepage on the north-east of the subdivision zone.
- It was concluded that the potential significance of impact of the proposal on both threatened frog populations may not be from direct removal of breeding habitat on the sandstone plateau, but possibly from the removal of sheltering (burrowing) and foraging habitat of the GBF and RCT. The potential for indirect impact by alteration to hydrology of habitats outside the subject site was noted.
- Following the habitat assessment it was concluded that there was adequate habitat outside the proposed residential zone to support a viable population of the GBF and RCT, but this needed to be confirmed by targeted surveys.
- The potential for the residential zone to disrupt movement corridors for the GBF were assessed and without specific information on the breeding, shelter and foraging habitats the significance of potential corridors was unknown and targeted surveys were recommended.

Following the recommendations from the habitat assessment targeted surveys were conducted to identify likely breeding areas of the GBF including tadpole searches and shelter locations, and to expand on the knowledge of the habitat used by the RCT. Targeted surveys were conducted in the period April to June 2013, and coincided with several significant rainfall events which are known to trigger amphibian activity.

- One breeding site was identified for the GBF. This site is in the valley to the north of the plateau and greater than 300 m from the subject site boundary. Intensive and extensive surveys of semi-permanent and permanent pools in drainage lines emanating from the plateau were undertaken and no other breeding location was found. The seasonal and climatic conditions at the time of the survey were ideal for detection of the GBF.

- No adults or juveniles GBF were detected in habitat considered to be suitable for burrowing or foraging. It is concluded that the density of GBF at the site is low, and that it is most unlikely that habitats on the plateau are used routinely for shelter and foraging. Furthermore, it is not likely that development with break a corridor that connects breeding habitat with foraging and shelter sites since there are no identified breeding sites close to the plateau.
- The considerable distance of the identified breeding habitat from the plateau and the relatively large area of surrounding habitat indicate that indirect impacts on hydrology are unlikely to impact on the GBF breeding habitat.
- In conclusion it is not likely that the proposal will impact on the local viable population of the GBF.
- There is no need for the placement of buffer zones around habitat on the escarpment since there are no identified breeding, sheltering or foraging habitat.
- Additional breeding habitats of the RCT were detected in targeted surveys and twelve breeding locations were identified within the study area outside the subject site. It is concluded that the local population occurs along most of the semi-permanent drainages and soaks that occur near the escarpment and down slope from the plateau. All of these breeding locations will not be directly impacted by the proposed development. There are four identified breeding locations within the subject site; one on the western end of the plateau (human made pit), two on the rock face seepage in the north-east, and one at the head of the drainage line to the south.
- The assessment concludes that movement of the RCT will mostly be in the escarpment and mid-slope areas and development of the plateau will not have a significant effect on the local population due to the removal of habitat or the breaking of corridors.
- The potential for impact on the population of the RCT is assessed to be related mostly to indirect impacts on the hydrology of the breeding habitat (rate, volume, and water quality of discharge). Specific mitigation measures are required to ensure that the hydrology of these sites is not altered by the proposal.

INTRODUCTION

The aim of this survey and assessment was to determine the distribution and abundance of two threatened amphibian species the Giant Burrowing Frog *Heleioporus australiacus* (GBF) and the Red-Crowned Toadlet *Pseudophryne australis* (RCT) on land at Ralston Avenue Belrose. A full description of the subject site and purpose for the assessment is provided in the report by Travers Bushfire and Ecology (2013).

Specifically the survey and assessment aimed to identify the habitat of the two threatened amphibians at the subject site and in the local area, and to assess the potential for the proposal to impact on the local viable population of these frogs. These are terrestrial frogs; they have specific habitat requirements and are listed as habitat specialists under the *NSW Threatened Species Conservation Act* 1995.

The GBF is a large (adults up to 82 mm in length) and robust terrestrial frog. The RCT is also a terrestrial frog but it is relatively small (adults up to 28 mm in body length). As its name suggest the GBF requires suitable sites in which to burrow and seek shelter. These burrowing sites are typically well away from the breeding site and are usually in sandy moist soils that are at least 0.2 m deep (Stauber 2006) and can be found in open forest and heath vegetation communities and less commonly in closed forest (> 70% canopy cover). Adult and juvenile frogs forage on the forest floor at times when the weather conditions are suitable (i.e. moist and humid with low wind so that the animals do not desiccate)(Penman 2005). Breeding sites occur in ephemeral pools and soaks associated with upper level drainages (Penman 2005; Penman, Lemckert et al. 2005; Stauber 2006). The egg mass is deposited in a foamy nest and the tadpoles are aquatic (Anstis 2002). Minimum larval periods ranged from 33 to 47 weeks at 11 breeding sites over a period of two years (Stauber 2006).

The RCT has a very different biology to the GBF. Adults are most commonly associated with breeding sites which are ephemeral pools and soaks that form on the escarpment of eroded Hawkesbury Sandstone parent rock. Adults forage on the forest floor but they spend the majority of their life near to the breeding site (Stauber 2006). The clutch of eggs is composed of a relatively small number (mean of 21) of relative large eggs (ovum diameter 1.6 – 2.8 mm)((Thumm and Mahony 2002; Thumm and Mahony 2005). The clutch is deposited beneath moist leaf litter and soil at the edge of an ephemeral pool. The period of embryonic growth and development can vary greatly depending on the flooding of the ephemeral pool. In many cases the clutch is deposited prior to rain occurring and it is not until the site is flooded that hatching occurs and the tadpole stage is then aquatic (Thumm and Mahony 2002; Thumm and Mahony 2005). There is a level of uncertainty surrounding the length of the tadpole stage mostly because some records are based on tadpoles raised in captivity which may lead to either a faster or slower development rate than in nature. A mean period of 78 days (minimum of 45 days) was determined in captivity with tadpoles held at the field temperature and fed ad libitum (Thumm and Mahony 2005). Hydro-period requirements for RCT tadpoles have been investigated in the field and only 4 of 12 sites with tadpoles resulted in successful metamorphosis and they all required hydroperiods greater than 110 days (Stauber 2006).

Both species occur predominantly on habitats found on Hawkesbury sandstone and to a much lesser degree on the Narrabeen Group of sandstones, both of Triassic origin (Thumm and Mahony 1999). Hawkesbury Sandstone derived soils are shallow (50 cm deep), highly permeable and of low fertility. They include Lithosols, Earthy Sands, Yellow Earths, Yellow and Red Podzolic Soils and Siliceous Sands (Chapman 1989; Chapman 1989). The study area occurs on the Lambert soil landscape unit and the landscape is described as “undulating to rolling low hills on Hawkesbury Sandstone, local relief 20-120

m, slopes < 20%. Rock outcrops > 50%. Broad ridges, gentle to moderately inclined slopes, wide rock benches with low broken scarps, small hanging valleys and areas of poor drainages. Open and close heathlands, scrub and occasional low open-woodland" (Chapman 1989; Chapman 1989).

Most breeding sites of the GBF are located in the upper parts of the topography, i.e. found associated with plateaus and slopes and not the valley floor. Investigations of the aspect of all locations in the NSW Atlas of Wildlife revealed no preference for any aspect segment (Stauber 2006), and there is no indication that aspect plays an important role in the distribution of breeding sites. There is a positive association with moderate slope (i.e. 6 to 11°) and minimal association with flat or steep areas. The Hawkesbury sandstone geology is often found in the higher parts of the topography, a fact reflected in the topographical distribution as well as the landscape morphology of the habitat of both species. Hawkesbury Sandstone weathers into deep precipitous gorges with reasonably sized creeks that flood during rain and then dry to a series of pools. These creeks are fed by numerous laterals of varying sizes and permanence. Most breeding locations of the GBF and RCT are within the top one third of elevated landscapes where these laterals are found (Stauber 2006). Bioclimatic species profiles have been produced for both species (Penman 2005; Stauber 2006) and the principal climatic components of the distributions describe a gradient of increasing precipitation and moisture index, and decreasing radiation, temperature range and temperature maximum. Both frogs mostly occur in areas that experience higher precipitation and associate moisture indices, and lower temperature ranges and lower temperature maxima compared to average values representative of the Sydney Basin. Stauber (2006) postulated that such preferences are likely to be beneficial to the aquatic larvae and terrestrial life stages of both species which require a reasonable period for successful larval growth to metamorphosis. Successful metamorphosis in habitat away from permanent watercourses in places where moisture holding capacity of soils are poor largely depends on replenishing rains, and reduced temperatures that result in lower evaporation rates. A milder climate is expected to convey benefits to tadpole development and provides for an extended breeding and larval period.

The habitat requirements of the GBF have been investigated in several detailed studies (Penman, Lemckert et al. 2005; Stauber 2006; Penman, Mahony et al. 2007; Penman, Lemckert et al. 2008). In summary breeding sites are not usually associated with cliffs, but is found predominantly on the upper slope, but also on mid slope and on flat ridges. The species also utilises gullies. Their habitat occurs in closed forest, open forest, woodland and various heath types. Ground story cover is generally greater than 50% with a mean height of 0.3 to 0.6 m and a diversity classification of 5 to 19 species. Top storey coverage was predominantly 5 to 75% and never exceeded 75%. Coverage from all three layers combined exceeded 75%. Breeding sites are associated with pools and in creeks, and crayfish are usually present and fish are absent. Water courses are ephemeral or spring fed. Breeding pools are semi-permanent (=ephemeral), and generally not permanent with soil or rock shelves making up the substrate and sides. Stauber (2006) found that GBF use flat ridges more often than RCT do. In these situations GBF use pools in hanging swamps or artificial small dams, whereas RCT are absent from such places.

RCT breeding sites are frequently found on the upper slopes or mid slope, but never in gullies or flats, and Thumm and Mahony (2005) reported that 68% are found within 200 m of cliffs. At these sites breeding groups consist of small groups of closely spaced individuals, and aggregations occur in suitable microhabitat (e.g. dense leaf litter piles). Movement of RCTs relative to the breeding locations has been investigated using marked individuals (Thumm 2005; Stauber 2006). In a study period of over 290 day the majority of recaptured individuals (82%) were less than 7.5 m from the location of first capture and the biological interpretation is that the animals showed high site fidelity (Stauber 2006). Low individual movement distances and the aggregation behaviour observed suggest that populations may be able to persist in relatively small areas of suitable habitat. The spatial requirements of individuals and populations however are predicted to be much higher than the space and resources offered by breeding

sites alone. One individual marked female was observed to use habitats that were 200 m apart and this indicates a considerable terrestrial movement for such a small frog.

Breeding biology and larval development of the RCT has also been closely investigated. Thumm (2005) reported a high rate of mortality in the period from embryonic development to metamorphosis and postulated that this was due to the unpredictable nature of rainfall in the Sydney Basin and the ephemeral character of breeding sites used by this frog. In most cases low survival was attributed to drying of the breeding site. This high mortality rate is balanced by a highly specialised breeding biology whereby the adult females are capable of breeding multiple times in a year and in all seasons compared to most frog species where breeding occurs only once and in a specific season.

The specific objectives of this investigation were to:

- Use knowledge of habitat requirements of the GBF and RCT to assess the likely breeding sites, burrowing and foraging habitats, and identify potential movement corridors. Utilise tadpole searches to confirm the occurrence of GBF and RCT breeding sites.
- Conduct terrestrial habitat searches to locate burrowing and foraging habitat.
- Use this information to consider potential impacts on the local viable population and to recommend buffers to protect habitat.

MATERIALS AND METHODS

Throughout this report the following terms are used; the subject site refers to areas within the site boundary (see Figure 1) and are equivalent to the subdivision zone. The study site includes the larger area of the site offset and up to 1 km from the site boundary. The topography, vegetation and condition of the subject site and study area are described in detail in the Ecological Assessment report by Travers Bushfire and Ecology (2013).

Field surveys focused on two target species the Red-crowned Toadlet, *Pseudophryne australis* (RCT) and Giant Burrowing Frog, *Heleioporus australiacus* (GBF), but also recorded the occurrence of other amphibians at the site and other fauna such as crayfish and fish. Often the occurrence of different species provides evidence of habitat quality and associations that provide important information on the likelihood of occurrence of the threatened frogs.

Field surveys for habitat assessment were conducted in the period 8th Feb to 16th Feb 2013. This was followed by targeted surveys conducted between 16th April to 8th June 2013. Nocturnal surveys were conducted on 16/4/2013, 24/4/2013, 8/5/2013, 8/6/2013 and diurnal surveys on 7/5/2013, and 25/5/2013.

Habitat assessment: After inspection of maps of the fauna records and survey outcomes for the subject site and study area, plus vegetation, topographic and soil landscape layers of the study area (see Figure 1), the subject site was inspected on foot. During this broad habitat assessment specific habitats that could potentially be used by the GBF and RCT were identified and a targeted survey strategy developed which involved the field survey methods that are described below. The targeted habitats for the GBF included small drainage lines that emanate from the plateau area, hanging swamps and soaks. Qualitative assessment of the leaf litter depth, soil composition and depth in each of the vegetation units were made by means of a small hand trowel and rule. Targeted searches for the RCT included seepages and soaks associated with the sandstone rock shelves and the coastal upland swamp vegetation community.

Stratification of the study area: The study area was subdivided by vegetation community and landscape into the following areas for field surveys. The plateau (above 155 m contour) which broadly corresponds with the subject site; the escarpment and bench areas below the plateau (below 155 to 125 m contour); mid-slope areas (below 125 m contour) with special emphasis on the drainage lines that emanate from the plateau. The location of semi-permanent (ephemeral) and permanent drainage lines were identified from a topographic map and these were given identifications such as N1 to N4 and S1 to S3 for drainages from the north and south of the plateau respectively.

Visual encounter surveys (VES): This method involves nocturnal searches for frogs using head torches. Adult and juvenile GBF that are active on the soil surface can be detected by spotlighting. This method is not useful for the RCT which does not have suitable reflective eyeshine. VES was conducted in habitats that were considered as suitable for the GBF (plateau, escarpment and benches, and mid-slope areas). Searches involved walking through the stratified habitat areas.

Targeted VES surveys were conducted for the GBF in habitat identified in the preliminary investigation as containing suitable soil structure and in vegetation communities that are known to form part of the preferred habitat for foraging and burrowing. Surveys were conducted along the contours where benches between rock escarpments occurred. These benches provide series of steps in the escarpment and were found to support open forest and heath communities with deep leaf litter and coarse sandy soils to a depth of at least 0.2 m. VES were also conducted along several tracks that run perpendicular to the escarpment (see Figure 1).

Searches of potential breeding habitat: This involved diurnal searches for tadpoles in pools, soaks and drainages. Where tadpoles were found a selection of individuals were collected and placed into clear plastic sample jars with water from the pool (~ 250 ml). Tadpoles were identified by reference to the field guide of Anstis (2002). A hand lens (10X) was used to examine the mouth parts, position of the spiracle, anal opening, pigmentation and body and tail shape of the tadpoles. Tadpoles were returned to the pool after identification. In one case tadpoles were held for a longer period to gain positive identification when one of the descriptive features did not accord with that in the guide of Anstis (2002). A positive identification of the tadpoles of the GBF was obtained from Marion Anstis (May 2013).

Aural surveys (AS): This involved listening for the characteristic male advertisement calls of the target species, and at identified potential habitats it involved the use of call-response. Most aural surveys were conducted during nocturnal surveys but they were also used with diurnal surveys for the RCT.

Automated Sound Recorders (ASR): At three locations that were considered as potential breeding habitat for the GBF and RCT we deployed digital sound recording devices (Songmeter SM2+). The locations were; 1) coastal upland swamp EEC (33° 43' 41.99S 151° 12 18.52E), 2) North-east rock seepage area (33° 43' 29.49S 151° 12 21.84E), and 3) sandstone drainage and pool (33° 43' 24.57S 151° 12 22.43E). They were in place for 54 days (16th April to 8th June) and were programmed to record for a ten minute period every hour between 1400 and 2200 hours. Recorded sound was analysed using the sound recognition software SoundID pro, and positive records were confirmed by listening to playback. To test for false negatives a selection of recorded periods was analysed by listening.

Rainfall: Daily rainfall data (January to June 2013) for the study area was obtained from the Bureau of Meteorology site at Belrose (**Number** 66182, **Lat**: 33.75° S **Lon**: 151.23° E **Elevation**: 158 m). There were several significant rainfall events (i.e. > 50 mm rainfall in 48 hrs) in the first six months of 2013, and where possible field surveys were targeted to follow these events, since amphibian activity is triggered by rainfall and the outcomes of breeding which results in tadpoles can be detected after these events. In late January there was 177 mm of rainfall over a three day period (27 to 29th); in February 52 mm (2nd

and 3rd) and 58 mm (23rd and 24th), in March 65 mm (1st and 2nd), in April 87 mm (3rd to 5th), and in May 72 mm (23rd to 25th).

Targeted field surveys were conducted over a period and in the season when weather conditions were ideal for the detection of the GBF and RCT. The first three months of the year resulted in above average rainfall for the study site. Heavy rainfall events are known to trigger breeding for the GBF and RCT, and the late summer and early autumn period are known to be peaks in the breeding season (Lemckert and Mahony 2008). The equal highest number of recorded male calling observation for the GBF have been made in the February-March period (Lemckert and Mahony 2008).

Results

Giant Burrowing Frog

No adults or juveniles were observed by VES or AS survey methods, and no records of male calling were obtained from the three ASR devices, and none were heard during habitat searches. No adults or juveniles were found in targeted VES along contours and perpendicular to contours, and no adults were observed or heard in searches near the identified breeding location.

Tadpoles, which are a direct indication of a breeding location, were found on the 24/4/2013 at one location (33° 43' 13.09S 151° 11' 54.54E) within the study area but outside the subject site. This breeding site is located towards the bottom of the valley to the north of the plateau in the catchment of Bare Creek. The site is at the base of a relatively large mid-slope area that is dominated by dense low and tall Heath vegetation that has a moderate slope up to 10°. The breeding location consists of a deeply eroded ponded area that feeds into a gutter that runs for a distance of 33 m along the upper side of the Heath walking track in Garigal National Park before it overflows across the surface of the track at the lower base of a small drainage bund ('wo-boy'). Tadpoles were observed in the ponded area, the gutter and in small pools on the upper and lower side of where the water flowed over the track. The eroded pond appears to be human made although the purpose is not evident. The walls are up to a metre high, non-vegetated, and are formed of bare earth indicating that it is not a natural drainage course. There are indications of an old fence (star pickets) at the scoured pond site. The base of the pond area is of fine sandy silt that is derived from the eroded area.

Due to the significance of the breeding location, with respect to its hydrology and proximity to the subject site, the origin of the water that supplied the pond and drainage was investigated. Water was observed to drain into the pond from a series of natural rock shelves about 10 m to the east and about 2 m above the pond. The pond is not part of a drainage line, although one occurs not more than 10 m away and is associated with a mitre drain and concrete culvert that passes under the track. Water depth in the pond was between 10 and 50 mm, in the drain it was up to 60 mm, and in the smaller pools between 10 and 30 mm. The pond was covered (>90%) by dense heath vegetation (*Hakea* and *Banksia* spp) but because it was deeply eroded there was a distance of about 1.5 m between the pond and the vegetation cover. The gutter was covered (>90%) by thick vegetation from the bank immediately above it and from smaller shrubs along its side, and it also contained a substantial amount of leaf litter material. The smaller pools were not covered but there were emergent reeds. The substrate of the pond, gutter and pools was of fine white to yellow sand. It was evident from the shallow flow and appearance of the sandy substrate that following heavy rainfall water and fine sand was carried across the track. The observation of several tadpoles in the shallow pools on the down-side of the wash away across the track indicated that some tadpole had swum or been carried across the track when flows were higher than at the time of inspection.

When first found on the 24th April the tadpoles were 9.5 mm in body length (Gosner development stage 27) which indicates that they were relatively early in growth and most likely the outcome of a breeding event associated with the rainfall that occurred in early April 2013 (rainfall total of 87.6 mm on the 3rd to 5th). The body size accords with that expected from measurements of growth obtained at two field locations (Stauber 2006).

Only one size class of tadpoles occurred and this is interpreted to indicate that all individuals were from a single breeding event. It is not known whether the tadpoles are from one or more pairs, but it is likely that it was only one pair. The number of tadpoles was estimated by counting the number in the pond area and in two sections of the gutter. In total there were estimated to be 150 tadpoles. Tadpoles of the common eastern froglet were also found in the gutter and small pools.

The progression of the tadpoles and condition of the habitat were monitored for 6 weeks following their detection. The pond and drainage remained charged throughout this period despite the absence of any significant rainfall for a period of about 4 weeks. Seepage into the pond and drain was sufficient to keep all the areas where the tadpoles were observed full with water, although the overflow across the track gradually reduced and the small pools on the down side of the track where several tadpoles had been observed on the first occasion were no longer present on the 25/5/2013. After 32 days the tadpoles had progressed significantly in growth to 15.6 mm body length, and the estimated number was only slightly less than when they were first counted.

We surveyed the identified breeding site after the significant rainfall event in late May (70.2 mm on the 23rd to 25th), and then again in early June (8th) to ascertain whether a breeding event occurred, but there was no evidence of adult male calling or of a new group of tadpoles.

Red Crowned Toadlet

After significant rainfall in late January and again in early April and late May adult males were heard calling from several sites and searches for tadpoles along drainage lines and soaks led to the detection of other breeding sites (Table 1 and Figure 1). Adults and tadpoles of the RCT were detected in 13 locations (Table 1). Only four of these was on the subject site (i.e. within the subject site boundary) and all other locations were within the offset site boundary (Figure 1).

Table 1. Locations where RCT were detected in auditory surveys.

Red-crowned Toadlet	Latitude			Longitude		
Western escarpment	33	43	18.726	151	11	42.104
	33	43	23.67	151	11	51.27
	33	43	19.72	151	11	58.03
Upland Coastal Swamp	33	43	43.43	151	12	16.7
	33	43	42.91	151	12	18.26
	33	43	41.89	151	12	18.64
	33	43	42.04	151	12	18.66
	33	43	42.78	151	12	19.04
Rock Shelf, northern escarpment	33	43	28.46	151	12	12.6
Rock shelf near Garigal Trk	33	43	29.22	151	12	21.96
	33	43	20.06	151	12	31.53
	33	43	34.34	151	12	47.5
Plateau, human made trench	33	43	34.19	151	11	59.4
Giant Burrowing Frog						
Garrigal Track	33	43	13.09	151	11	54.54

The majority of locations are associated with seepages sites and small ephemeral drainages at the edge and downslope from the escarpment. No locations were found lower in the valley. Three breeding locations were detected within the subject site. Detection was made by AS, ASRs and tadpole collection. Tadpoles were collected at four locations where calling was not detected, and positive identification was made by reference to the key characteristic in Anstis (2002).

Discussion

Giant Burrowing Frog

Intensive and extensive surveys of habitat at the subject site and in the study area resulted in the detection of one confirmed breeding site of the GBF. The breeding site is more than 300 m outside the subject site and occurs lower in the valley at an altitude of 91 m, whereas the plateau is between 155 and 162 m in altitude. Surveys included targeted searches of likely breeding areas along drainage lines and direct evidence of breeding, as determined by the occurrence of tadpoles, was detected in only the one location. There was no evidence of a breeding location on the subject site or in the escarpment area downslope from the escarpment.

Habitat searches in the heath and woodland habitats on the plateau for foraging and sheltering adults and juveniles did not result in the detection of any frogs. Surveys were conducted under suitable weather conditions, at an appropriate time of the year and with suitable intensity to detect adults in these habitats. Non detection indicates that GBF are not common in the habitats on the plateau. It is not possible to say that non-detection means that GBF do not use habitat on the plateau for sheltering

(burrowing) and foraging but it is possible to say that the density of frogs must be low if none are detected in intensive surveys.

Confirmation of GBF breeding location: The confirmed breeding location of the GBF is in a small soak and drainage that occurs next to the Heath Track in Garigal National Park (33°43' 13.09S 151°11' 54.54E, see Figure 1). Tadpoles of the GBF were first observed in a small pool, drainage gutter and small pools during a nocturnal survey on the 24th of April. Tadpoles were positively identified by the distinctive mouth parts and body features as described by Anstis (2002). However, the tadpoles were at an early stage of development and they were not strongly pigmented as indicated in the description of Anstis (2002). Comparisons were made with tadpoles of the striped marsh frog and common eastern froglet that were found in numerous locations at the study site, and it was evident that they were not of either of these two species. To confirm the identification as the GBF one tadpole was collected and examined by Marion Anstis who provided an independent identification. With respect to the lack of characteristic pigmentation she considered that this was possibly because the tadpoles were in an early development stage.

Comparisons of the body measurements of the tadpoles taken at the time they were found and then again after six weeks with those recorded for two field clutches by Stauber (2006) indicates that the egg clutch from which they were hatched was deposited after the rainfall event of early April when 72.6 mm of rain fell over a three day period. If this rain event, or that in late January, were triggers for breeding of the GBF in other habitats in the study area and subject site it would be expected that tadpoles would be observed in suitable habitat. There was no evidence of tadpoles in targeted surveys of ephemeral and permanent pools along five drainage lines emanating from the plateau area during visual encounter and habitat surveys. The conclusion is that the study area has a low density population of the GBF.

Tadpoles of the GBF grow rapidly and the length of the larval stage is dependent on water temperature, and the larval period for two egg masses in nature extended for about 33 weeks (Stauber 2006). These egg masses were deposited in late February and the larval period extended through the autumn and winter period with metamorphosis occurring in spring (early October), and during this period the water temperature was low throughout winter. Therefore it is likely that tadpoles at the breeding location detected will not metamorphose until November 2013, and the site will need to retain water or be replenished by rainfall until that time.

Distribution and abundance of GBF in the study area and at the subject site.

The outcome from targeted surveys indicates that GBF are not abundant in the study area. Surveys involved several methods known to be effective for detecting the GBF (VES, AS and habitat searches), and the surveys were conducted at the most appropriate season and under favourable weather conditions.

Detection of tadpoles which indicated a breeding location in the Bare Creek catchment on the northern side of the study area provide positive evidence that the species occurs in the study area and also confirms that weather conditions during the survey period were suitable for the detection of the tadpoles and therefore directly breeding habitat. The tadpoles at the breeding site were easy to observe and relatively abundant and there is no reason to believe that if they occurred in the numerous other ephemeral and permanent drainage lines and soaks that were investigated that they would not have been detected. Tadpoles of several common species were routinely detected in searches of the drainage lines and soaks at the site. The most plausible conclusion is that the GBF is not abundant in the study area and that despite the occurrence of several ephemeral drainage lines with isolated pools which are considered to be suitable breeding habitat, within dense heath vegetation communities, they do not support an abundant population. Evidence from several intensive research investigations of the

GBF show that the density of populations of this frog are low and the outcomes of the current surveys are consistent with these studies (Stauber 2006, Penman 2005).

Close attention was directed in targeted habitat searches to the coastal upland swamp EEC community and ephemeral drainage lines below the escarpment and at mid-slope in the landscape. The absence of observations of calling or tadpoles is considered to represent a real indication that these sites were not used by the GBF for breeding. For example, the use of an automated sound recording device in the coastal upland swamp provided clear evidence of the occurrence of RCT in this habitat, but there was no evidence of calling by GBF over the six week period of survey. In total this is equivalent to an aural survey of 80 minutes per day for six weeks (i.e. 56 hours of survey). This survey period included a significant rainfall event in late May that resulted in activation of calling of the RCT. However, no breeding of GBFs were observed at the known breeding site at this time. Perhaps this rainfall event was too late in the season to enable GBF breeding. Nonetheless, if breeding had occurred in either of the significant rainfall events in January or April, tadpoles should be in the pools and be relatively easy to detect. Thus it is reasonable to conclude that no breeding occurs in these habitats.

Buffers to protect breeding, foraging and shelter habitats:

Following intensive field investigations the conclusion reached is that GBF do not have breeding habitat on the plateau or upper slopes at the study site. The only identification of breeding habitat is on the lower slope on the northern side of the study site. This breeding location is greater than 300 m from the subject site boundary, but within the offset site boundary (see Figure 1). There is no need to provide a buffer zone around the breeding site because of its distance from any potential impact. Similarly, the distance of 300 m from the subject site boundary provides a buffer for shelter sites and foraging areas for the frog. There are records of GBF dispersing distances of greater than 300 m from a breeding site, but the average distance of dispersal of 66 m derived from four study sites is below 300 m (Stauber 2006).

It is necessary to provide some consideration of the detection of a juvenile GBF on the plateau that was found in a cage trap transect (Figure 7 – Travers, Bushfire and Ecology). There are several possible explanations for this observation. Firstly, it could be that this individual had dispersed away from the identified breeding location on the lower slopes to the north and moved up onto the plateau. This would require a displacement of a minimum distance (straight line distance) of over 350 m. Research investigations indicate that a movement of this distance is within the maximum measured for GBF adults (Stauber 2006, Penman 2005), but is greater than the average distances moved. These research investigations reported mainly on adult movement with only minor observations on juveniles and it is possible that juveniles disperse greater distances since it is well accepted that this is the life stage of dispersal in terrestrial amphibians. Secondly, it is possible that the juvenile dispersed from an undetected breeding location higher up the slope and closer to the plateau. Searches of the drainage lines and seepages on the mid-slope did not result in the detection of any additional breeding sites. Several of the drainages in this area provide habitat that is typical for GBF but no evidence of breeding was found. Thirdly, it is possible that the juvenile was from a breeding location on the plateau. Once again we conducted extensive searches of areas on the plateau and identified only one location with suitable habitat for breeding, which is the 'coastal upland swamp EEC' to the south east of the study site. This landscape is often referred to as a 'hanging swamp' (sensu Chapman and Murphy 1989), which are known to provide breeding and sheltering habitat for GBFs (Stauber 2006). The occurrence of a human made scrape which formed a pond in the 'coastal upland swamp EEC/hanging swamp' was identified as a suitable location for breeding and tadpoles of the GBF. The GBF has been found to use human constructed dams and mitre drains in several locations (Stauber 2006), and the pond was observed to contain crayfish and their burrows, a feature that has been identified at many GBF breeding locations. Furthermore, the bench area surrounding the coastal upland swamp EEC was found to have

ample leaf litter and a soil profile with coarse sandy soil to 0.2 m which in a woodland vegetation community meets the characteristic habitats used by GBF for burrowing. Several field methods were used to assess whether the coastal hanging swamp EEC was habitat for the GBF. Searches for tadpoles were made on numerous occasions (four field surveys at day and night), spotlighting in the wetland area and surrounding habitats, and the placement of a sound recorder for a period of over 40 days.

No evidence was found that GBF use this habitat for breeding, burrowing or foraging. The survey period covered two significant rainfall events that coincide with the known breeding season for the GBF (Penman, Lemckert et al. 2005; Lemckert and Mahony 2008) but no evidence of calling, or reproduction was recorded. At the same time breeding did occur at the study site to the north, and on both occasions that the rainfall was significant the wetland was charged and the human made pool contained water throughout the period (late February to early June).

Targeted searches were conducted in the area of low heath vegetation on the plateau at the location where the juvenile GBF was found in a trap line survey (see Travers Bushfire and Ecology 2013). There were no semi-permanent or permanent ponds in this area that would support tadpoles of the GBF, and it is evident that the juvenile found could not be from a local breeding area. The soil in the low heath vegetation community at the location is sandy and up to 0.2 m in some areas and is considered to be suitable for burrowing by GBF. The soils at the location sit on top of a relatively flat sandstone ridge with a slight basin depression that forms a depauperate hanging swamp which can be identified by the growth of reeds and sundews where water is retained. After heavy rainfall water seeps from the edge of the heath and this site provides suitable burrowing and foraging habitat for GBF, but is a relatively small area of low heath in the context of the extent of this vegetation community at mid-slope outside of the subject site.

Movement:

GBF are terrestrial frogs that spend the majority of their life in habitats away from those where breeding occurs. The distance that GBFs move away from breeding sites and the continuity of habitat around breeding sites are significant factors in conserving populations of this frog.

The identified breeding habitat in the study area is greater than 300 m away from the boundary of the subject site and it is most likely that few dispersing adults or juveniles will be impacted by development of the natural habitats on the plateau. GBFs have been recorded to move distances greater than 300 m, however the average distance is 66 m (Stauber 2006). Movement of individual GBFs have been investigated in several studies (Penman 2005; Stauber 2006) although these studies have used different methods they provide valuable information on habitat use of the GBF. The first approach used a repeated survey method with marked individuals of three independent populations located in the Sydney Basin (Stauber 2006). The mean distance moved by adult males between captures was 93 m (range of 13 to 663 m). However one animal moved 663 m and if this animal is removed from the analysis the mean distance moved decreases considerably to 66 m. When the location of captures were considered in the context of habitat features, the majority of frogs (90%) were located within 160 m of a creek and males were found to move further than females. In the second study, which was conducted on the south coast of NSW, frogs were fitted with radio-transmitters and 'tracked' over a period of six months in an open forest habitat (Penman 2005). Adults were found to have 'home ranges' and displacement from one period to another was minimal. The frogs foraged in a 'home range' that did not overlap with neighbours and on many occasions the adult returned to a burrowing site. These home ranges were up to 300 m away from the known breeding location. Both studies indicate that outside of the breeding season adult GBFs may be up to 300 m away from the breeding site and move within a home range area. The great majority of the mid-slope landscape in the study area which is outside the

development zone provides for a large area of habitat for foraging and sheltering by the GBF population, and thus to support the local viable population.

The isolation of the identified breeding habitat in the study area means that it is unlikely that development on the plateau breaks a movement corridor between habitats used by GBFs. While it is possible GBFs could move from the valley and mid-slope area up onto the plateau and across to the valley on the other side it is not likely that many individuals would do this. Firstly, this would require an individual to move up to three times greater than the average measured (Stauber 2006; Penman 2005), and secondly the number of individuals would be low since the density of individuals per hectare measured by Stauber (2006) and Penman (2005) is very low. Visual encounter surveys conducted in the study area at times of suitable weather failed to record adult or juvenile GBFs and serve to strengthen the argument that they are not abundant at the study site.

Viable Population

There is no evidence from the targeted field surveys for the GBF that the proposed development of the subject site (=residential zone) will impact on a local viable population. Targeted surveys of potential breeding habitat on the plateau area, which broadly coincides with the subject site, failed to find any evidence of breeding by GBF. Furthermore, at the locations where potential breeding habitat was identified during preliminary habitat assessments there was no breeding detected after heavy seasonal rainfall. Positive identification of a breeding site of the GBF outside the subject site following a significant rainfall event in early April (87 mm on 3rd to 6th April) confirms that the rains provided a suitable trigger for breeding at this time. Intensive searches of soaks and drainages on the plateau and upper slopes did not result in the detection of breeding sites and indicates that the area does not support a large GBF population, and that these drainages are not used for breeding sites. An alternative explanation is that suitable habitat is restricted to the site found.

The distance of the GBF breeding site from the subject site boundary is considerable (> 300 m) and it is not likely individuals from the breeding site will disperse to habitat on the subject site and if individuals do move this distance it would only be a small proportion of the population. Thus it is not likely that development of the subject site will remove important foraging and burrowing sites for the local population of GBFs.

Similarly, the distance between the identified breeding location and the plateau is such that it is unlikely that the plateau is part of a corridor of movement for the GBFs, and thus that development of the plateau area would not impact on the local viable population by breaking a movement corridor.

It is unlikely that development of the subject site would impact on the hydrology of the identified GBF breeding site, because of its distance from the subject site and the large catchment area for infiltration that supports the hydrology of the breeding site are to the east and outside the area of impact of the subject site (see Figure 1 showing contours). Water that flows into the breeding site comes from a large seepage zone that is associated with a rock shelf. It appears that the rock shelf is an impervious layer and that water that has infiltrated the upper layers of rock and soil are expressed as a soak where this layer is exposed. The slope above the rock shelf is not steep and supports a large area of short and tall heath vegetation communities. Observations of the GBF breeding site over a period of six weeks showed that it was being supported by the seepage of water over this period, and the water level in the breeding area did not reduce. There was an observable reduction in flow out of the system across the track six weeks after the rainfall event that is considered to have triggered breeding, however the pond, drainage and pools occupied by the GBF tadpoles remained fully charged. A significant rainfall event in May (71 mm over 23rd to 25th May) increased the flow through the system and water was again passing through the system and overflowing across the track. Tadpoles of the GBF were observed to grow by 50% in size in this period and if we accept the minimum time for field development to metamorphosis as

being 33 to 37 weeks (~ 8 months)(Stauber 2006) then the system would need to retain water and be replenished until the end of November 2013 for successful metamorphosis to occur.

During field surveys at the subject site repeated observations of several ephemeral soaks were made and it was notable that many ceased to flow and dried gradually after the heavy rainfall event in early April, and it is clear that many would not support the long period required for successful completion of the larval period of the GBF. Locations that did contain pools that were sufficiently large to be classed as semi-permanent were found along the drainage lines and these were thoroughly searched, without success, for tadpoles of the GBF.

Red-crowned Toadlet

Habitats associated with the escarpment at the study site provide important breeding habitat for the RCT. These sites are generally below the plateau and are associated with the exposed sandstone and rock benches and small hanging valleys. The majority of these identified breeding habitats are outside the boundary of the subject site and would not be directly impacted by the removal of habitat on the plateau. The greatest potential impacts of the proposal on the RCT will be from changes to the hydrology of the breeding sites and to a lesser extent from the removal of terrestrial habitat used for foraging and shelter.

Most of the breeding sites are found in soaks and small ephemeral pools that form where water seeps out when it encounters the impervious base rock layers beneath the soil which is on top of the plateau. These sites are usually at the edge of the escarpment and there are typically fissures in the rocks and the formation of small hanging gullies with ephemeral pools. After periods of heavy rainfall the soils on the upper surface of the plateau becomes saturated and the ground water reaches the relatively impervious layer of the base rock from where it seeps out at the edges and is directed to the gullies.

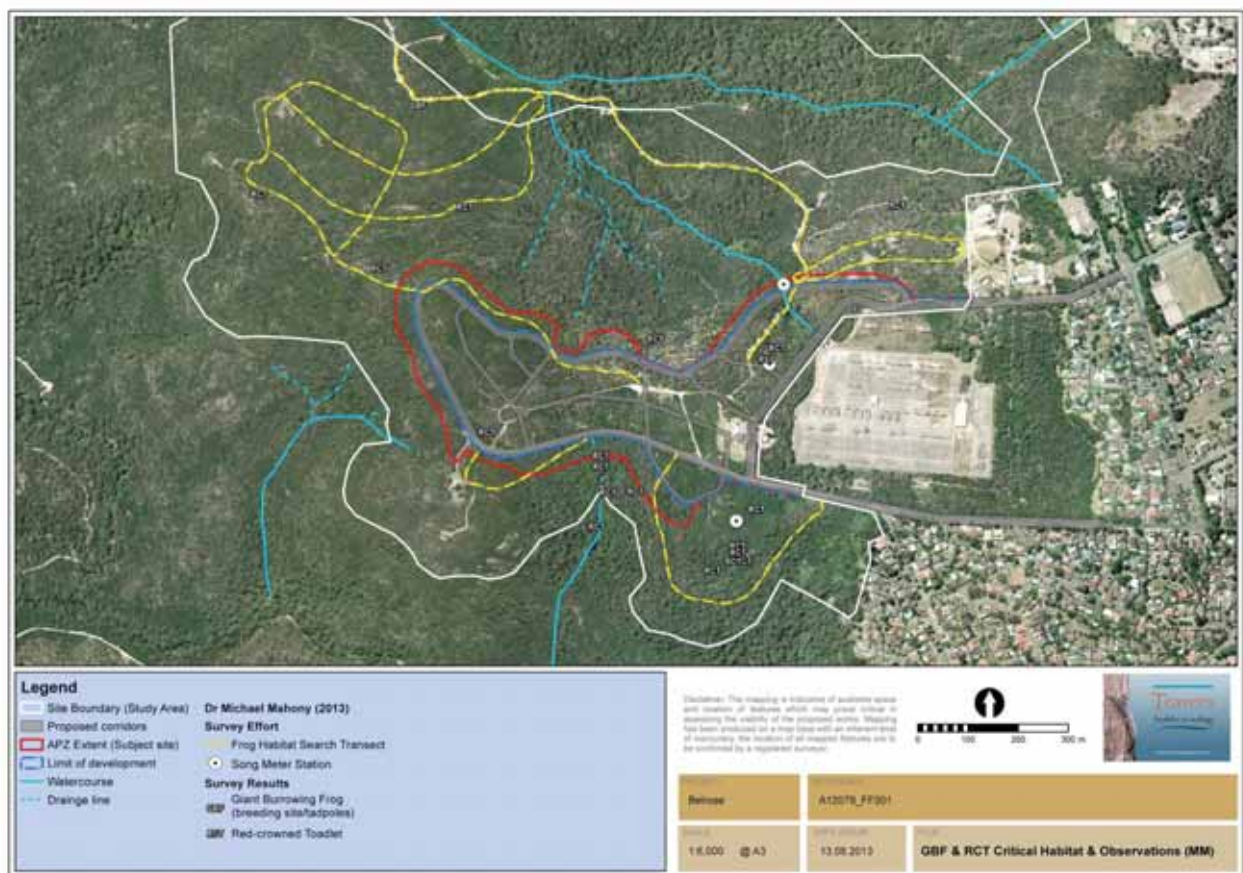
Alterations to the hydrology of these small soaks and ephemeral pools will most likely impact on the breeding habitat of the RCT. Prevention of impact to these areas will require particular emphasis to the hydro-period and volume of water that flows in these sites. These two features are determined by the infiltration of rainwater into the soils on the upper layer of the plateau, the rate of discharge, and the occurrence of replenishing rains. Discharge of water from the upper soil layers is a slow process which maintains the small soaks for sufficient time to enable growth and development of the tadpoles of the RCT to metamorphosis. Measurements of the hydro-period of a series of known breeding sites revealed only a moderate probability for the successful completion of the life cycle in these ephemeral pools. Thumm (2005) hypothesised that the long breeding season and repeated egg deposition observed in the RCT was an adaptation to deal with ephemeral nature of these breeding sites. While it may seem that this situation could be remedied by the provision of additional water to these sites this often results in the invasion of competitive species such as the common eastern froglet and exclusion of the RCT.

Another identified negative outcome of developments in the landscape above the ephemeral soaks used by RCTs is the addition of nutrients to discharged water that results in a change to the productivity of the ephemeral pools (Thumm and Mahony 1999). Nutrients produce a cascade effect which begins with the invasion of weeds which results in increased trapping of sediments, which then encourages competitive species, and eventually renders the ephemeral pools unsuitable for the RCT.

Development of the plateau area will remove habitat that is used by the RCT for foraging and shelter but this is not likely to affect the status of the local population since there is a large and continuous area of habitat that includes all of the escarpment and mid-slope areas in the study site. The majority of identified breeding sites are at the edge of the escarpment and downslope from the escarpment in the mid-slope area and it is most likely that adults and juveniles utilize habitat in this area to forage and

shelter. It is likely that RCTs would move onto the plateau to forage and seek shelter, but this is not the only terrestrial habitat that is available to them. RCTs are capable of moving distances of greater than 100 m between breeding sites (Stauber 2006) and they are occasionally found foraging up to 50 m away from breeding sites (Thumm 2005). However, Stauber (2006) found a high level of fidelity to a breeding site and the mean distance moved was less than 10 m over a 12 month period. Thus protection of the considerable area of RCT habitat below the escarpment and at mid-slope should protect the local viable population.

There is no evidence from the field survey that removal of habitat on the plateau will break a corridor that connects habitats used by the RCT. The majority of breeding sites were at the edge or below the escarpment and movement among breeding sites is likely to be at this level and not across the plateau.



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Eastern Pygmy Possum Advice - Dr Ross Goldingay

A7

Report on Habitat of the Eastern Pygmy-possum on Land near Ralston Ave, Belrose

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Background

This report was requested by *Travers bushfire and ecology*. It considers issues relating to the presence of the eastern pygmy-possum (*Cercartetus nanus*) on lands located off Ralston Avenue at Belrose, on the northern edge of Sydney, approximately 15 km north of the Sydney CBD. There is a proposal to develop a portion of land in this area for residential development. The total area to be impacted as a result of the proposed residential development, associated asset protection zones and proposed road extensions is 25 ha.

In order to consider the potential impact of the proposed development on the eastern pygmy-possum the following instructions were provided in a brief to me:

1. Identify habitat areas suitable for breeding and foraging and whether any important habitat may be affected.
2. Identify potential significance of impact on Eastern Pygmy Possum.
3. Whether is there is adequate separation or buffer between the proposed residential zone and important habitat areas.
4. Whether the planning proposal is likely to result in significant movement or connectivity restriction on the local population.
5. Prepare a plan showing important habitat areas, distinguishing between potential breeding and foraging areas.
6. Make recommendations for any survey that may be required to identify important habitat areas

This report provides a preliminary response to these questions.

Habitat near Ralston Ave, Belrose

The habitat within the proposed development area includes short and tall heath, coastal upland swamp, low open forest, open forest, sandstone gully forest and riparian woodland/forest. All of these habitats contain species of banksia, eucalyptus, corymbia and angophora (*Travers bushfire and ecology* 2013) that form important components of the diet of the eastern pygmy-

possum (see Tulloch 2004; Rueegger 2011; Goldingay unpublished data). Indeed, banksias which are an important source of nectar and pollen are abundant and widespread across the tall heath and the low open forest habitats (see below).

Evaluation

1. Identify habitat areas suitable for breeding and foraging and whether any important habitat may be affected.

Foraging habitat

The diet of the eastern pygmy-possum consists predominantly of nectar and pollen, but insects are also included and may be important when nectar and pollen are absent or less abundant (Turner 1984; Huang et al 1987; van Tets and Whelan 1997). The eastern pygmy-possum occurs in a broad range of habitats from heathland to rainforest (Bowen and Goldingay 2000; Harris and Goldingay 2005a; Tulloch and Dickman 2006; Harris et al. 2007a). Its foraging habitat most commonly contains species of banksia. Two species that are particularly important for nectar feeding are *Banksia ericifolia* and *B. serrata* (Harris 2010; Rueegger 2011; Goldingay, Harris and Rueegger unpublished data).

Banksia ericifolia appears to be particularly important when present and regulates breeding activity in Royal National Park (Goldingay and Rueegger unpublished data). This species is abundant in tall heath in the area of the proposed development. It also occurs in the low heath, the low open forest and the open forest. Other species of banksia and myrtaceae will also be important for nectar and pollen when they are in flower. Therefore, basically all vegetation communities in the proposed development and the offset lands will provide foraging habitat for the eastern pygmy-possum. The main point of interest is that the tall heathland with higher densities of various banksia species will be most influential and is likely to drive breeding in the local population.

Breeding habitat

Despite the eastern pygmy-possum using a wide range of different shelter types for nesting (Tulloch 2004; Goldingay 2011) it now appears that females are quite selective of the sites they use for breeding (Rueegger et al. 2012). Tree hollows are likely to be favoured such that a local shortage may limit the local population size of this species.

Within Royal National Park we recorded 19 tree hollows used by 8 pygmy-possums (Rueegger 2011). Four of these pygmy-possums were males and some of the females were not breeding at the time of study so the following records represent trees hollows used for shelter as well as those used for breeding. The majority of hollows (13) were in live trees and the majority (12) were hollows in the trunk. The most commonly used tree species (8 records) were the red bloodwood (*E. gummifera*), followed by the Sydney peppermint (*E. piperita*) and *B. serrata*. The diameter at breast height of these trees averaged 36.9 ± 6.3 (SE) cm (11-90 cm). The entrances to hollows ranged from 0.5 to 9 m above the ground (mean 2.7 ± 0.5 m). Entrances to hollows averaged $3.8 (\pm 0.4)$ cm (range 2-7 cm) in the horizontal dimension and $5.1 (\pm 0.3)$ cm (range 3-8 cm) in the vertical dimension. The depth of these hollows averaged 27.6 ± 7.3 cm (range 6-125 cm) from the entrance. Radio-tracking of the eastern pygmy-possum has also been conducted by Harris (2010) in Royal National Park and Barren Grounds Nature Reserve. These studies show that eastern pygmy-possums use tree hollows within a range of tree species based on what is available, they

select hollows with a small entrance (our nest boxes had entrances of ~2.5 x 4.5 cm) and their hollows are commonly close to the ground (~3 m). Hollows with a large chamber relative to the size of one pygmy-possum, which can be difficult to determine, will be required for breeding.

An inspection was made on 6 August 2013 of the proposed development area. This revealed that many scribbly gums (*E. haemastoma*) within the low open forest contained small hollows with an entrance of 2-5 cm diameter. An eastern pygmy-possum was previously recorded in one such hollow but this was vacant when inspected on 6 August 2013. However, a hollow was found that contained a recently abandoned leaf nest of a type characteristic of the eastern pygmy-possum (see Rueegger et al. 2012).

An inspection was made of trees (particularly scribbly gums) within the offset lands on 7 August 2013. Relatively few of these trees contained hollows. It is not known whether this is indicative of this area or due to biased sampling.

Will important habitat be affected?

Important areas of foraging habitat and breeding habitat (as described above) will be affected by the proposed development.

2. Identify potential significance of impact on Eastern Pygmy Possum

Impacts on the eastern pygmy-possum from the proposed residential development could be direct and indirect. The loss of habitat from clearing for the residential development would have a direct impact (see below). The most serious indirect impact from the development would be if residents in the area keep house cats. There are many reports in the literature of domestic cats preying on the eastern pygmy-possum (Harris and Goldingay 2005a; Harris et al. 2007b, 2008). The full impact of this is currently unknown but is likely to be substantial. Moreover, domestic cats are likely to contribute to a local feral cat population. This indirect impact of the development could be removed by proposing that cat ownership be disallowed in the residential development.

Foraging habitat for the eastern pygmy-possum appears to encompass almost all vegetation communities in the study area (proposed residential area, APZ and Offset lands) with the exception of the modified community (community E) and possibly the riparian woodland-forest (not examined). The most important community would be the Tall Heath (community B) due to the high density of *B. ericifolia* and presence of other banksia species. The vegetation mapping conducted by *Travers bushfire and ecology* (2013) suggests that there would be a loss of 6.9 ha of Tall Heath from the proposed residential area and APZ. In contrast, the Offset lands contain 20.1 ha of this habitat.

Breeding habitat could be found in several vegetation communities where trees occur but the brief examination of the area bounded by the proposed residential area and APZ suggest that scribbly gums within the low open forest may be the primary source of tree hollows to be used for breeding. At this point it is unknown whether the low open forest in the Offset lands is equivalent in tree hollow density to that in the proposed residential and APZ areas. However, in terms of the areas of this community in each zone, vegetation mapping by *Travers bushfire and ecology* (2013) suggests that there are 9.0 ha of Low Open Forest in the proposed residential area and APZ area, compared to 38.8 ha in the Offset lands.

It is difficult to estimate the overall impact of the proposed development on the local population of the eastern pygmy-possum because population studies on this species are difficult to conduct and none with sufficient detail has been published. The impact of the loss of 6.9 ha of high quality foraging habitat (Tall Heath) may be sustainable when offset by 20.1 ha in the Offset Lands. The loss of breeding habitat if defined by the Low Open Forest in the development area (9.0 ha) may be sustainable if offset by 38.8 ha of Low Open Forest in the Offset Lands and it provides equivalent breeding habitat. Further surveys (see question 6 below) are required to determine the adequacy of the offset.

Another key point with having confidence that the proposal will not have a significant impact on the local population of the eastern pygmy-possum is knowing whether there are opportunities for individuals to disperse east and west across the Forest Way between the adjoining National Parks. This could be achieved if culverts are present under this road enabling dispersal movement. This should be investigated. If none are present rope-bridges (e.g. Goldingay et al. 2013) could also be useful for this species. Ultimately broader connectivity will provide greater confidence that the loss of habitat will not threaten a local population (e.g. Taylor and Goldingay 2012).

3. Whether is there is adequate separation or buffer between the proposed residential zone and important habitat areas.

As stated above, most vegetation communities appear to offer foraging habitat. This habitat abuts the proposed APZ area so there is no separation. Based on very preliminary observations the Low Open Forest appears to have the most potential for providing breeding habitat. This community also abuts the APZ area so again there is no separation of important habitat areas from the proposed residential zone.

4. Whether the planning proposal is likely to result in significant movement or connectivity restriction on the local population.

Foraging habitat for the eastern pygmy-possum occurs all around the proposed development site. Therefore, if the development proceeded there would be some localised restriction to the movement by individuals but the movement of pygmy-possums would not be significantly restricted due to the broad extent of open forest and other vegetation communities to the west of the site. Eastern pygmy-possums are highly mobile animals moving as much as 500 m in a night (unpublished data). Therefore, the spatial location of the proposed development will not pose a particular restriction on movements by the local population.

5. Prepare a plan showing important habitat areas, distinguishing between potential breeding and foraging areas.

I would argue that all habitats across the development site and the Offset Lands contain foraging habitat. I would suggest that the Tall Heath provides the most important foraging habitat due to the higher density of *B. ericifolia* in that community compared to other communities. Therefore, the existing vegetation map can be used to represent the different foraging areas.

As for potential breeding habitat, the one recent breeding hollow that was discovered on 6 August 2013 was in an *Angophora crassifolia* which is apparently common in the Low Open Forest. Furthermore, the tree species in which hollows were most frequently observed was the scribbly gum and this species is most common in the Low Open Forest also.

Therefore, the existing vegetation map can be used to represent the different breeding areas with that vegetation mapped as Low Open Forest offering the best breeding habitat.

6. Make recommendations for any survey that may be required to identify important habitat areas.

The eastern pygmy-possum can be a difficult animal to conduct surveys for (Bowen and Goldingay 2000; Harris and Goldingay 2005a,b; Harris et al. 2007a,b). The published literature for this species is now quite detailed and enables many conclusions to be reached based on just a few observations such as the two for the study area (an animal in a short tree hollow and a leaf nest in another tree hollow). Therefore, further surveys of the study area to detect this species are not warranted. However, what is required is more detailed information on the distribution and abundance of tree hollows that potentially provide breeding sites for the eastern pygmy-possum. This would provide more confidence in determining whether the Offset Lands provide important areas of breeding habitat in comparison to what may be lost in the development area.

Conducting a survey for tree hollows that may be suitable for the eastern pygmy-possum requires that special attention be given to the hollow preferences of this species. A survey that simply documents the abundance of tree hollows will not be adequate. Someone with specialist knowledge of tree hollows used by eastern pygmy-possums would be desirable. The survey should attempt to quantify the abundance of these specific tree hollows in the different vegetation communities in the development zone and the Offset Lands. Replicate quadrats will be required in the different vegetation communities. This might be supplemented with some opportunistic assessment in case suitable tree hollows are scarce and quadrats produce few data.

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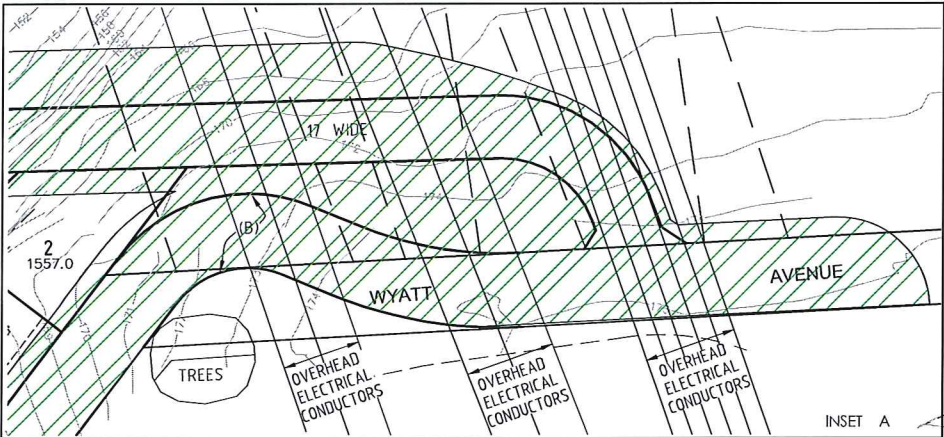
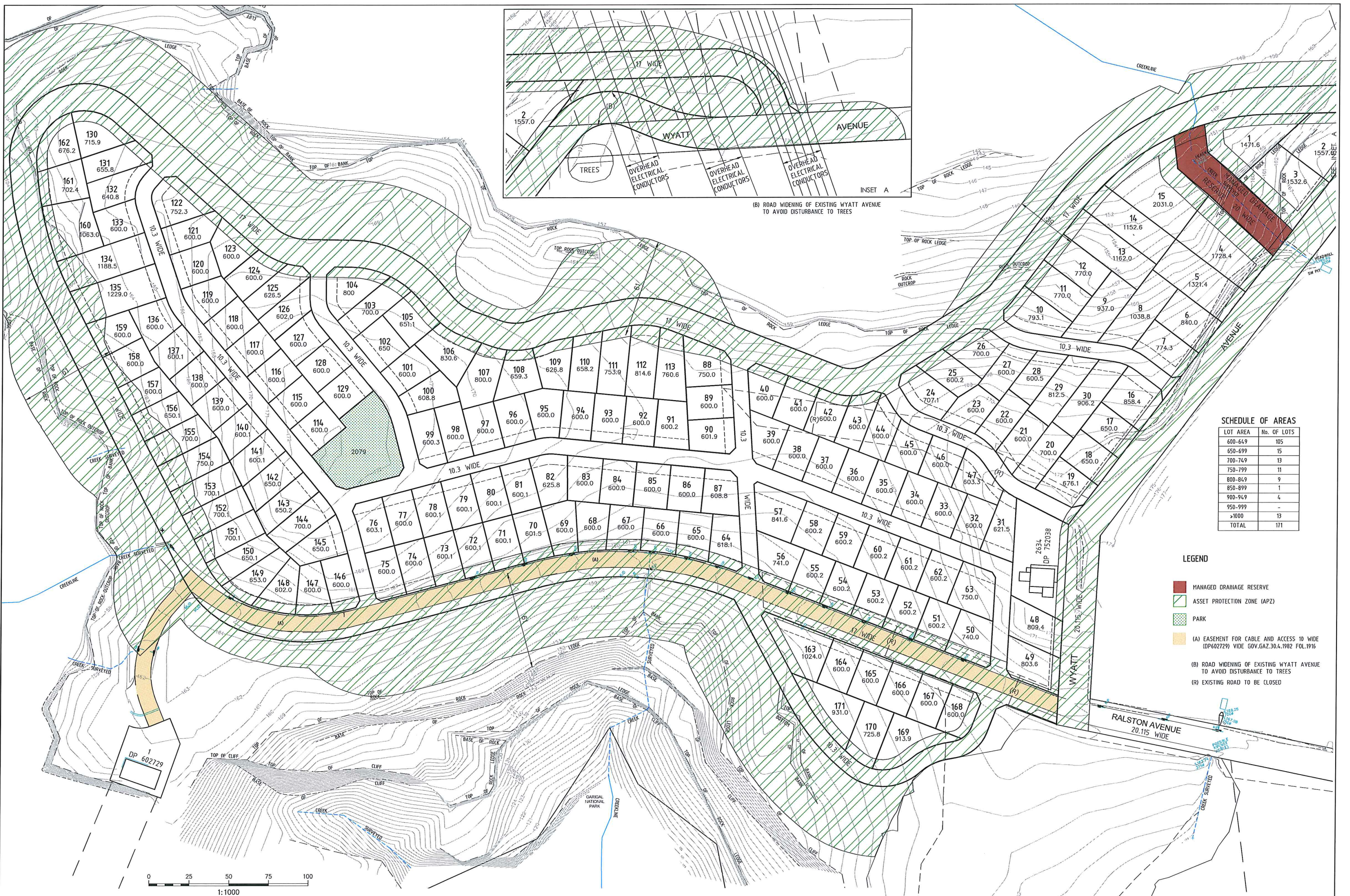
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Attachment 3



(B) ROAD WIDENING OF EXISTING WYATT AVENUE TO AVOID DISTURBANCE TO TREES

SCHEDULE OF AREAS

LOT AREA	No. OF LOTS
600-649	105
650-699	15
700-749	13
750-799	11
800-849	9
850-899	1
900-949	4
950-999	-
>1000	13
TOTAL	171

- LEGEND**
- MANAGED DRAINAGE RESERVE
 - ASSET PROTECTION ZONE (APZ)
 - PARK
 - (A) EASEMENT FOR CABLE AND ACCESS 10 WIDE (DP602729) VIDE GOV.GAZ.30.4.1982 FOL.1916
 - (B) ROAD WIDENING OF EXISTING WYATT AVENUE TO AVOID DISTURBANCE TO TREES
 - (R) EXISTING ROAD TO BE CLOSED

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U. Mayne
Registered Surveyor NSW

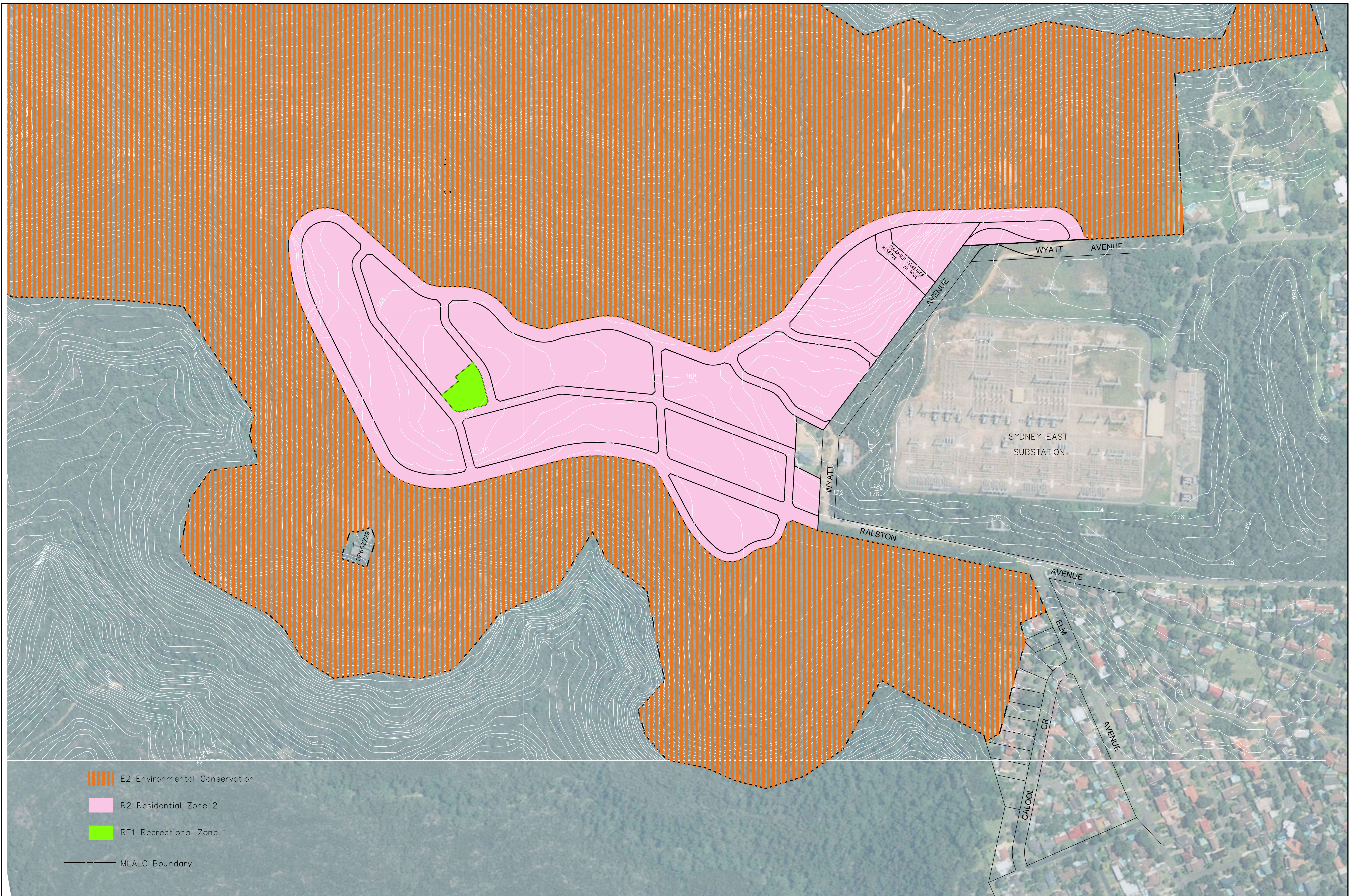
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Locked Bag 5
Gordon NSW 2072
P 1300 587 000
F 02 9499 7760
www.lts.com.au

Client MCPL ON BEHALF OF METROPOLITAN LALC
Drawing title
PLAN OF PROPOSED SUBDIVISION OF LOT 1 IN DP1139826 AND ROAD CLOSURES AT RALSTON AVENUE, BELROSE

datum
AHD
site Area
WARRINGAH
project number
30401
scale
1:1000 @A1
reference number
40097PS
date of survey
6-08-2013
SHEET
OF 1 SHEETS

D	00/00/00	-	00
C	00/00/00	-	00
B	00/00/00	-	00
A	15-8-2013	NORTH EAST CORNER OF SITE REVISED	-
Revision	Date	Description	Reference

Attachment 4

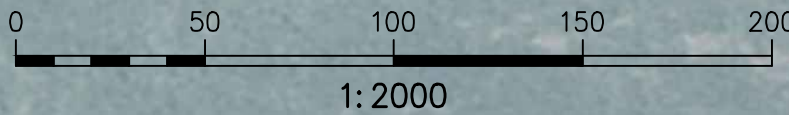


||||| E2 Environmental Conservation

■ R2 Residential Zone 2

■ RE1 Recreational Zone 1

--- MLALC Boundary



D	00/00/00	-		00
C	00/00/00	-		00
B	00/00/00	-		00
A	00/00/00	-		00
Revision	Date		Description	Reference

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Client MCPL ON BEHALF OF METROPOLITAN LALC

Drawing title
PLAN OF PROPOSED REZONING FOR PROPOSED
SUBDIVISION OF LOT 1 IN DP1139826 AND ROAD
CLOSURES AT RALSTON AVENUE, BELROSE

datum
AHD

site Area

LGA
WARRINGAH

project number
30401

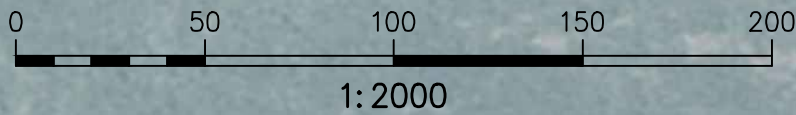
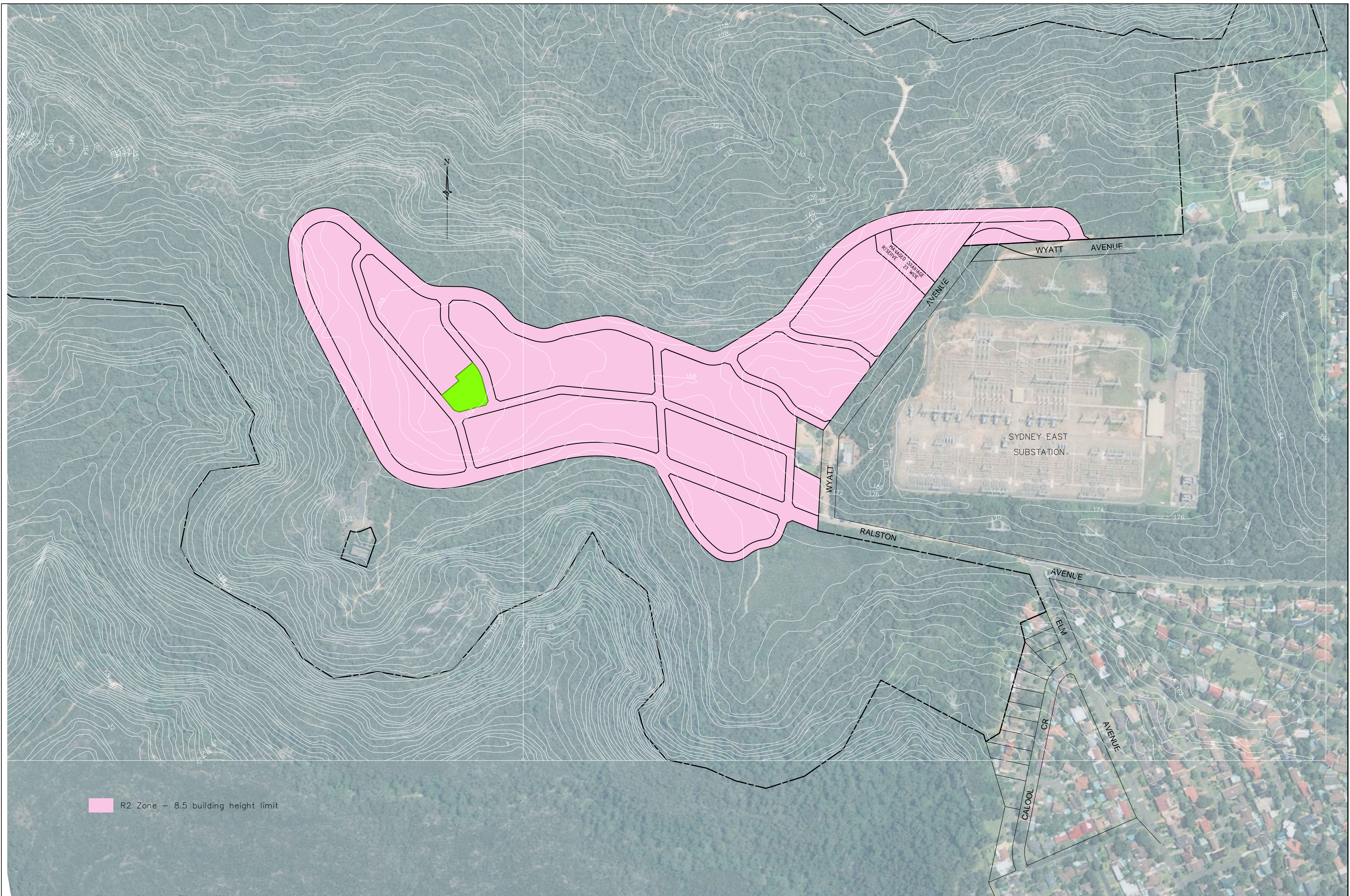
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OF SHEET
1

reference number
40097BUILTFORM

date of survey
15-08-2013

SHEETS
1



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C	00/00/00	-		00
B	00/00/00	-		00
A	00/00/00	-		00
Revision	Date		Description	Reference

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Registered Surveyor NSW

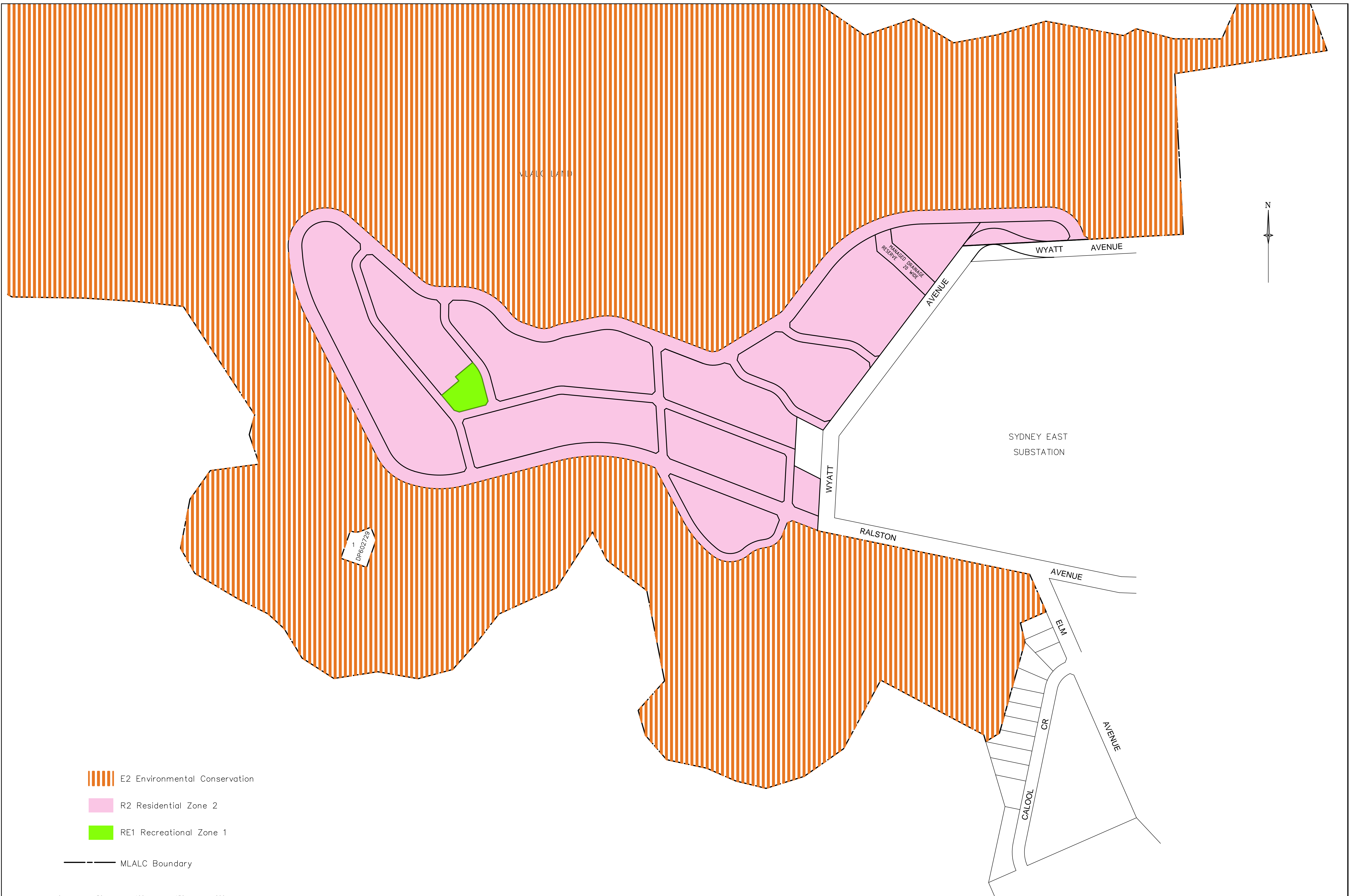


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Drawing title
PLAN OF PROPOSED REZONING FOR PROPOSED
SUBDIVISION OF LOT 1 IN DP1139826 AND ROAD
CLOSURES AT RALSTON AVENUE, BELROSE

datum AHD	project number 30401	reference number 40097
site Area	scale 1:2000 @A1	date of survey 15-08-2013
LGA WARRINGAH	OF SHEET 1	SHEETS 1

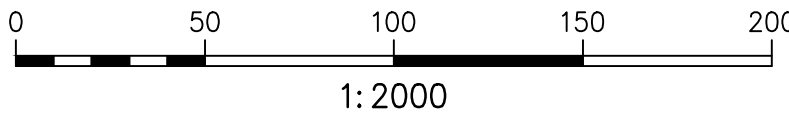


E2 Environmental Conservation

R2 Residential Zone 2

RE1 Recreational Zone 1

MLALC Boundary



D	00/00/00	-		00
C	00/00/00	-		00
B	00/00/00	-		00
A	00/00/00	-		00
Revision	Date		Description	Reference

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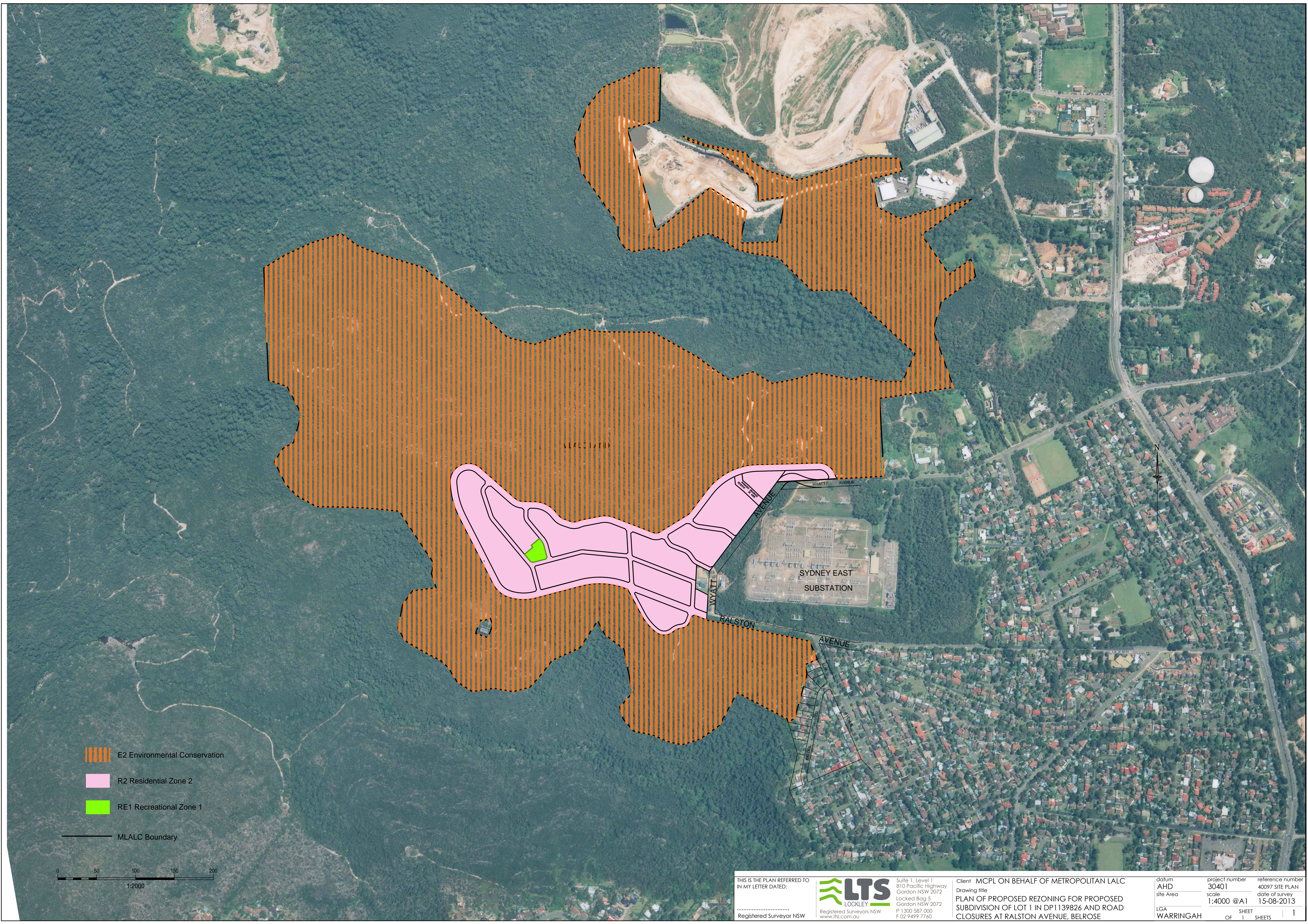


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Drawing title
PLAN OF PROPOSED REZONING FOR PROPOSED
SUBDIVISION OF LOT 1 IN DP1139826 AND ROAD
CLOSURES AT RALSTON AVENUE, BELROSE

datum AHD	project number 30401	reference number 40097REZONE
site Area	scale 1:2000 @A1	date of survey 15-08-2013
LGA WARRINGAH	OF 1	SHEET SHEETS 1



||||| E2 Environmental Conservation

□ R2 Residential Zone 2

□ RE1 Recreational Zone 1

— MLALC Boundary

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PLAN OF PROPOSED REZONING FOR PROPOSED
SUBDIVISION OF LOT 1 IN DP1139826 AND ROAD
CLOSURES AT RALSTON AVENUE, BELROSE

datum
AHD
site Area
LGA
WARRINGAH

project number	30401	reference number	40097 SITE PLAN
scale	1:4000 @A1	date of survey	15-08-2013
OF	1	SHEET	1

Attachment 5

BELROSE

Fuel Management Plan

TABLE OF CONTENTS

SECTION 1.0 – INTRODUCTION

This section will outline the makeup of the bushfire fuel management and the basis of why the land is to be fuel managed and to what extent

- 1.1 Land ownership
- 1.2 Landscape context
- 1.3 Objectives
- 1.4 Fuel management strategies and responsibilities
- 1.5 Legal affectations upon land title
- 1.6 Policy and planning context
- 1.7 Local government area policies and plans
- 1.8 Rural Fire Service (RFS) / NSW Fire Brigades jurisdiction

SECTION 2.0 – FUEL MANAGEMENT

This section will review how fuel management is undertaken and what that means in very specific terms

- 2.1 Necessity
- 2.2 Components
- 2.3 Accumulation
- 2.4 Expectations
- 2.5 Fire behaviour
- 2.6 Fuel types
- 2.7 Fuel loads
- 2.8 Strategies
- 2.9 Conservation

SECTION 3.0 – BUSHFIRE INFLUENCE ON THE LOCAL LANDSCAPE

This section will place a context on the way bushfire affects the current landscape and the future developed landscape. This plays a vital part in the design of an effective fuel management system.

- 3.1 Landscape context
- 3.2 Natural landscape descriptions
- 3.3 Climate and fire history

SECTION 4.0 – ENVIRONMENTAL PROTECTION

This section deals with the critical elements that require protection to achieve ecological sustainability on the site

- 4.1 Ecological conservation of the landscape
- 4.2 Guiding principles of ecological fire management
- 4.3 Specific local ecological resources
- 4.4 Threatened flora and fauna
- 4.5 Garigal National Park and other environmental conservation areas
- 4.6 Riparian corridors and catchment values
- 4.7 Roost and nest tree sites
- 4.8 Impact on soil nutrients
- 4.9 Escarpment and outcrop protection
- 4.10 Cultural resources

SECTION 5.0 – PROTECTION OF ASSETS & INFRASTRUCTURE

This section outlines the specific manner in which all values will be protected and how those values will be managed and by who

- 5.1 Management of Asset Protection Zones
- 5.2 Retention of vegetation in the IPA/OPA
- 5.3 Ecological / environmental monitoring
- 5.4 Access to APZ for ongoing management

SECTION 6.0 – MANAGING THE ENVIRONMENT

This section deals with the more strategic approach to insitu and peripheral fire management and how that links in with existing Council and RFS planning regimes.

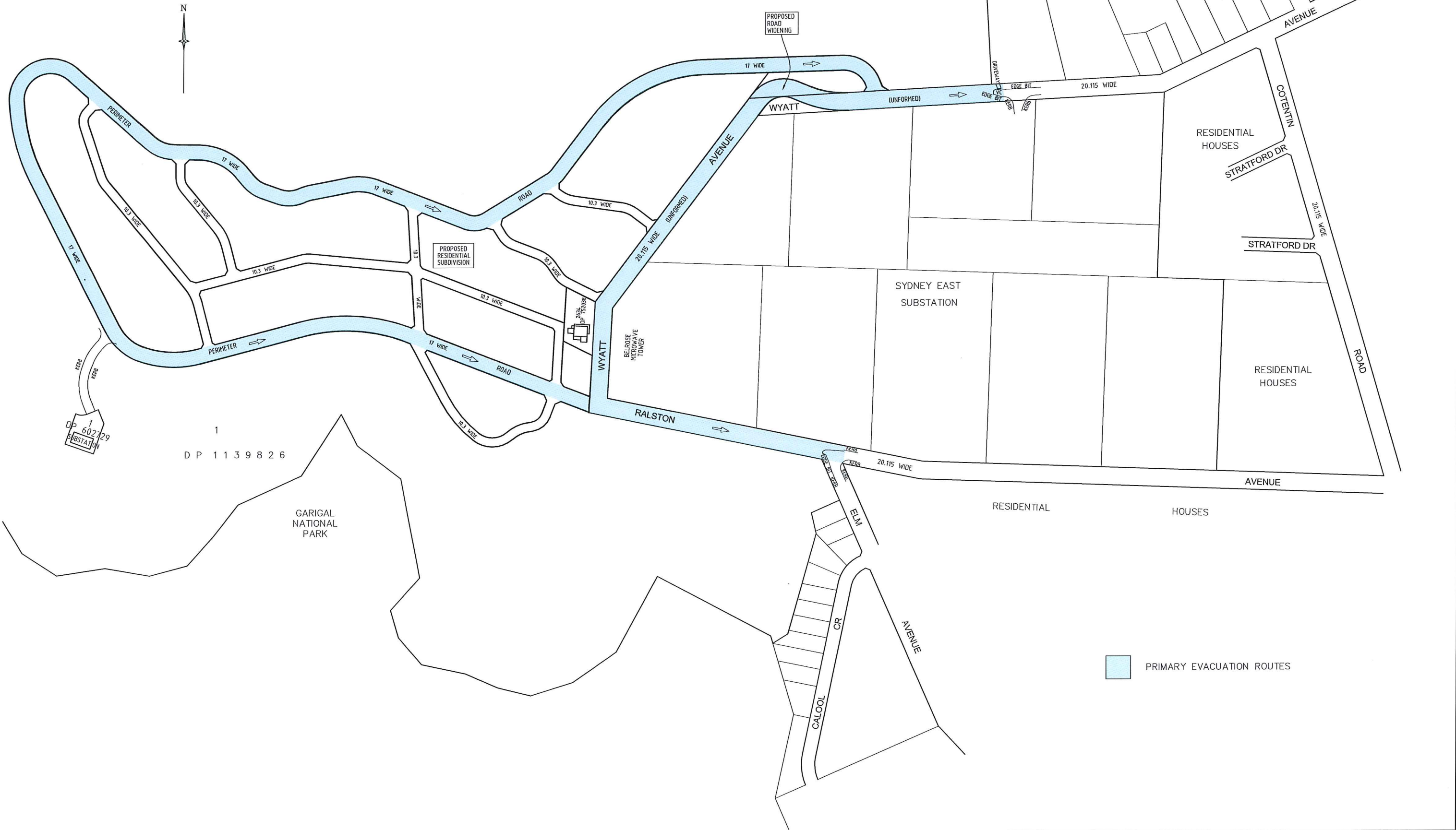
- 6.1 Bushfire Fuel Management Zones
- 6.2 Asset Protection Zones (APZ's)
- 6.3 Strategic Fire Management Zones (SFMZ's)
- 6.4 Heritage Management Zones (HMZ's)

SECTION 7.0 – PLAN ADMINISTRATION

This sections deals with how the approach of will be managed in the long term and how the fuel management specifications will be guaranteed

- 7.1 Management of works
- 7.2 Environmental assessment of scheduled works
- 7.3 Approvals required to undertake fuel management works
- 7.4 Monitoring and reporting requirements
- 7.5 Monitoring fuel, fire regimes and changes to biodiversity
- 7.6 Operations works schedule
- 7.7 Asset protection zones
- 7.8 Fire management access
- 7.9 Plan review

Attachment 6



DP 1 602 729
SUBSTATION

1
D P 1 1 3 9 8 2 6

GARIGAL
NATIONAL
PARK

PROPOSED
RESIDENTIAL
SUBDIVISION

253
DP 1 553 381
BELROSE
MICROWAVE
TOWER

PROPOSED
ROAD
WIDENING

WYATT

SYDNEY EAST
SUBSTATION

RALSTON

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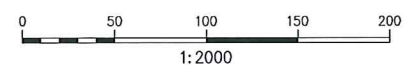
CALLOOL

RESIDENTIAL
HOUSES

RESIDENTIAL
HOUSES

RESIDENTIAL
HOUSES

PRIMARY EVACUATION ROUTES



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B	00/00/00	-	00
A	00/00/00	-	00
Revision	Date	Description	Reference

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Registered Surveyor NSW

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Client MCPL ON BEHALF OF METROPOLITAN LALC
Drawing title
PLAN SHOWING PRIMARY EVACUATION ROUTES FROM
PROPOSED SUBDIVISION OF LOT 1 IN DP1139826 AND
ROAD CLOSURES AT RALSTON AVENUE, BELROSE

datum AHD	project number 30401	reference number 40097EVAC
site Area	scale 1:2000 @A1	date of survey 15-08-2013
LGA WARRINGAH	SHEET OF 1	SHEETS 1

Attachment 7

22 August 2013

The General Manager
Attention: Theo Zotos - Senior Strategic Planner
Warringah Council
Civic Centre
725 Pittwater Road
DEE WHY NSW 2099

Dear General Manager,

**Metropolitan Local Aboriginal Land Council (MLALC) - Voluntary Planning Agreement
Relating to Rezoning of Land at Ralston Avenue, North Belrose**

1 Introduction

We act for the Metropolitan Local Aboriginal Land Council (MLALC) (the Applicant). The Applicant seeks to rezone their site at Ralston Avenue, North Belrose (the Land), described as follows:

- Lot 1 in Deposited Plan 1139826

Consistent with recent discussions between representatives of Council, and representatives of MLALC, the purpose of this letter is:

- To outline the 'in principle' terms of a voluntary planning agreement (VPA) under s93F 1(a) and (b) of the *Environmental Planning and Assessment Act 1979* (EPA Act) to be negotiated between the MLALC (the Applicant) and Warringah Council related to the rezoning and development of the Land as discussed between the parties; and
- To constitute a formal offer to enter into a VPA subject to negotiation for the purposes of s93I (3) of the EPA Act.

In preparing this letter, consideration has been given to the following documents:

- The *Development Contributions Practice Note on Planning Agreements* published by the Department of Planning dated 19 July 2005;
- *Planning Circular* PS 11-012 dated 15 March 2011;
- *Planning Proposal: Ralston Avenue, Belrose* prepared by Urbis dated April 2013; and
- Council's email correspondence 16 July 2013

2 Land to which the VPA applies

The VPA applies to the land described as "Lot 1 in Deposited Plan 1139826" of the document titled *Planning Proposal: Ralston Avenue, Belrose prepared by Urbis dated April 2013* (Planning Proposal).

3 Instrument change to which this VPA relates

The VPA relates to the instrument change sought in the Planning Proposal (the Rezoning).

4 Development to which this VPA relates

The VPA would apply to development on the Land to provide residential and public recreation areas on 13.15% of the site, or 17.79ha of land, and 86.5% of the site or 117.51ha of land proposed to be zoned E2 Environmental Conservation lands which arises from the Rezoning and which is otherwise consistent with the development described in Section 3 of the Planning Proposal.

5 Development contributions and other public benefits and timing of provision

The agreement will be negotiated between the Applicant and Council at a future time and consider the following in respect of the Proposed Development:

- 5.1 Approval and construction of a seagull treatment at Ralston Avenue; (Following determination of a subdivision Development Application and construction prior to the completion of subdivision works)
- 5.2 Implementation of a desired road layout; (To be provided prior to determination of subdivision Development Application)
- 5.3 The location, indicative footprint, ownership and maintenance of water management facilities (OSD and water quality) (Prior to works commencing on site)
- 5.4 The embellishment of the proposed park and the management and maintenance arrangements for the park. (Prior to occupation of the park lot)
- 5.5 The need to finalise other documents e.g. Biodiversity Certification, APZ Fuel Management Plan. (Prior to works commencing on site)

6 Time when the VPA would be entered into

The applicant will provide at the time of lodging a development application for the proposed subdivision a draft VPA document. The VPA would be entered into by the Applicant in connection with the Rezoning, on the date of determination of the subdivision development application.

We look forward to progressing the VPA and welcome discussions with Council to negotiate the VPA.

Yours sincerely,



Matthew O'Donnell
Associate Director

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