Appendix H

Biodiversity technical assessment

M1 PRINCES MOTORWAY IMPROVEMENT PROJECT

PICTON ROAD TO BULLI TOPS

(STAGE 1 – PICTON ROAD TO BELLAMBI CREEK)

BIODIVERSITY ASSESSMENT

Prepared for Roads and Maritime Services
October 2016

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ACRONYMS

Acronyms	Definition
cm	Centimetres
DEC	(Former) Department of Environment and Conservation (NSW)
DECC	(Former) Department of Environment Climate & Change (NSW)
DECCW	(Former) Department of Environment Climate Change & Water (NSW)
DoE	Commonwealth Department of the Environment
DPI	NSW Department of Primary Industries
DSEWPaC	(Former) Department of Sustainability, Environment & Water Protection & Conservation (Commonwealth)
EEC	Endangered Ecological Community
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
FM Act	Fisheries Management Act 1994
ha	Hectare
km	Kilometre
KTP	Key Threatening Process
LEP	Local Environmental Plan
LGA	Local Government Area
m	Metres
M1	Princes Motorway 1 (between Bulli Pass at Bulli Tops and Picton Road at Mount Ousley, previously Mount Ousley Road)
MNES	Matters of National Environmental Significance
MU	Mapping Unit
NorBE	Neutral or Beneficial Effect
NPWS	National Parks and Wildlife Service, NSW
NSW	New South Wales
OEH	Office of Environment and Heritage, NSW.
PCT	Plant Community Type
REF	Review of Environmental Factors
Roads and Maritime	Roads and Maritime Services
ROTAP	Rare or Threatened Australian Plants
SEPP	State Environmental Planning Policy
SEPP 44	State Environment Planning Policy No. 44 – Koala Habitat Protection
SMCMA	(former) Sydney Metropolitan Catchment Management Authority
SMEC	Snowy Mountains Engineering Corporation

Acronyms	Definition
TSC Act	Threatened Species Conservation Act 1995 (NSW)
WoNS	Weeds of National Significance
Wollongong LGA	Wollongong Local Government Area

Document status

Document status	Date	Prepared by	Reviewed by
Draft 1	03/08/16	Anne Baumann	Liam Hogg
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Revised final	21/11/16	Michael Drowley	Liam Hogg

Executive Summary

Proposal

Roads and Maritime Services NSW (Roads and Maritime) propose to upgrade the M1 Princes Motorway (previously Mount Ousley Road) for 8.3 kilometres, between Picton Road at Mount Ousley and Bulli Pass at Bulli Tops. The upgrade involves road widening and realignment of the M1 Princes Motorway from a four lane divided road (two lanes in each direction), to a six lane divided road (three in each direction). The upgrade of M1 Princes Motorway at Mount Ousley would be constructed in two stages as funding becomes available. Stage 1 (southern section) extends between the Picton Road interchange and Bellambi Creek, Mount Ousley. Stage 2 (northern section) extends between Bellambi Creek and Bulli Pass at Bulli Tops.

Scope

This Biodiversity Assessment report provides an ecological impact assessment for Stage 1 (southern section), a four kilometre section of the M1 Princes Motorway, on the Illawarra escarpment between the Picton Road interchange and Bellambi Creek, Mount Ousley. The scope of the study was to describe flora and fauna species and habitat within the study area, determine the likelihood of occurrence of threatened species and ecological communities of State or Federal conservation significance, assess the impacts of the proposal on them and recommend mitigation measures to avoid or minimise these impacts. This technical study will be used to inform a Review of Environmental Factors (REF) for Stage 1 under Part 5 of the EP&A Act.

Methodology

Terrestrial ecological surveys were undertaken by SMEC ecologists on 25-26 and 28 November 2013, 9-10 November 2014, 19-23, 26-31 October 2015, 20 January 2016 and 4-8 and 25-29 April 2016. Field surveys comprised a total of 22 Biobank plots/transects conducted in November 2013, October 2015 and January 2016; 2 days of targeted threatened flora searches in November 2013 and 2014, baseline fauna surveys and a hollow bearing tree survey in October 2015. Terrestrial ecological surveys have previously been carried out for a similar proposal (Lesryk 2010) within the general vicinity of the present study area. In addition, terrestrial ecological surveys have been undertaken within and surrounding the study area as part of the Russell Vale Coal mine expansion proposal.

Impact Assessment

The M1 Princes Motorway is adjacent to remnant native vegetation within the WaterNSW Metropolitan Special Area and the Illawarra Escarpment State Conservation Area, the majority of which consists of good condition dry and moist eucalypt forest within an important wildlife corridor. Around 283hectares of native vegetation will be removed to accommodate the proposed road upgrade, including around 2.3 hectares of the Coastal Upland Swamp Endangered Ecological Community (EEC) listed under both the TSC and EPBC Acts.

It has been assumed that all mapped upland swamp habitat situated within the construction footprint would be directly impacted by the proposal with the reduction in extent of two and the isolation of one smaller patch of upland swamp. Based on the stream, swamp and groundwater assessment conducted by Geoterra (2016) SMEC understands that the

proposed works are not anticipated to have a significant overall effect on recharge to the underlying aquifer, stream baseflow or stream water quality where the currently temporary aquifers seep into local catchments.

Surveys resulted in one capture of Eastern Pygmy-possum on the eastern boundary of the proposed construction footprint. This is likely to represent the most westerly boundary of a wider existing viable population.

Assessments of significance were undertaken for the Coastal Upland Swamp EEC and Eastern Pygmy-Possum, as well as seven flora, twenty three fauna species and two migratory species that have the potential to occur in the study area. With the incorporation of targeted mitigation measures, the direct and potential indirect impacts are not considered significant and no referral or Species Impact Statement is required.

Recommendations

It is recommended to implement an upland swamp monitoring program which should be detailed in the Flora and Fauna Management Plan for the proposal. For the Eastern Pygmy-possum, incorporation of recommended mitigation measures into the project design include fauna connectivity strategy, nest box installation and mitigation monitoring to minimise the impacts to this species.

Other recommendations to minimise the impacts of the proposal include the retention of remnant forest and swamp habitat, protection of hollow bearing and habitat trees where practicable, pre-clearance surveys and clearing supervision by a qualified ecologist with experience in fauna handling, weed management and rehabilitation of affected habitat. With the adoption of these specific mitigation measures, the overall impact of the proposal on biodiversity would be reduced.

1 Introduction

1.1 Background

Roads and Maritime Services NSW (Roads and Maritime) propose to upgrade the M1 Princes Motorway (previously Mount Ousley Road) for around 8.3 kilometres, between Picton Road at Mount Ousley and Bulli Pass at Bulli Tops. The upgrade involves road widening and realignment of the M1 Princes Motorway from a four lane divided road (two lanes in each direction), to a six lane divided road (three lanes in each direction).

The upgrade of the M1 Princes Motorway at Mount Ousley would be built in two stages. Stage 1 (southern section) extends between the Picton Road interchange and Bellambi Creek, Mount Ousley. Stage 2 (northern section) extends between Bellambi Creek and Bulli Pass at Bulli Tops.

Roads and Maritime commissioned SMEC Australia (SMEC) to undertake a flora and fauna survey and Biodiversity Assessment of the proposal, targeting threatened species and communties that potentially occur in the area. It is understood that this Biodiviersity Assessment report is for Stage 1 and would accompany the Review of Environmental Factors (REF) being prepared (by SMEC) for the proposal under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 Project description

Roads and Maritime propose to upgrade the M1 Princes Motorway (previously Mount Ousley Road) for 8.3 kilometres, between Picton Road at Mount Ousley and Bulli Pass at Bulli Tops. Stage 1 (southern section) extends between the Picton Road interchange and Bellambi Creek, Mount Ousley along a four kilometre section of the M1 Princes Motorway, on the Illawarra escarpment, and forms part of the National Land Transport Network.

Key features of the proposal would include:

- Widening and realignment primarily on the eastern side of the existing alignment, to a six lane (three in each direction) divided road from Picton Road to south of Bellambi Creek bridge
- Widening sections of the existing road from four lanes to six lanes from:
  - Picton Road interchange to 600 metres north of Picton Road
  - 1.65 kilometres north of Picton Road to the Fire Trail (Access 7) location
- Realignment to the east of the existing road to provide six lanes from:
  - 600 metres north of Picton Road to 1.65 kilometres north of Picton Road
  - 2.7 kilometres north of Picton Road to 70 metres south of Bellambi Creek bridge
- Provision of a three metre wide shoulder for both carriageways
- Posted vehicle speed limit of 100 kilometres per hour
- Expansion of the road surface area including the replacement of safety barriers, relocation of road signage and infrastructure (such as permanent variable message

signage)

- Realignment and earthworks including bank stabilisation works and environmental management measures
- Four major cuts up to 475 metres long and up to 14 metres in height
- Three major fill embankments up to 275 metres long and up to 20 metres in height
- Provision for ITS infrastructure including:
  - Vehicle detection loops in the pavement
  - CCTV infrastructure
  - Emergency phones and truck stopping bays (with storage for 25 metre B-Double)
- Water quality management measures and drainage structures
- Continued provision for public utilities within the proposal footprint, where practicable.
- Property acquisition at various location to provide construction and operational access to access tracks. (Wollongong Coal Limited, Endeavour Energy and WaterNSW)
- Temporary infrastructure to allow project works including site compounds, utility connections, sedimentation and erosion control, temporary access roads, temporary pavement for road traffic, stockpiling sites and other infrastructure as required

Landscaping and urban design features.The location of the proposed road upgrade is shown in Figure 1.

FIG NO. 1 **FIGURE TITLE** Location of Proposal

0 0.5 1 2 3 4 5
1:100,000 Km

Construction Footprint
Construction Vehicle Access Track
NPWS Estates

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure1_Location of proposal.mxd

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1.3 Previous Studies

1.3.1 SMEC (December 2014)

SMEC prepared a Biodiversity Technical Study for RMS in December 2014 in relation to the original Mount Ousley Road climbing lanes proposal, this being an earlier predecessor to the current concept design. This study assessed the construction of four climbing lanes only. The study comprised a total of ten BioBanking Assessment Methodology (BBAM) field plots/transects as well as a fauna habitat assessment carried out over a three day period (25-26, 28 November 2013) and targeted threatened flora searches conducted over a two day period (9-10 November 2014). The Biobank plots sampled all native vegetation types present within the study area, comprising a 40 metre zone from the edge of both the proposed southbound and northbound climbing lanes. Threatened flora searches were undertaken via random meander transects in suitable habitats. Existing regional vegetation mapping (NPWS 2002; 2003) was used for the investigations to map native vegetation communities within the study area.

Section 5A (*Environment Planning and Assessment Act 1979* (EP&A Act)) and *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) assessments were undertaken for one endangered ecological community (EEC), Coastal Upland Swamp in the Sydney Basin Bioregion, eight flora and 23 fauna species with potential to occur in the study area. SMEC (2014) concluded a significant impact unlikely on this EEC and potential habitat of the 27 threatened species considered.

Recommendations were made by SMEC (2014) to minimise the impacts of the proposal including the retention of remnant forest and swamp habitat, protection of hollow bearing and habitat trees, weed management and rehabilitation of affected habitat. With the adoption of specific mitigation measures, the overall impact of the proposal on biodiversity was determined by SMEC (2014) to be low. No detailed fauna surveys nor biodiversity offsetting studies were undertaken as part of this report.

The current report builds on this earlier SMEC (2014) report and includes additional flora and fauna surveys undertaken in spring 2015 and autumn 2016 as well as an updated impact assessment and mitigation measures based on a revised design and construction footprint for Stage 1of the proposal.

1.3.2 ERM (2013)

Environmental Resources Management (ERM) produced an Environmental Assessment Report in February 2013 (ERM 2013) for the Russell Vale Underground Expansion Project at NRE No. 1 Colliery in the Southern Coalfield. Detailed environmental assessment included, subsidence, surface and groundwater, upland swamps and terrestrial and aquatic ecology.

The proposal intersects with the Mount Ousley road upgrade study area with the Wonga East Area 1 longwall mining domain in close vicinity to the section of proposed road upgrade north of Picton Road. At Wonga East, mining has historically been undertaken in three different coal seams with further longwall mining proposed.

The longwall proposal was reported to not involve any direct clearing of the Coastal Upland Swamp EEC and was found to be unlikely to significantly affect the EEC. However, ERM (2013) noted that the proposed longwall mining may result in subsidence and alter hydrological processes of the swamps in particular the headwall swamps. Thirty nine swamps within 600 m of the Wonga East proposed workings met the definition of Coastal Upland Swamp EEC, 14 of which lie within the predicted 20 mm subsidence zone, according to the ERM study. An ongoing monitoring regime within swamps of special significance is to be implemented to identify subsidence impacts as soon as possible after they occur (ERM 2013).

ERM's assessment found that potential for significant impacts were likely for the EPBC Act and *NSW Threatened Species Conservation Act 1995* (TSC Act) listed species, Giant Burrowing Frog (*Heleioporous australiacus*) and on the potential breeding habitat for the Heath Frog (*Littoria littlejohni*) in first order streams associated with upland swamps. In addition, the Red-crowned Toadlet (*Pseudophryne australis*) habitat had the potential to be affected in the tributaries of Lizard Creek (further west of the study area). Assessments for the Large-eared Pied Bat (*Chalinolobus dwyeri*) and other cave dependent bats including the Large-footed Myotis (*Myotis macropus*) and Eastern Bentwing-bat (*Miniopterus fuliginosus*), concluded negligible to low risk of modification, destruction, removal or isolation of breeding habitat associated with the cliffs and/or steep slopes.

Pultenaea aristata, listed as vulnerable under the EPBC Act and TSC Act was recorded in upland swamps including Wonga East. It was concluded that the habitat for this species would not be removed and it is unlikely to be modified due to proposed subsidence as this species was associated with drier vegetation on the fringes.

1.3.3 GeoTerra (2012)

A groundwater assessment was undertaken by GeoTerra (2012) (Annexure P of ERM 2013) as part of the Russel Vale coal expansion proposal. The assessment states that the maximum subsidence in Wonga East (which incorporates the Mt Ousley Climbing Lanes study area) is predicted to range up to 1.2 m, however the upland swamps and creeks are not predicted to lose water. GeoTerra (2012) predicted temporary water table changes due to subsidence depending on swamps permeability, recharge and climatic conditions.

A groundwater model was developed by Geoterra (2012) to represent aquifers and to predict potential impacts from the coal expansion proposal. A monitoring regime and contingency measures were also developed to monitor changes to the groundwater system during mining operations.

1.3.4 Lesryk (2010)

Lesryk Environmental Consultants (2010) undertook ecological investigations for a similar proposal involving five climbing lanes on Mount Ousley Road between Bulli Pass and Picton Road. Baseline and targeted flora and fauna surveys were carried out in February 2010. No TSC/EPBC listed threatened flora species, populations or EECs were recorded as part of the surveys. Two migratory birds listed under the EPBC Act, Rufous Fantail (*Rhipidura rufifrons*) and the Black faced Monarch (*Monarcha melanopsis*) as well as three species listed under the TSC Act, Gang Gang Cockatoo (*Callocephalon fimbriatum*), Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*)

were recorded by Lesryk (2010). A further four TSC listed microbats were considered by Lesryk (2010) as possible occurrences within the study area. Lesryk (2010) concluded that the proposal would not have a significant impact on state and Commonwealth-listed species recorded or predicted to occur within the study area and recommended that a standard suite of ecological mitigation measures (eg. pre-clearing surveys, clearing supervision) be carried out to minimise impacts on flora and fauna.

1.4 Study Area and construction footprint

For the purposes of this report, the study area is defined as the construction footprint. The construction footprint is the area directly impacted by the proposal. Several amendments have occurred to the construction footprint since the initial study area was defined. Two additional flora plots were surveyed beyond the study boundary on the eastern side of the study area to incorporate some of the downstream upland swamp types. The proposed construction footprint is shown in Figure 2.

Figures 1 to 10 illustrate the proposed construction area for the road widening as well as the construction compound areas. This is the area that is expected to be disturbed by vegetation removal, general road construction, operation of machinery and construction of access.

The construction boundaries have been developed to allow:

- Adequate space for efficient and safe construction
- Flexibility in construction for the relocation of water management measures (such as basins) to areas of lower environmental sensitivity.

An access track (Brokers Nose Fire Trail) would be used during construction by light vehicles to transport equipment and materials. The existing, cleared access track may require minor site preparation work to make good for construction vehicles, however no clearing of vegetation outside of the existing track alignment would be considered necessary.

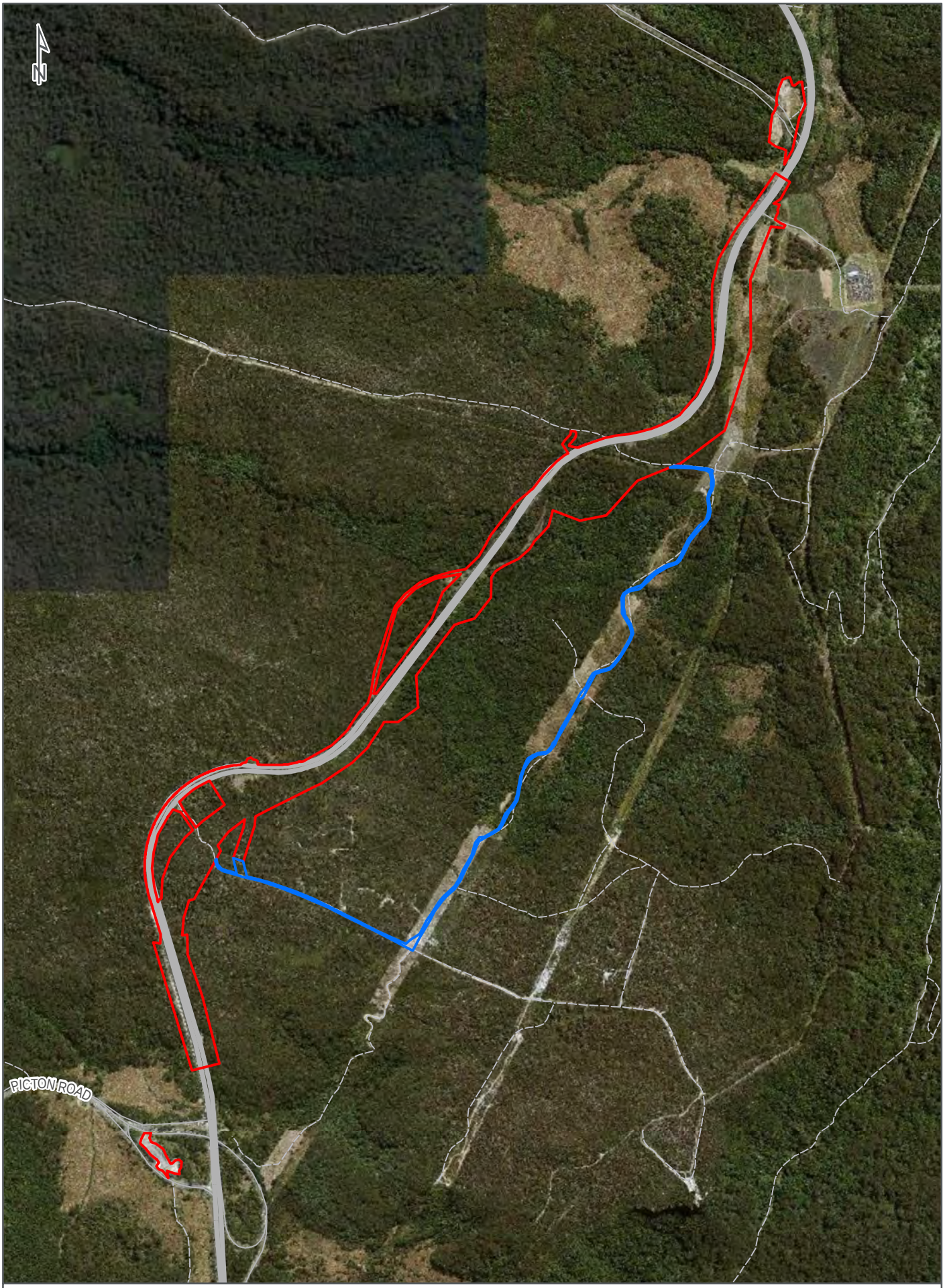

FIG NO. 2 **FIGURE TITLE** Construction Footprint

Construction Footprint
Construction Vehicle Access Track

0 100 200 400 600
1:16,000 Metres

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure2_Study area and construction footprint.mxd

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1.5 Legislative context

1.5.1 Environmental Planning and Assessment Act 1979

This technical report has been prepared to consider the potential environmental impact of the proposal, in keeping with the legislative requirements of Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The EP&A Act provides the statutory basis for planning and environmental assessment in New South Wales (NSW). This biodiversity specialist report is provided as part of the environmental assessment and technical considerations prepared in support of the Review of Environmental Factors (REF) for the proposal.

1.5.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act requires that Commonwealth approval be obtained for certain actions, and establishes an assessment and approvals system for actions that have or are likely to have, a significant impact on Matters of National Environmental Significance (MNES). Matters of NES considered in this technical report include listed threatened species, populations and ecological communities as well as migratory species protected under international agreements. Particular consideration has been given to potential impacts on threatened biota that occur or could occur in the study area. Potential impacts are discussed in Section 4 and Appendix E of this report.

1.5.3 Threatened Species Conservation Act 1995

The TSC Act protects threatened flora and fauna species, endangered populations and ecological communities and their habitats within NSW. Particular attention has been given to potential impacts on threatened biota listed under the TSC Act that occur or could occur in the study area. Potential impacts are discussed in Section 4 and Appendix D of this report.

1.5.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) protects threatened species, populations and ecological communities of fish and marine vegetation, and other living resources of Australian waters. There is the potential for threatened species to occur in the Cataract River system and a number of mapped tributaries flow west across the study area including Cateract Creek and Bellambi Creek. This is discussed further in Section 3.1.2.

1.5.5 State Environmental Planning Policy 44 (Koala Habitat Protection)

State Environmental Planning Policy (SEPP) 44 (Koala Habitat Protection), made under the EP&A Act is considered in this report, as areas identified under this SEPP may be affected by the proposal. The objective of SEPP 44 is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline. The SEPP requires the preparation of plans of management before development consent can be granted in relation to areas of core Koala habitat. Section 3.10

of this report includes an assessment of whether the study area contains Koala habitat as defined in the SEPP.

1.5.6 Noxious Weeds Act 1993

Under the *Noxious Weeds Act 1993*, public authorities are required to control noxious weeds which are likely to spread to adjoining land. Section 3.5 of this report considers weeds declared as noxious in the Wollongong LGA that occur within the study area.

1.6 Environmental setting

The Stage 1 study area is located within the Wollongong Local Government Area (LGA), the Hawkesbury-Nepean Catchment and the Sydney Basin Bioregion. It is located on the eastern edge of the Woronora Plateau where it meets the Illawarra Escarpment. The study area and construction footprint for Stage 1 are shown in Figure 2 .

1.6.1 Soils and geology

Geology

Stroud *et al*. (1985) mapped the study area as predominantly Hawkesbury Sandstone and Bulgo Sandstone with an undifferentiated map unit between these two geologies. The geological units are described as:

Map unit	Description
Hawkesbury sandstone	Medium to coarse-grained quartz sandstone, very minor shale and laminate lenses
Bulgo Sandstone	fine to medium-grained quartz lithic sandstone with lenticular shale interbeds
Undifferentiated	undifferentiated interbedded quartzose and quartz lithic sandstone, siltstone

Soils

The soil landscapes of the study area are mapped (Hazelton and Tille 1990) as predominantly Warragamba (wb) and Hawkesbury (ha) with very small area of Lucas Heights (lh) in the north east. Warragamba and Hawkesbury are colluvial landscapes with steep slopes, identified as highly erodible. Lucas Heights soils generally occur on moderately inclined slopes. Each soil unit is described as:

- Hawkesbury (ha): Occur on the upper slopes and ridge lines, the Hawkesbury Sandstone Group is apparent, with broad sandstone outcrops and small cliffs. Soils are derived from medium to coarse grained quartz sandstone with minor shale and laminate lenses. Shallow discontinuous Lithosols/Siliceous sands occur in association with rock outcrops, while Earthy Sands, Yellow Earths and locally deep sands occur over the sandstone;
- Warragamba (Wb): Occur on the lower slopes, derived from Narrabeen Sandstone of the Warragamba Group, consisting of fine-grained lithic sandstone occasionally interbedded with thin shale lenses. Shallow to deep Lithosols occur on crests, Brown Earths and Red Podzolic soils on upper slopes and Yellow Podzolic soils on lower slopes;

- Lucas Heights (Lh): At the Bellambi Creek crossing area, soils are potentially in a transitional zone between Lh and the Hawkesbury soil landscape. Soils of the Mittagong Formation occur as a shallow layer over Hawkesbury sandstone and consist of interbedded shale, laminate and fine to medium-grained quartz sandstone. Moderately deep hardsetting Yellow Podzolic Soils and Yellow Soloths occur on ridges and plateau surfaces, Lateritic Podzolic Soils on crests Yellow earths on shoulders of plateau and ridges and earthy sands on valley flats.

1.6.2 Topography and drainage

The study area is within the Hawkesbury-Nepean Catchment. The topography of the study area varies from very gently to steeply inclined at the Picton Road off-ramp then becoming moderately inclined along the western side of the Princes Motorway. Elevation is between 330 metres and 450 metres.

A number of mapped creeks and drainage lines run across the study area. In the north tributaries drain into Bellambi Creek which flows west across the study area. In the south, two tributaries drain west into Cataract Creek crossing the site. A tributary to Rocky Creek drains westward just south of the study area at the Picton Road interchange.

1.6.3 Land use

The proposal is located along the M1 Princes Motorway (Mount Ousley Road), within a largely natural bushland environment between Bellambi Creek, and Picton Road, Mount Ousley. Some localised development is present, mainly for electricity and gas infrastructure. The proposal is located within the WaterNSW Metropolitan 'Special Area', which is managed to protect Sydney's drinking water catchments. The Illawarra Escarpment State Conservation Area is located to the north of the study area.

1.7 Study aims

The key aims of this study are to:

- Undertake a literature review and standard biodiversity database searches to determine a comprehensive spectrum of threatened species, populations and endangered ecological communities previously recorded in the vicinity of the study area and use the results to guide and inform field survey design for the 2015 / 2016 field surveys.
- Conduct detailed fauna surveys (eg. Anabat, call playback, spotlighting, bird surveys, camera trapping, Elliott trapping and nest box installation and inspections) to inventory native and exotic fauna utilising habitats present within the study area, with an emphasis on threatened species with the potential to occur on site.
- Supplement the plots/transects undertaken by SMEC in November 2013 with additional plots/transects to satisfy the Biobank Assessment Methodology (2014) minimum survey requirements.
- Identify and assess likely impacts to flora and fauna arising from the Stage 1 proposal.
- Undertake assessments under the EP&A and EPBC Acts including the preparation of tests of significance for threatened biota occurring or potentially occurring within the study area.

- Identify measures for managing impacts on native and threatened biota during design, construction and operation.

2 Methodology

2.1 Desktop Review

A desktop review was undertaken prior to the commencement of field surveys and included database searches and a review of relevant literature to identify a spectrum of State and Commonwealth-listed threatened species, populations and ecological communities previously recorded in the vicinity of the study area. Results from the literature review were used to inform the baseline and targeted flora and fauna surveys undertaken as part of this updated ecology report.

The following databases and resources were investigated:

- NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database (BioNet) within a 10 kilometre radius of the site (March 2016).
- Protected Matters Report that documents all Matters of National Environmental Significance (NES) within 10 kilometres of the site. Matters of NES include threatened species, communities and migratory species which are listed under the EPBC Act (Department of the Environment) (March 2016).
- NSW National Parks and Wildlife Service (NPWS) (2003) The Native Vegetation of the Woronora, O'Hare's and Metropolitan Catchments, NSW NPWS, Sydney.
- NSW National Parks and Wildlife Service (NPWS) (2002) Native Vegetation of the Illawarra Escarpment and Coastal Plain, NSW NPWS, Sydney.
- The Native Vegetation of the Sydney Metropolitan Area, Office of Environment Heritage NSW, Hurstville (OEH, 2013).
- Draft Upland Swamp Environmental Assessment Guidelines, Office of Environment and Heritage, Hurstville (OEH, 2012).
- Lesryk Environmental Consultants (2010) Flora and Fauna Assessment Mt Ousley Climbing Lanes, prepared for NSW Roads and Maritime Services.
- Biodiversity Technical Study M1 Princes Motorway Climbing Lanes. Report prepared for RMS, December 2014 (SMEC, 2014).
- NSW Department of Primary Industries Noxious Weeds List (DPI 2014).
- Draft Upland Swamps Offsets Policy (Integrated Mining Proposal) – NSW Department of Planning (2015).
- Russell Vale Coal Expansion major project proposal (ERM 2013).

2.2 Flora

Survey methods for the terrestrial ecological investigations are detailed below and were consistent with the *Threatened Species Survey and Assessment: Guidelines for developments and activities* (working draft) (DEC 2004).

2.2.1 Vegetation mapping

The Woronora VIS regional vegetation mapping (NPWS 2002) was used to provide the initial base vegetation map for the study area. Adjustments to the NPWS (2002) vegetation linework were subsequently made following the completion of the flora surveys and were generally limited to those areas that were ground truthed by SMEC botanists (this being the vicinity of the Biobank plots within the study area).

2.2.2 Biobank surveys

Ten Biobank plots were surveyed by SMEC ecologists during initial studies of the Stage 1 and Stage 2 areas in November 2013 (Plots NE1, NE2, NE3, SE1, SE2, NW1, NW2, SW1, SW2, SW3).

These were supplemented with an additional 11 plots/transects surveyed during 19-22 October 2015 and 20 January 2016, to satisfy the BioBanking Assessment Methodology (BBAM) (OEH, 2014) minimum survey requirements. These plots were stratified across the entire Stage 1 and Stage 2 study area. Data was collected according to BBAM (OEH, 2014) and included 20 x 20 metre plot based full floristic surveys and 20 x 50 metre plot and transect sites.

The additional 11 Biobank plots (SE3, NE4, NE5, NE6, NE7, SE8, SE4, SE5, SE6, SE7, SE9) were undertaken by SMEC ecologists on 19-22 October 2015. An additional plot (SE10) was surveyed opportunistically outside the study area on 20 January 2016.

A list of the Woronora VIS vegetation map units within the study area, corresponding plant community type (PCT) aerial extents and the total number of Biobank plots undertaken in each PCT is provided in Table 1. (Aerial extent of the PCT is shown for the full extent of the Stage 1 and Stage 2 study area as this entire area was used to calculate the number of biobanking plots required). Locations of the Biobank plots for Stage 1 are shown in Figure 6.

Table 1. Biobank Plot stratification across the Stage 1 and Stage 2 study areas.

Illawarra/Woronora VIS map unit (NPWS 2003)	Equivalent BioBanking Plant Community Type (PCT)	Areal extent of PCT in Stage 1 and 2 Study area	Number of Biobank Plots completed and references	EEC
MU15 Tall Open Blackbutt Forest (19.2 ha) MU6 Moist Blue Gum – Blackbutt Forest (18.3 ha)	Blackbutt-Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (SR516)	37.3 ha	6 SW1, NW1, NE1, NE3, NW2, NE7	N/A

Illawarra/Woronora VIS map unit (NPWS 2003)	Equivalent BioBanking Plant Community Type (PCT)	Areal extent of PCT in Stage 1 and 2 Study area	Number of Biobank Plots completed and references	EEC
MU32 Escarpment Edge Silvertop Ash Forest (10.0 ha)	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (SR629)	10.0 ha	3 NE2, NE4, NE5	N/A
MU42 Upland swamp – Banksia Thicket (0.3 ha) MU43 Upland Swamp – Tea-tree Thicket (2.6 ha) MU44 Upland swamp – Sedgeland- Heath Complex (0.9 ha)	Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin (HN662)	3.8 ha	5 SE4, SE1, SE6, SE7*,	Coastal Upland Swamps in the Sydney Basin Bioregion (TSC Act and EPBC Act)
MU45 Upland swamp - fringing Eucalypt woodland (0.5 ha)	Needlebush - banksia wet heath on sandstone plateaus of the Sydney Basin Bioregion (HN560)	0.5 ha	1 SE10*	N/A
MU29 Exposed Sandstone Scribbly Gum Woodland (10.8 ha)	Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion (SR513)	10.8 ha	3 SE2, SE3, SE9	N/A
MU26 Sandstone Gully Peppermint Forest (3.1 ha)	Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (SR658)	3.1 ha	2 SW2, SE8	N/A
MU2 Coachwood Warm Temperate Rainforest (16.5 ha)	Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion (HN517)	16.5 ha	3 SW3, SE5, NE6	N/A

* = BBAM survey plot conducted beyond study area boundary.

2.2.3 Threatened Flora Surveys

Targeted threatened flora surveys were carried out by SMEC ecologists on 9-10 November 2014 via random meander transects (Cropper 1993) in suitable habitat types

within the study area. These surveys targeted threatened flora previously recorded in the vicinity of the study area (eg *Pultenaea aristata*).

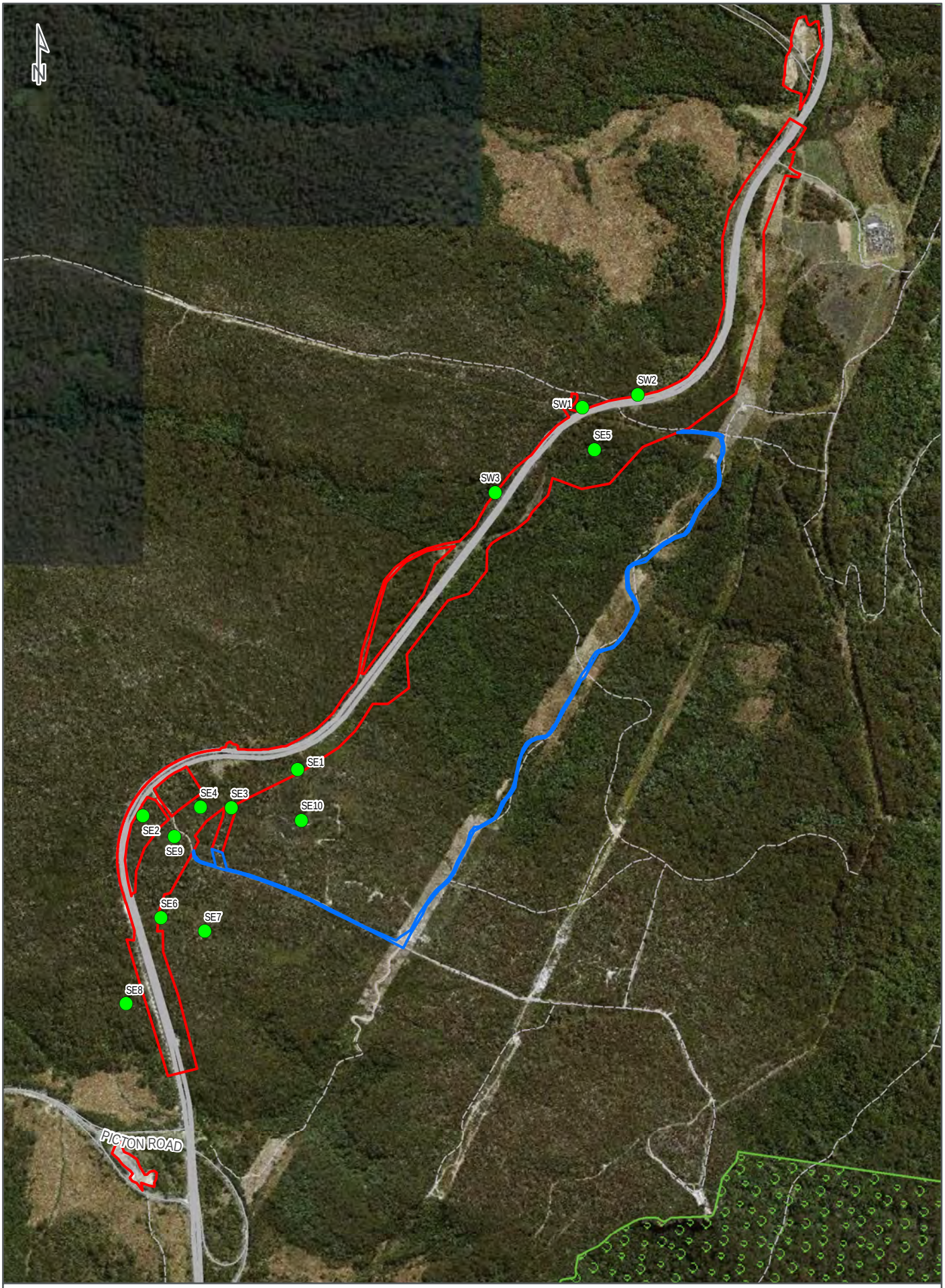

FIG NO. 3 **FIGURE TITLE** Field Survey Locations – Flora

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Flora Plot Locations
Construction Footprint
Construction Vehicle Access Track
NPWS Estates

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure3_Field survey locations _flora.mxd

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2.3 Fauna

Baseline and targeted threatened fauna and habitat surveys were undertaken by SMEC ecologists on 19-30 October 2015, as outlined below. Nestboxes were installed in January 2016 and additional targeted surveys for the Eastern Pygmy-possum were conducted during April and May 2016.

2.3.1 Habitat Assessment

The fauna habitat assessment was conducted over a three day period (25-26, 28 November 2013) to assist in determining the likelihood of presence of threatened fauna species. Habitat characteristics considered include the presence of hollow bearing trees, fallen logs, leaf litter and other ground debris, drainage lines, ponds, the structure of vegetation communities and the presence of fruiting/flowering plant species to assess the habitat suitability for a range of fauna species.

Using the random meander technique, searches were carried out for signs of fauna activity such as tracks, scats, scratches and notches on trees, as well as any opportunistic sightings, to identify the presence of common and threatened fauna species.

Habitat information recorded at each sampling site included: height and density of vegetation layers, leaf litter, fallen timber, tree hollows (position on tree and size), stags, rock shelves, soil type, presence of water and any human-made habitats.

A hollow bearing tree assessment was conducted on 26-30 October 2015 within the construction footprint. The information recorded included: GPS location of the tree, species name, size and type of hollow classified as small (<5 centimetre diameter), medium (5-10 centimetre), Large (10-20 centimetre) and extra large (> 20 centimetre), approximate height of hollow, and presence of fissures and photograph of each tree. The results of this survey are summarised in Section 3.6.1

2.3.2 Fauna surveys October 2015

Fauna surveys were undertaken from 19-30 October 2015 throughout the Stage 1 study area. Climatic variables such as rainfall, temperature, wind speed, moon phase and cloud cover at the time of the survey were recorded along with time and duration of the surveys. The Stage 1 study area includes the fauna survey Sites 2A, 3, 4 and 5.

Additional observational data was recorded including opportunistic fauna sightings, identification of predator scats and mammal markings. These incidental observations have also been included in this report. The following methods were employed during the surveys:

Ultrasonic bat detection

Acoustic surveys were undertaken with an Anabat II ultrasonic detector and attached ZCAIM. Surveys were undertaken all night (eight hours) for three nights per site at two sites, (Sites 4 and 5) to maximise species detection. These sites were chosen as having potentially suitable flyways for bat detection. Sonograms were viewed with Analook for Windows v0.3.3.1.7 and identified using the guidelines and reference library in Pennay *et al.* (2004).

To ensure reliable and accurate results:

- Recordings containing less than three pulses were not analysed (Law et al 1999).

- Only search phase calls were analysed (McKenzie et al 2002).
- Three categories of confidence in species identification were used (adapted from Mills et al 1996):

  Definite – identity not in doubt
  Probable – low probability of confusion with species of similar calls
  Possible – medium to high probability of confusion with species with similar calls.

Call playback

Call playback of recordings was undertaken at all sites except site 2A. The survey aimed to illicit a call response from nocturnal animals, particularly birds and mammals. The survey included two call playback events at each location on separate nights and was preceded by a 10 minute listening period before any calls were played. Recorded calls were then broadcast for five minutes using a loud speaker and followed by a 10 minute period of listening for a response. This was followed by localised spotlight searches and subsequent intermittent call playback to check for individuals that may have moved closer to investigate but had not audibly responded.

Calls played during the survey included four owl species: Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Sooty Owl (*Tyto tenebricosa*) as well as Sugar Glider and Yellow-bellied Glider.

Spotlighting

Spotlighting was carried out at all sites except site 2A. This survey consisted of two survey events for each site carried out on separate nights to survey for nocturnal mammals and birds. Transects were approximately 300–500 metre long and were surveyed for a minimum of 20 minutes each by two observers using handheld spotlights and binoculars. Spotlighting was typically carried out in conjunction with call playback at each site in an attempt to improve detection rates.

Birds

Surveys were undertaken for both diurnal and nocturnal birds. Area searches with a species time curve were used to survey diurnal bird species during their peak activity time, usually at dawn. Bird surveys were conducted twice at dawn and twice at dusk at each of the four survey locations (site 2A was excluded).

Spotlight surveys throughout the study area were used to identify nocturnal birds. In addition, habitat searches were conducted throughout the day for suitable roosting trees and nest sites.

Amphibians

Day and night habitat searches were conducted over two separate nights in October 2015 at two sites, (4 and 2A) with nocturnal call playback and aural searches. There had been two millimetres of rainfall two days prior to survey and also two millimetres recorded on the second day of survey. Species targeted were Green and Golden Bell Frog, Little John's Frog, Giant Burrowing Frog, Red-crowned Toadlet and Stuttering Frog.

Mammals

Mammals were surveyed at each of the main sites (excluding site 2A) through a combination of nocturnal spotlighting (see above) and camera traps. Cameras were set up for two nights in Sites 3, 4 and 5 within the study area. All cameras were baited to encourage detection.

In addition to this characteristic marks were also recorded during habitat assessment including scratches, scats, dens, hollows latrine sites.

Reptiles

Day and night habitat searches were conducted at all sites except site 2A. Opportunistic sightings were noted when encountered.

The locations of the fauna survey sites are shown in Figure 4. Sampling effort for fauna surveys is shown in Table 3.

2.3.3 Targeted Eastern Pygmy-possum survey autumn 2016

Twenty-five nest boxes for the Eastern Pygmy-possum (EPP) were installed in January 2016 (see Figure 4 for locations). Surveys were undertaken for the EPP during autumn 2016 incorporating nest box checks and Elliot trapping. Table 2 summarises the survey effort.

Table 2. Summary of survey effort for the Eastern Pygmy-possum

	Week 1	Week 2	Total
Dates	11-4-16 – 15/4/16	26/5/16 – 30/4/16	10 days
Traps	60 traps, 4 nights	60 traps, 4 nights	480 trap nights
Nest boxes	25, 2 checks	25 boxes, 2 checks	100 nest boxes

Elliot Traps were installed in flowering *Banksia ericifolia* trees during both weeks of the nest box checking. The 60 traps were arranged in ten grids of 6 traps. The traps were placed around or near nest boxes 1, 4, 7, 13, 17, 19, 20, 21, 22 and 23.

Traps were baited with rolled oats, peanut butter and honey. Diluted honey was sprayed around the entrance to each trap. Traps were checked daily, commencing at dawn. All species captured were recorded.

Details recorded for each individual EPP captured included:

- Microchip/transponder number and date inserted (if new individual)
- Location of capture
- Weight to nearest 0.5 grams
- Caudal fat index (as described by Bladon et al 2002)
- Sex
- Presence and type of parasites
- Breeding condition:

- Females – examining pouches for young, enlarged nipples etc, record the number and size of young (only without stress to the mother – note there is a risk of dislodgement)
- Males – length and width of testes (use testis index of Ward 1990)

- Assign age using weight and reproductive criteria, following Ward 1990.

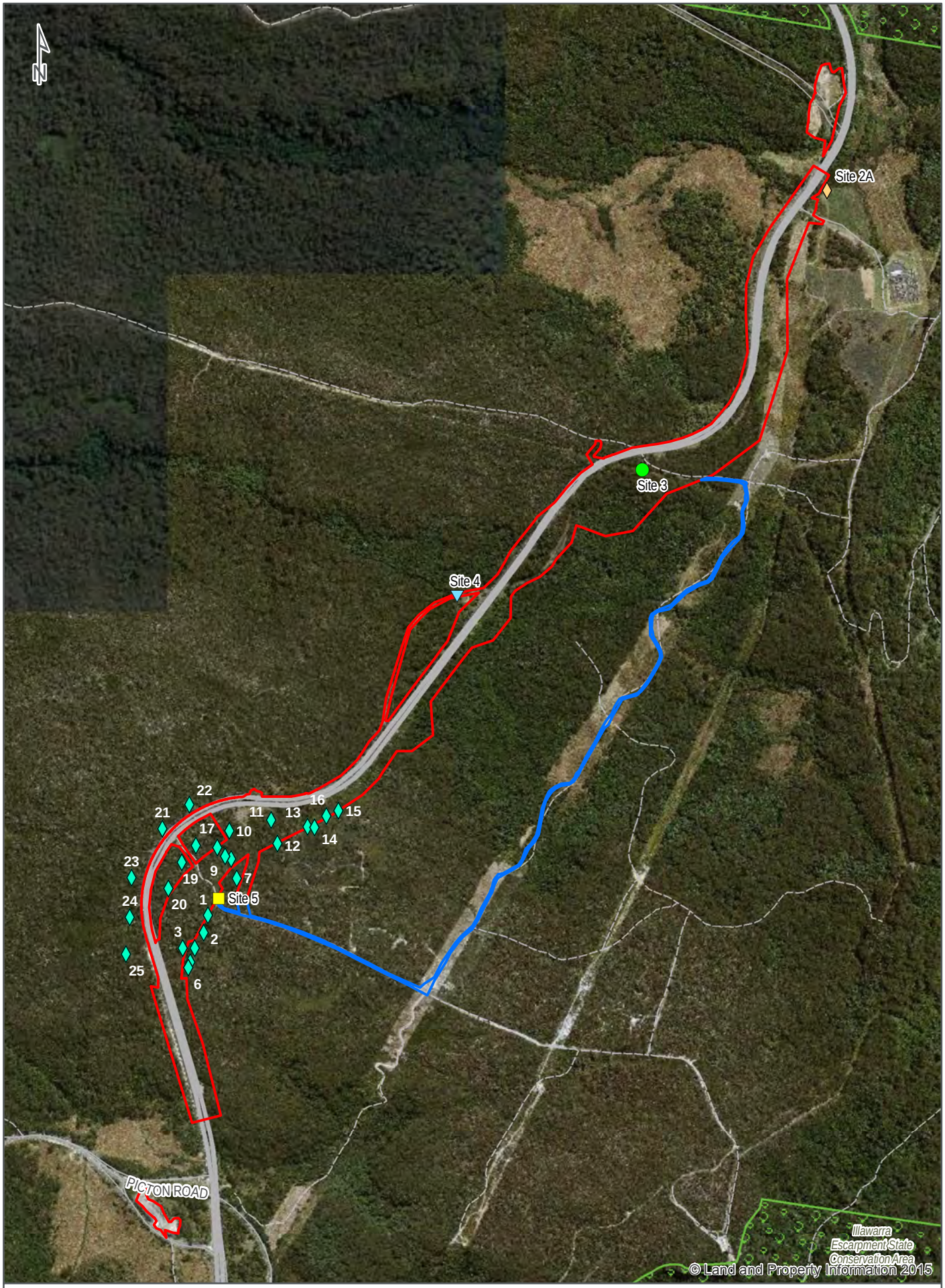

FIG NO. 4 **FIGURE TITLE** Field Survey Locations – Fauna

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- Eastern Pygmy-Possum Nestbox Locations
- Frogs
- Spotlighting, Birds, Call Playback
- Spotlighting, Birds, Call Playback, Camera
- Spotlighting, Birds, Call Playback, Camera, Anabat
- Spotlighting, Birds, Call Playback, Frogs, Camera, Anabat
- Construction Footprint
- Construction Vehicle Access Track
- NPWS Estates

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure4_Field survey locations_fauna.mxd

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Table 3. Sampling effort for fauna surveys for M1 Princes Motorway realignment

Target Species	Survey timing	SMEC Methodology (based on DEC 2004)
AMPHIBIANS		
Green and Golden Bell Frog	Aug-Mar after rain, any emergent aquatic veg Sep–Jan calling period	Systematic day habitat search – 20 minute per vegetation type Night habitat search of damp and watery sites – 20 minute on two separate nights Nocturnal call playback - at least one playback on each of two separate nights after rain during October. Avoid overuse of call playback during the breeding season.
Little John's Frog	Feb–Aug calling period	
Giant Burrowing Frog	late spring/summer Feb–Apr calling period	
Red-crowned Toadlet	any, after rain	
Stuttering Frog	Sep–Apr calling period	
NOCTURNAL BIRDS		
Masked Owl	Breed when conditions are favourable and food items are plentiful.	Surveys for all species conducted over five separate nights. Initial 10 minutes listening followed by a 10 minute spotlight search for all species. Intermittent call playbacks for each target species of three minutes, followed by a seven minute listening period and another seven minutes spotlighting and listening. Day habitat search.
Powerful Owl	Spring/summer	
Sooty Owl	Spring/summer	
Barking Owl	Breed in late winter. Most eggs are laid from July to September.	

Target Species	Survey timing	SMEC Methodology (based on DEC 2004)
DIURNAL BIRDS		
Various species		Area search (species-time curve approach): 30 minute observation and listening search within a two hectare (50 by 200 metre) area. Undertaken within two different patches of each vegetation type repeated on two different days. Undertaken at dawn and dusk.
MAMMALS		
Yellow-bellied Glider	Any	Call playback: Two sites per vegetation type. Call play back conducted twice at each site on two separate nights Spotlighting: 2 x 20 minute searches for four nights for each vegetation type. Scratch search on trees in suitable habitat – 20 minute search.
Eastern Pygmy-Possum	Spring/Summer	Spotlighting: 2 x 20 minute searches for four nights for each vegetation type. Scratch search on trees in suitable habitat – 20 min search. Targeted EPP survey in January 2016 for two weeks using 25 nestboxes and 60 Elliot Traps placed near nest boxes (See section 2.3.3 for more detail).
Grey-headed Flying-fox	Any	Spotlight observations Daytime roost observations (if any)
Spotted-tailed Quoll	Any	Sampling restricted to:

Target Species	Survey timing	SMEC Methodology (based on DEC 2004)
Eastern Quoll	Any	Searching for habitat resources, den sites and latrine sites. Baited camera trapping in three locations for two nights. Spotlighting.
Koala	Any	Call playback: Two sites per vegetation type. Call play back conducted twice at each site on two separate nights. Spotlighting. Active search for scats and scratches in suitable habitat.
Southern Brown Bandicoot (eastern)		Spotlighting: 20 minute searches in relevant habitat. Trapping was not undertaken for this species.
Brush-tailed Rock-wallaby		Spotlighting: 20 minute searches in relevant habitat.
New Holland Mouse		Spotlighting: 20 minute searches in relevant habitat. Trapping was not undertaken for this species.
MICROBATS		
Southern Myotis Eastern False Pipistrelle Greater Broad-nosed Bat Eastern Bentwing Bat Eastern Freetail-bat Large-eared Pied Bat	Spring/Summer/Autumn	Ultrasonic detection: For a duration of two entire nights at each location. One location within each vegetation type and one located along each creek (to detect Southern Myotis).
REPTILES		

Target Species	Survey timing	SMEC Methodology (based on DEC 2004)
Rosenberg's Goanna	Any	Searched for habitat resources Baited camera trapping Spotlighting

2.4 Limitations

Limitations to the flora and fauna surveys, which may impact on survey results, include:

- No trapping targeting the Southern Brown Bandicoot (Eastern) or New Holland mouse was undertaken. These species were not surveyed due to the low likelihood of occurring at the site, based upon historic atlas records and known habitat types present.
- Surveys were restricted to a week of overall mobilisation at site due to available resources.
- It should be noted that frog surveys only were conducted at Site 2A as habitat was considered optimal.
- Targeted surveys were not conducted for the Greater Glider (*Petauroides volans*) which was listed as vulnerable under the EPBC Act in May 2016 as it was not listed at the time surveys were conducted. Survey methods however included spotlighting which is recognised as a suitable method for detecting this species.

3 Desktop and Survey Results

3.1 Desktop review results

3.1.1 Threatened Flora

A total of 28 flora species and two endangered flora populations listed under the TSC and/or EPBC Acts have been historically recorded within 10 kilometres of the study area. Based on a habitat assessment, these 28 species and two populations were filtered to determine a shortlist of species and populations that could reasonably be expected to potentially occur in the Stage 1 study area. The assessment is outlined in the likelihood of occurrence table provided in Appendix C.

Species that were assessed as having a medium to high chance of occurring within the Stage 1 study area include:

- *Acacia bynoeana* (Bynoe's Wattle)
- *Cryptostylis hunteriana* (Leafless Tongue Orchid)
- *Daphnandra johnsonii* (Illawarra Socketwood)
- *Epacris purpurascens var. purpurascens*
- *Grevillea parviflora subsp. parviflora* (Small-flowered Grevillea)
- *Pomaderris adnata* (Sublime Point Pomaderris)
- *Pultenaea aristata* (Prickly Bush-pea)

Threatened flora records within 10 km of the study area are shown in Figure 5.

3.1.2 Threatened Fauna

Sixty threatened fauna species have been recorded within 10 kilometres of the study area, of which 59 are listed under the TSC Act and 23 under the EPBC Act (Appendix C). Using a risk based approach the likelihood of occurrence of these species was determined. The study area was deemed to provide suitable habitat and availability of resources for 23 of these species. Species that have a medium to high chance of occurring, or which have been observed within the study area include:

- *Heleioporus australiacus* (Giant Burrowing Frog)
- *Litoria littlejohni* (Littlejohn's Tree Frog)
- *Pseudophryne australis* (Red-crowned Toadlet)
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo)
- *Callocephalon fimbriatum* (Gang Gang Cockatoo)
- *Petroica boodang* (Scarlet Robin)
- Petroica phoenicea (Flame Robin)

- *Daphoenositta chrysoptera* (Varied Sittella)
- *Glossopsitta pusilla* (Little Lorrikeet)
- *Hieraaetus morphnoides* (Little Eagle)
- *Ninox strenua* (Powerful Owl)
- *Tyto tenebricosa* (Sooty Owl)
- *Tyto novaehollandiae (Masked Owl)*
- *Myotis macropus* (Southern Myotis)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)
- *Mormopterus norfolkensis* (Eastern Freetail Bat)
- *Platyrrhinus vittatus* (Greater Broad-nosed Bat)
- *Cercartetus nanus* (Eastern Pygmy-possum)
- *Petaurus australis* (Yellow-Bellied Glider)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Hoplocephalus bungaroides* (Broad-headed Snake)
- *Varanus rosenbergi* (Rosenberg's Goanna)

Threatened fauna records within 10 kilometres of the study area are shown in Figure 5. One probable Eastern Bentwing-bat record is within the Study area.

There are records of three fish species occurring in the Wollongong LGA that are threatened under the FM Act: Macquarie Perch, Trout Cod and Australian Grayling. Macquarie Perch is the only one of these species shown to have an indicative distribution within the vicinity of the study area in the nearby Cataract River system (DPI 2015), however there is a lack of suitable habitat within the study area itself as the proposed works do not intersect any defined stream channels at Brokers Nose, and only a single headwater channel of a first order gully near the watershed with Bellambi Creek.

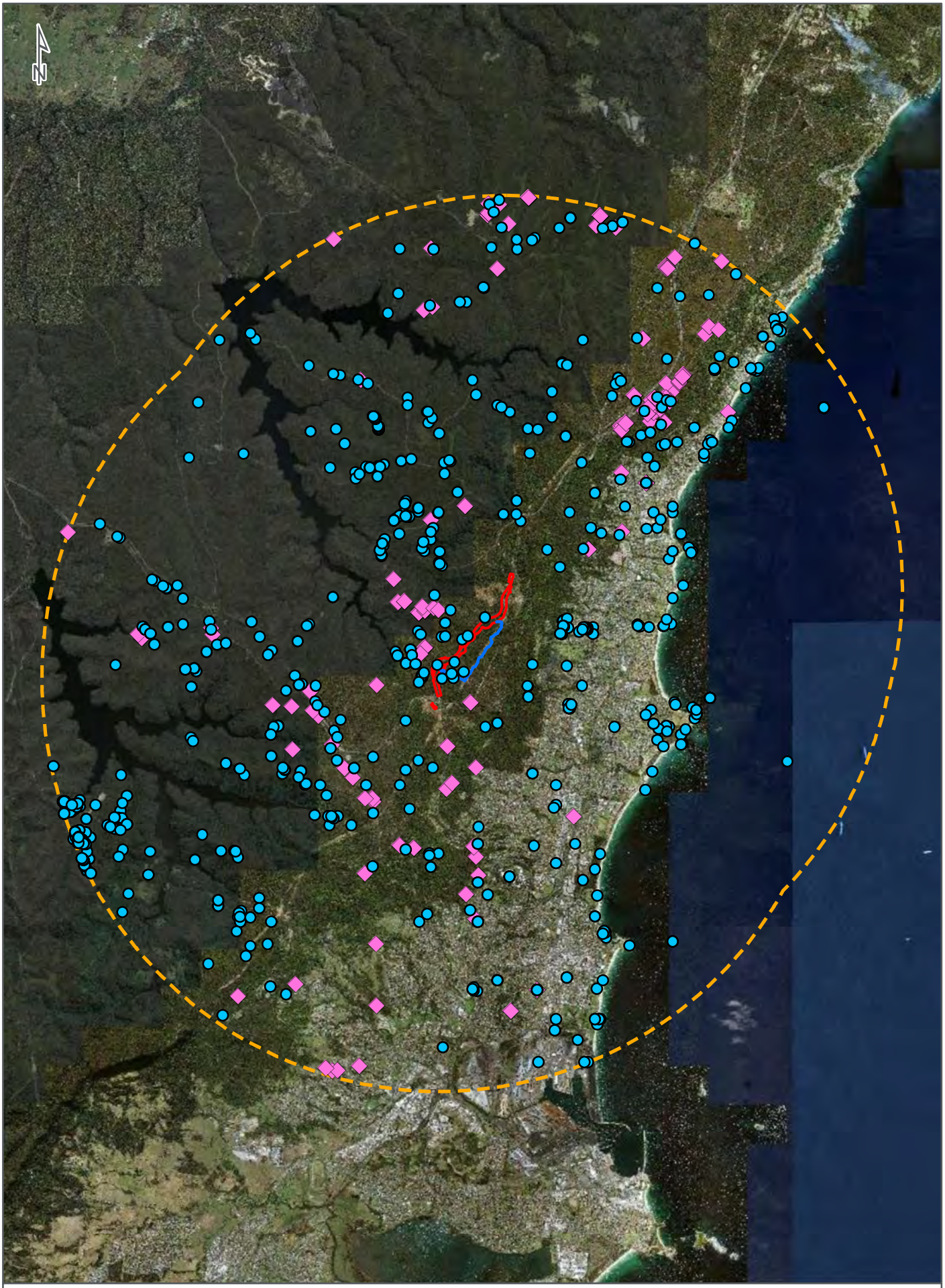

FIG NO. 5 **FIGURE TITLE** Locations of Threatened Species Recorded

Threatened Fauna Record
Threatened Flora Record
10km Buffer
Construction Footprint
Construction Vehicle Access Track

0 0.5 1 2 3 4 5
Km
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Location: \\AUSYFP01\Group\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure5_Threatened species records within 10 km radius.mxd

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3.2 Vegetation communities

Within the proposal study area 170 native species and zero exotic species were recorded from 13 plots. Seven native vegetation communities exist in the proposal study area. A full floristic list recorded from the proposal study area is provided in Appendix A in Table 9.

The Woronora VIS regional vegetation mapping (NPWS 2002) was used to provide the initial vegetation map for the study area. This was subsequently refined, to some extent following field investigations using ESRI ArcMap (Figure 6).

Summary profiles or descriptions of the native vegetation communities recorded in the study area during the present investigations are provided below. Vegetation community classification follows that of the Woronora, O'Hare's and Metropolitan Catchment (NPWS 2003).

3.2.1 Vegetation Community No. 1 – Coachwood Warm Temperate Rainforest

Occurrence	Survey Plots	Plant community equivalencies
This community was recorded along rocky gully lines and sheltered gully slopes associated with Cataract, Bellambi and Allen Creeks and their tributaries in the Stage 1 and Stage 2 study areas, on moist sands and loamy sands, often behind steep road embankments	SW3, SE5, NE6	MU2 Coachwood Warm Temperate Rainforest (NPWS 2003); Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion (VIS 2.1 PCT HN517) Moderate to Good condition

Floristics and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**10-20 m**	**70%**	*Ceratopetalum apetalum, Doryphora sassafras, Syncarpia glomulifera, Livistona australis, Cryptocarya glaucescens*
Subcanopy Trees and Shrubs:	**8-10 m**	**20%**	*Acmena smithii, Tasmannia insipida, Pittosporum undulatum, Citriobatus pauciflora, Cyathea australis, Cyathea leichhardtiana, Synoum glandulosum subsp. glandulosum, Notelaea venosa, Trochocarpa laurina, Eupomatia laurina, Ficus coronata.*
Ground Covers:	**0-1 m**	**10%**	*Blechnum cartilagineum, Arthropteris tenella, Lastreopsis decomposita, Gymnostachys anceps, Blechnum patersonii, Lomandra*

Stratum	Height	Projected foliage cover	Species
			longifolia, Calochlaena dubia, Microsorum scandens, Pseuderanthemum variabile
Vines & Climbers			*Eustrephus latifolius, Palmeria scandens, Morinda jasminoides, Parsonsia straminea, Pandorea pandorana, Tylophora barbata, Rubus moluccanus* var *trilobus, Pandorea pandorana, Smilax australis, Marsdenia rostrata*
Epiphytes/lithophytes			*Asplenium australasicum, Pyrrosia rupestris*

EECs and Threatened Species

Whilst this plant community has some floristic affinity with the TSC-listed EEC 'Illawarra Escarpment Subtropical Rainforest', it is not considered representative of the EEC based on the absence of key subtropical canopy species, the absence of clay topsoils and its position on the plateau rather than the more sheltered aspects of the escarpment slopes (where the EEC typically occurs). Notwithstanding the above, OEH regards all remaining rainforest stands as 'rare', being of high conservation value.

This plant community represents potential habitat for the TSC Act listed rainforest shrub, *Daphnandra johnsonii*. This species was not detected during the targeted threatened flora surveys undertaken in spring 2013 (northern section) or November 2014 (southern section).

3.2.2 Vegetation Community No. 2 – Escarpment Edge Silvertop Ash Forest

Occurrence	Survey Plots	Plant community equivalencies
This community was recorded on generally free draining sands and loamy sands in the northern section of the study area on partially exposed hillslopes.	NE2, NE4, NE5	MU32 Escarpment Edge Silvertop Ash Forest (NPWS 2003); Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (VIS 2.1 PCT SR629). Moderate to Good condition

Floristics and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**20-25 m**	**30%**	*Eucalyptus sieberi, Eucalyptus piperita, Syncarpia glomulifera subsp. glomulifera, Corymbia gummifera, Eucalyptus pilularis.*
Shrubs:	**2-4 m**	**30%**	*Allocasuarina littoralis, Persoonia mollis, Persoonia linearis, Persoonia levis, Elaeocarpus reticulatus, Platysace linearifolia, Lomatia silaifolia, Banksia spinulosa, Aotus ericoides, Leptospermum polygalifolium, Pultenaea linophylla, Epacris pulchella.*
Ground Covers:	**0-1 m**	**35%**	*Gonocarpus teucrioides, Entolasia marginata, Lomandra longifolia, Caustis flexuosa, Lomandra filiformis var. filiformis, Patersonia glabrata, Lepidosperma laterale, Sticherus flabellatus, Lepyrodia scariosa, Pteridium esculentum, Xanthosia pilosa, Entolasia stricta, Dianella caerulea, Hibbertia aspera, Lomandra glauca, Dampiera stricta*
Vines and climbers			*Smilax glyciphylla, Hardenbergia violacea, Cassytha glabella, Pandorea pandorana.*

EECs and Threatened Species

This plant community is not considered to be analogous with any TSC Act or EPBC Act listed EECs.

No threatened species were recorded as part of the targeted threatened flora surveys nor are any known to be closely associated with this plant community in general on the eastern plateau edge.

3.2.3 Vegetation Community No. 3 – Exposed Sandstone Scribbly Gum Woodland

Occurrence	Survey Plots	Plant community equivalencies
This community was recorded on freely draining sands in the southern section of the Stage 1 study area on exposed ridges on the eastern and western sides of Mt Ousley Road south of Cataract Creek.	SE2, SE3, SE9	MU29 Exposed Sandstone Scribbly Gum Woodland (NPWS 2003); Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion (VIS 2.1 PCT SR513). Moderate to Good condition

Floristics and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**10-15 m**	**15%**	*Eucalyptus racemosa, Corymbia gummifera, Eucalyptus oblonga, Eucalyptus sieberi, Eucalyptus piperita.*
Small Trees and Shrubs:	**2-8 m**	**35%**	*Banksia serrata, Banksia spinulosa var. spinulosa, Leptospermum trinervium, Aotus ericoides, Platysace linearifolia, Persoonia mollis, Dillwynia retorta, Petrophile sessilis, Eriostemon australasius, Isopogon anemonifolius, Phyllanthus hirtellus, Lambertia formosa, Hakea sericea, Persoonia levis, Epacris pulchella, Acacia suaveolens, Phyllota grandiflora.*
Ground Covers:	**0-1 m**	**20%**	*Entolasia stricta, Lomandra obliqua, Lepyrodia scariosa, Dampiera stricta, Lepidosperma laterale, Darwinia grandiflora, Lycopodium deuterodensum, Anisopogon avenaceus, Lomandra glauca, Xanthorrhoea resinosa, Lindsaea linearis, Lomandra cylindrica, Leptocarpus tenax, Actinotus minor, Calochilus campestris, Patersonia glabrata, Burchardia umbellata.*

EECs and Threatened Species

This plant community is not considered to be analogous with any TSC Act or EPBC Act listed EECs.

No TSC Act EPBC Act listed threatened flora species were recorded as part of the targeted threatened flora surveys conducted in spring 2013 or spring 2014. This plant community is considered potential habitat for the TSC-listed shrubs *Epacris purpurascens* var. *purpurascens* and *Pultenaea aristata*.

One Rare or Threatened Australian Plants (ROTAP) species was recorded in this plant community in plots SE2 and SE9, this being the prostrate shrub *Darwinia grandiflora (*ROTAP classification = 2RCi*)*, which was in flower during the baseline surveys. This species formed large mat-like clumps throughout the plot and the community extent in general.

3.2.4 Vegetation Community No. 4 – Moist Blue Gum-Blackbutt Forest

Occurrence	Survey Plots	Plant community equivalencies
This community was recorded on moist sands and loamy sands predominantly in the northern section of the study area	NE3, NW2, NE7	MU6 Moist Blue Gum-Blackbutt Forest (NPWS 2003);

Occurrence	Survey Plots	Plant community equivalencies
on sheltered hillslopes north of Cataract Creek.		Blackbutt-turpentine-Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (VIS 2.1 PCT SR516). Moderate to Good condition

Floristics and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**20-30 m**	**40%**	*Eucalyptus saligna x botryoides, Eucalyptus pilularis, Syncarpia glomulifera subsp. glomulifera.*
Subcanopy Trees and Shrubs:	**3-12 m**	**30%**	*Clerodendrum tomentosum, Acmena smithii, Cryptocarya glaucescens, Doryphora sassafras, Ceratopetalum apetalum, Synoum glandulosum subsp. glandulosum, Trochocarpa laurina, Livistona australis, Elaeocarpus reticulatus.*
Ground Covers:	**0-1 m**	**15%**	*Entolasia marginata, Lomandra longifolia, Pteridium esculentum, Oplismenus imbecillis, Gymnostachys anceps, Blechnum cartilagineum, Calochlaena dubia, Oxalis perennans, Hibbertia dentata, Hypolepis muelleri, Goodenia ovata.*
Vines and Climbers			*Eustrephus latifolius, Smilax australis, Tylophora barbata, Pandorea pandorana* subsp. *pandorana, Morinda jasminoides, Pseuderanthemum variabile, Geitonoplesium cymosum.*

EECs and Threatened Species

This plant community is not considered to be analogous with any TSC Act or EPBC Act listed EECs.

No TSC Act or EPBC Act listed threatened flora species were recorded as part of the targeted threatened flora surveys conducted in spring 2013 or spring 2014. This plant community is considered potential habitat for the ROTAP-listed shrub, *Hibbertia nitida*.

3.2.5 Vegetation Community No. 5 – Tall Open Blackbutt Forest

Occurrence	Survey Plots	Plant community equivalencies
This community was recorded on freely draining sands and loamy sands predominantly in the northern section of the study area on the eastern side of Mt Ousley Road on partially exposed ridges north of Cataract Creek. Generally occurs on exposed ridges and hillslopes on the plateau compared with community no. 4.	SW1, NW1, NE1	MU15 Tall Open Blackbutt Forest (NPWS 2003); Blackbutt-turpentine-Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (VIS 2.1 PCT SR516). Moderate to Good condition

Floristics and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**25-35 m**	**30%**	*Eucalyptus pilularis, Syncarpia glomulifera subsp. glomulifera, Eucalyptus piperita.*
Subcanopy Trees and Shrubs:	**2-5 m**	**20%**	*Acacia binervata, Notelaea longifolia f. longifolia, Persoonia linearis, Leucopogon lanceolatus var. lanceolatus, Elaeocarpus reticulatus.*
Ground Covers:	**0-1 m**	**20%**	*Lomandra longifolia, Dianella caerulea, Pteridium esculentum, Calochlaena dubia, Dichondra repens, Pratia purpurascens, Viola hederacea.*
Vines and Climbers			*Hibbertia dentata, Smilax glyciphylla, Clematis aristata, Eustrephus latifolius, Pandorea pandorana subsp. Pandorana.*

EECs and Threatened Species

This plant community is not considered to be analogous with any TSC Act or EPBC Act listed EECs.

No TSC Act or EPBC Act listed threatened flora species were recorded as part of the targeted threatened flora surveys conducted in spring 2013 or spring 2014. This plant community represents potential marginal habitat for the threatened shrub *Pultenaea aristata*, although the author deems this shrub to be much more closely associated with Scribbly Gum Woodlands and upland swamp communities on the plateau.

3.2.6 Vegetation Community No. 6 – Sandstone Gully Peppermint Forest

Occurrence	Survey Plots	Plant community equivalencies
This community was recorded on moist sands and loamy sands predominantly in the southern section of the study area on the western side of Mt Ousley Road on sheltered hillslopes south of Cataract Creek.	SW2, SE8	MU26 Sandstone Gully Peppermint Forest (NPWS 2003); Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion (VIS 2.1 PCT SR658). Moderate to Good condition

Floristics and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**20-25 m**	**40%**	*Eucalyptus piperita, Corymbia gummifera, Syncarpia glomulifera, Eucalyptus pilularis.*
Subcanopy Trees and Shrubs:	**2-4 m**	**20%**	*Zieria smithii, Banksia spinulosa var. spinulosa, Acacia terminalis, Acacia ulicifolia, Persoonia linearis, Persoonia levis, Leptospermum polygalifolium subsp. polygalifolium, Leucopogon lanceolatus var. lanceolatus, Notelaea longifolia, Citriobatus pauciflorus, Trochocarpa laurina, Persoonia mollis.*
Ground Covers:	**0-1 m**	**20%**	*Entolasia marginata, Dianella caerulea, Lomandra filiformis, Patersonia glabrata, Pseuderanthemum variabile, Pteridium esculentum, Lepidosperma laterale, Lomandra longifolia, Xanthosia tridentata, Gonocarpus teucrioides, Amperea xiphoclada, Lomandra obliqua, Goodenia heterophylla, Oplismenus imbecillis, Lindsaea linearis.*
Vines and Climbers			*Smilax glyciphylla, Pandorea pandorana*

EECs and Threatened Species

This plant community is not considered to be analogous with any TSC Act or EPBC Act listed EECs.

No TSC/EPBC-listed threatened flora species were recorded as part of the targeted threatened flora surveys conducted in spring 2013 or spring 2014. This plant community represents potential habitat for the ROTAP shrub *Hibbertia nitida*.

3.2.7 Vegetation Community No. 7 – Upland Swamps

Occurrence

This vegetation type was recorded in the southern portion of the study area on the eastern side of the existing Mount Ousley Road on moist sands and loamy sands, at the uppermost headwaters of unnamed tributaries of Cataract Creek. This plant community overlies a shallow perched aquifer system and becomes inundated following rainfall for short durations. A number of community variants were recorded and sampled within the study area, corresponding to the spectrum of hydraulic gradients experienced by the community, with Banksia thickets colonising the 'drier' swamp areas through to the sedgelands which colonise the 'wetter' swamp areas. The Fringing Eucalypt Woodland variant is considered a

transitional community between the free draining Scribbly Gum Woodlands and the drier upland swamp variants.

Upland Swamp variant – Banksia Thicket

Survey Plots	Plant community equivalencies
SE4	MU42 Upland Swamps: Banksia Thicket (NPWS 2003); Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin (VIS 2.1 PCT HN662). Moderate to Good condition

Floristic and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**10-15 m**	**5%**	*Eucalyptus racemosa, Eucalyptus sieberi*

Stratum	Height	Projected foliage cover	Species
Shrubs:	**to 4 m**	**40%**	*Banksia ericifolia subsp. ericifolia, Leptospermum rotundifolium, Isopogon anemonifolius, Hakea dactyloides, Leptospermum polygalifolium, Platysace linearifolia, Leucopogon lanceolatus, Kunzea ambigua, Hakea sericea, Petrophile pulchella, Aotus ericoides.*
Sedges, Rushes, Forbs and Subshrubs	**to 1.5 m**	**70-90%**	*Darwinia grandiflora, Epacris microphylla, Burchardia umbellata, Dampiera stricta, Selaginella uliginosa, Lindsaea linearis, Empodisma minus, Lepyrodia scariosa, Entolasia stricta, Cassytha glabella, Bauera microphylla, Leptocarpus tenax, Eurychorda complanata, Lomandra cylindrica, Actinotus minor.*

Upland swamp variant – Tea Tree Thicket

Survey Plots	Plant community equivalencies
SE1, SE6	MU43 Upland Swamps: Tea Tree Thicket (NPWS 2003); Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin (VIS 2.1 PCT HN662). Moderate to Good condition

Floristic and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**to 7 m**	**5%**	*Eucalyptus racemosa, Corymbia gummifera*
Shrubs:	**to 4 m**	**40%**	*Leptospermum rotundifolium, Leptospermum juniperinum, Leptospermum polygalifolium, Melaleuca squarrosa, Banksia oblongifolia*
Sedges, Rushes, Forbs and Subshrubs	**to 1.5 m**	**90%**	*Empodisma minus, Baloskion gracile, Entolasia marginata, Leptocarpus tenax, Lindsaea linearis, Sowerbaea juncea, Mirbelia rubiifolia, Epacris microphylla, Dampiera stricta, Burchardia umbellata, Lomandra cylindrica, Tetrarrhena turfosa, Schoenus brevifolius, Eurychorda complanata.*

Upland swamp variant – Sedgeland Heath Complex – Cyperoid Heath

Survey Plots	Plant community equivalencies
SE7	MU44 Upland Swamps: Sedgeland-Heath complex (NPWS 2003); Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin (VIS 2.1 PCT HN662). Moderate to Good condition

Floristic and Structure Summary

Stratum	Height	Projected foliage cover	Species
Shrubs:	**to 2.5 m**	**10%**	*Banksia oblongifolia, Melaleuca squarrosa, Hakea teretifolia, Leptospermum juniperinum, Banksia ericifolia, Isopogon anemonifolius, Platysace linearifolia.*
Sedges, Rushes, Forbs and Subshrubs	**to 1.5 m**	**100%**	*Lepidosperma limicola, Gymnoschoenus sphaerocephalus, Empodisma minus, Leptocarpus tenax, Xyris sp., Tetrarrhena turfosa, Bauera microphylla, Gleichenia dicarpa, Mirbelia rubiifolia, Stackhousia nuda, Baloskion*

Stratum	Height	Projected foliage cover	Species
			gracile, Eurychorda complanata, Lepyrodia scariosa, Drosera binata, Baumea teretifolia.

Upland Swamp variant – Fringing Eucalypt Woodland

Survey Plots	Plant community equivalencies
SE10	MU45 Upland Swamps: Fringing Eucalypt woodland (NPWS 2003). Needlebush - banksia wet heath on sandstone plateaus of the Sydney Basin Bioregion (VIS 2.1 PCT HN560) Moderate to Good condition

Floristic and Structure Summary

Stratum	Height	Projected foliage cover	Species
Trees:	**5-12 m**	**8%**	*Eucalyptus racemosa*
Shrubs:	**to 1.5 m**	**<1%**	*Acacia elongata, Banksia ericifolia subsp. ericifolia, Hakea teretifolia, Banksia serrata, Petrophile sessilis, Isopogon anemonifolius, Persoonia levis, Persoonia linearis, Persoonia mollis subsp. nectens, Leptospermum polygalifolium, Leptospermum trinervium, Leucopogon lanceolatus*
Groundcovers:	**to 1 m**	**84%**	*Entolasia stricta, Eurychorda complanata, Leptocarpus tenax, Mitrasacme polymorpha, Platysace linearifolia, Lepyrodia scariosa, Lomandra longifolia, Lomandra filiformis, Pteridium esculentum*

EECs and Threatened Species

All four upland swamp community variants are considered potential habitat for the shrub, *Pultenaea aristata*. This species was not detected during the baseline and targeted threatened flora surveys undertaken by SMEC in 2013 and 2014, although this species has been recorded locally in Upland Swamp and Scribbly Gum Woodland habitats as part of the ecological investigations for the Russel Vale underground coal mine expansion proposal (Biosis 2012). The ROTAP species *Darwinia grandiflora* (ROTAP classification = 2RCi), which was in flower during the baseline surveys was recorded in the Banksia thicket variant in Plot SE4.

All four community variants are listed in the VIS 2.1 Classification database as equivalent to both the TSC Act and EPBC Act listed EEC 'Coastal Upland Swamp in the Sydney Basin Bioregion' (OEH 2016).

The distribution of these native vegetation communities recorded in the study area is shown in Figure 6.

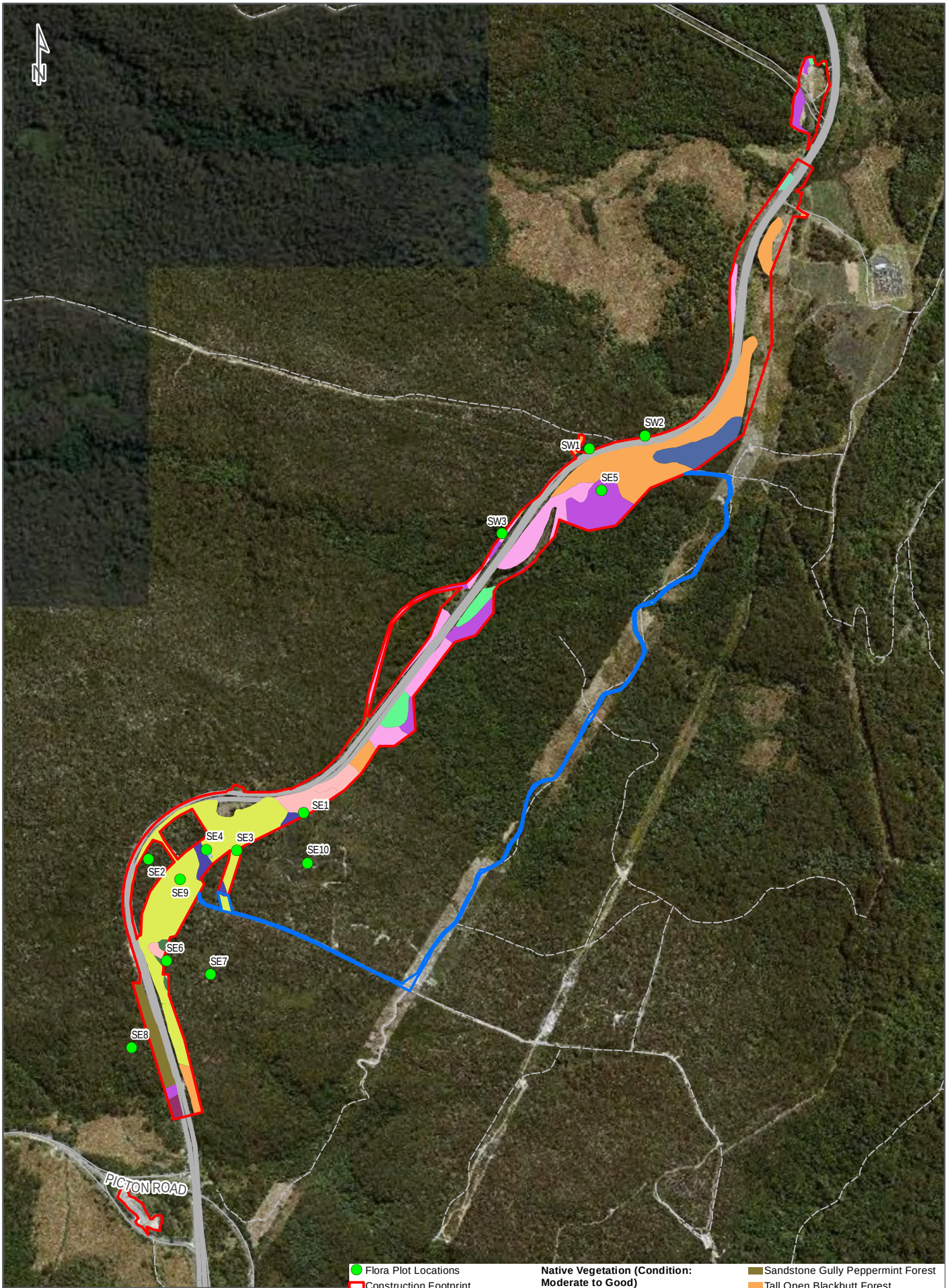

FIG NO. 6 **FIGURE TITLE** Native Vegetation Map

0 100 200 400 600
1:15,000 Metres

- Flora Plot Locations
- Construction Footprint
- Construction Vehicle Access Track
- Artificial Wetlands
- Regenerating Vegetation
- Weeds and Exotics

Native Vegetation (Condition: Moderate to Good)

- Coachwood Warm Temperate Rainforest
- Escarpment Edge Silvertop Ash Forest
- Exposed Sandstone Scribbly Gum Woodland
- Moist Blue Gum-Blackbutt Forest
- Sandstone Gully Peppermint Forest
- Tall Open Blackbutt Forest
- Upland Swamps: Banksia Thicket
- Upland Swamps: Fringing Eucalypt Woodland
- Upland Swamps: Sedgeland-Heath Complex
- Upland Swamps: Tea-Tree Thicket

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure6_Native vegetation map.mxd

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3.3 Threatened Flora

Targeted searches undertaken throughout the northern and southern portions of the study area did not detect any TSC Act or EPBC Act listed threatened flora species. No species listed as threatened under either the TSC Act or EPBC Act were recorded during the targeted surveys.

One ROTAP taxon, *Darwinia grandiflora*, was recorded in Plots SE2, SE4 and SE9, scattered throughout the Scribbly Gum Woodland and upland swamp habitats within the study area. Locations of recorded *Darwinia grandiflora* are shown on Figure 6 and 7.

It is noted, however, that *Pultenaea aristata*, listed as vulnerable under both the TSC Act and EPBC Act, although not recorded during threatened species surveys carried out by SMEC, has been recorded as part of the Russell Vale coal mine expansion flora assessment in the upland swamp areas by Biosis in 2012 and by ERM in 2013 and was recorded in the Wonga East mining domain area. The closest record is approximately 600 metres west of the Mount Ousley road upgrade study area (ERM 2013).

3.4 Endangered Ecological Communities (EECs)

One endangered ecological community listed under the TSC Act and EPBC Act was identified during field surveys, this being *Coastal Upland Swamps in the Sydney Basin Bioregion*. This EEC equates to vegetation community no. 7 and its four variants, namely, Upland swamp: Banksia Thicket (MU42); Upland swamp: Tea tree thicket (MU43), and Upland swamp: Sedgeland-heath (MU44) and MU45 (Upland Swamp: Fringing eucalypt woodland).

The PCTs held within the VIS Classification Database were allocated to each upland swamp community and all four are listed in the VIS 2.1 Classification database as equivalent to both the TSC Act and EPBC Act listed EEC 'Coastal Upland Swamp in the Sydney Basin Bioregion' (OEH 2016).

The communities identified on site meet the descriptions of the listed communities under both the TSC Act and the EPBC Act. There is no separate listing advice of the community under the EPBC Act.

The upland swamp community is associated with Hawkesbury sandstone plateaus of the Sydney Basin Bioregion and contains vegetation and fauna that are associated with periodically waterlogged soils (annual rainfall for Belambi AWS is 1,114 millmetres (BOM 2016)) meeting the description from the Final determination (NSW Scientific Committee 2012) and Conservation advice (TSSC 2014). Vegetation types include open graminoid heath, sedgeland and tall scrub. Upland swamps are characterised by a diverse assemblage of vegetation and although typically treeless may include scattered trees (NSW Scientific Committee, 2012, TSSC 2014). Thirty characteristic listed species were recorded within the sampled plots within this community.

The final determination for this community notes that vegetation boundaries of upland swamps are not static but will shift according to localised hydrology, including surface and shallow groundwater hydrology.

Coastal upland swamps and associated flora and fauna species can be considered groundwater dependent ecosystems. The threatened species profile for this community

describes coastal upland swamps as occurring primarily on impermeable sandstone plateaux with shallow groundwater aquifers in the headwaters and impeded drainage lines of streams, and on sandstone benches with abundant seepage moisture.

The location of the Coastal Upland Swamp EEC in the locality is shown in Figure 7.

3.5 Weeds

Lesryk Environmental Consultants (2010) recorded three weed species in the study area reported to be listed as noxious in the Wollongong LGA under the Noxious Weeds Act 1993. These were:

- *Eragrostis curvula* (African Lovegrass) (not currently listed as Noxious for Wollongong LGA)
- *Rubus ulmifolius* (Blackberry) (Class 4)
- *Lantana camara* (Lantana) (Class 4).

The 2014 SMEC surveys small areas dominated by weed species adjacent to the existing road, occupying only about one hectare of the entire study area. Noxious species observed include *Rubus fruticosus* (Blackberry) (Class 4) and *Lantana camara* (Lantana) (Class 4) and the following environmental weed species (not listed as noxious) were observed:

- *Ageratina adenophora* (Crofton weed)
- *Bidens pilosa* (Cobblers Pegs)
- *Chloris gayana* (Rhodes grass)
- *Ehrharta erecta* (Panic Veldtgrass)
- *Foeniculum vulgare* (Fennel)
- *Gomphocarpus fruticosus* (Narrow leaf cotton bush)
- *Hydrocotyle bonariensis.*
- *Lantana camara* (Lantana)
- *Ligustrum sinense* (Small-leaved Privet)
- *Olea europa* subsp. *cuspidata* (African Olive)
- *Pennisetum clandestinum* (Kikuyu)
- *Solanum mauritianum* (Wild Tobacco)
- *Tagetes minuta* (Stinking Roger).

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

The control measure for these weeds are that ‘the growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread’ (NSW Dept of Primary

Industries website (http://www.dpi.nsw.gov.au/content/aboutus/about/legislation-acts/noxious-weeds, accessed 26 April 2016)

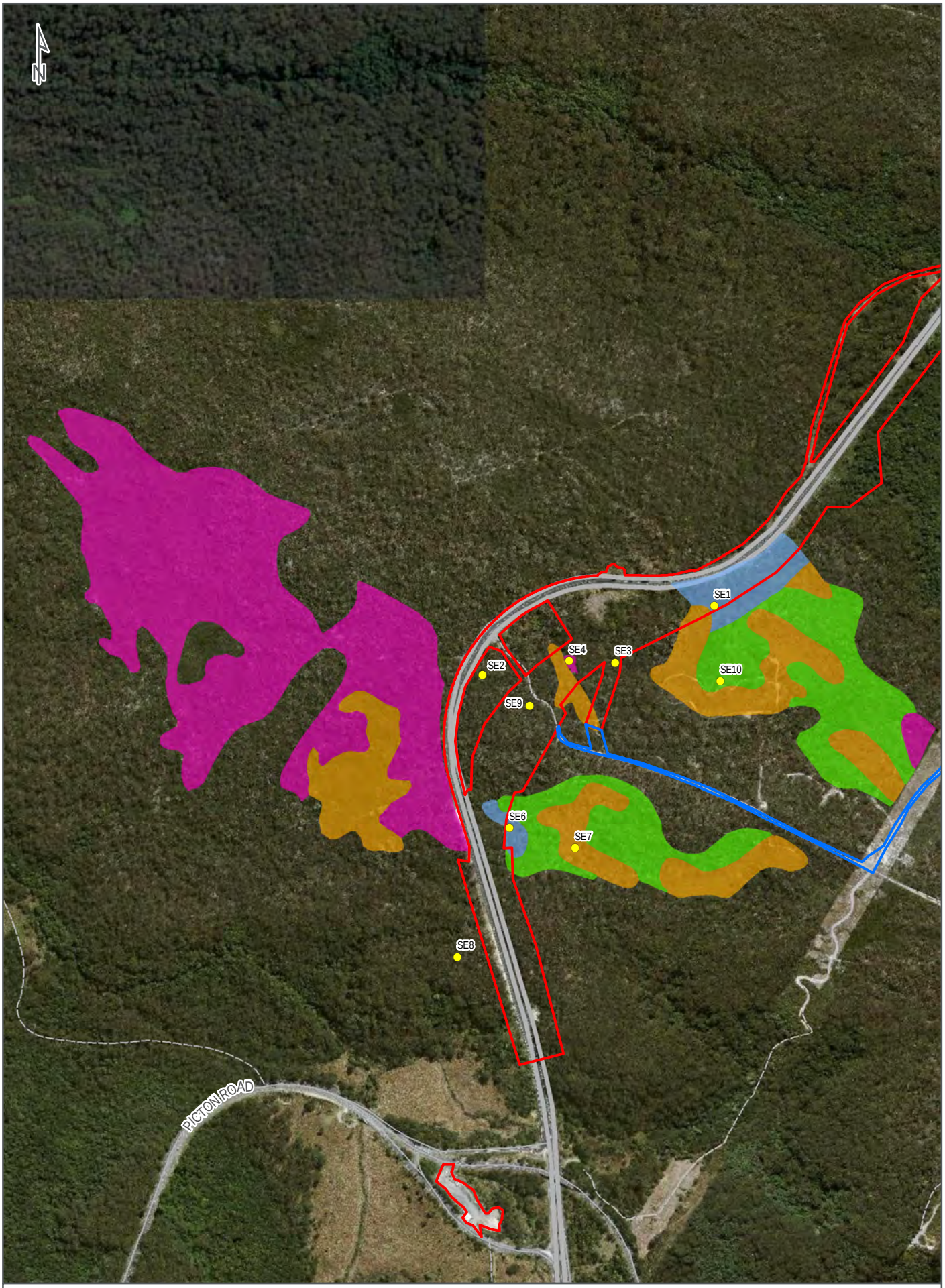

FIG NO. 7 **FIGURE TITLE** Location of Endangered Ecological Communities

0 100 200 400
Metres
1:10,000

- Flora Plot Locations
- Construction Footprint
- Construction Vehicle Access Track
- Upland Swamps: Banksia Thicket
- Upland Swamps: Fringing Eucalypt Woodland
- Upland Swamps: Sedgeland-Heath Complex
- Upland Swamps: Tea-Tree Thicket

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure7_Location of EECs_01.mxd

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3.6 Fauna

3.6.1 Habitat assessment

Vegetation types

Vegetation types within the study area included tall open Eucalypt forest with limited midstorey and groundcover; and Coachwood warm temperate rainforest with a closed canopy; open midstorey and limited groundcover. In the south west there was a large area of sandstone scribbly gum woodland vegetation with a relatively open mid-storey containing *Banksia* species, and approximately 50% groundcover; and associated Upland swamps, with a very dense but low canopy of <4 m height containing Banksias and Tea-tree species; a dense shrubby mid-storey and a 100% groundcover of sedges and grasses.

Aquatic habitat

Aquatic habitat exists in two tributaries to Cataract Creek which cross the study area whilst Cataract Creek itself flows west to meet the Cataract River. A tributary to Rocky Creek also crosses the very southern tip of the study area flowing west. The rainforest contained a small waterway which was partly fed by a stormwater drain. No riparian vegetation was found bordering the creek. Though not optimal habitat, it could be utilised by the threatened Southern Myotis (*Myotis macropus*). Drainage channels occurred within the upland swamp and scribbly gum woodland areas containing up to 30 centimetres of water (in November 2014).

Habitat features

Fallen logs, coarse woody debris, hollow-bearing trees and rocks were identified in the study area and several wombat burrows were observed. The scribbly gum woodland contained occasional rocks and a large rock-shelf covered in leaf litter. The rock-shelf provides potential habitat for the threatened Rosenberg's Goanna (*Varanus rosenbergi*) as well as the Red-crowned Toadlet (*Pseudophryne australis*) and possibly the Spotted-tailed Quoll (*Dasyurus maculatus*). This vegetation also provides foraging habitat for a number of microbats and owls

There were 173 hollow bearing trees recorded in the Stage 1 proposal footprint (Figure 8). Hollows are an important habitat requirement for a number of threatened species including Little Lorikeets, Powerful Owl; Barking Owl and various microbats. Hollows ranged in size with 57 small, 173 medium, no large and 37 extra large. Of the 173 trees recorded, 21 had fissures. Four of these trees were observed to be old growth trees with diameter at breast heights around 1.5 metres. Around 70 hollows were located in the Scribbly Gum Woodland and upland swamp areas providing breeding habitat for these species and Eastern Pygmy-possum.

The upland swamp vegetation and adjacent rock ledges provides suitable habitat for a number of threatened species including the Southern Brown Bandicoot (*Isoodon obesulus*), the Eastern Pygmy-possum (*Cercartetus nanus*) and possibly the Rosenberg's Goanna (*Varanus rosenbergi*). The Grey-headed Flying Fox (*Pteropus poliocephalus*) is known to forage on nectar from Banksias and Melaleucas.

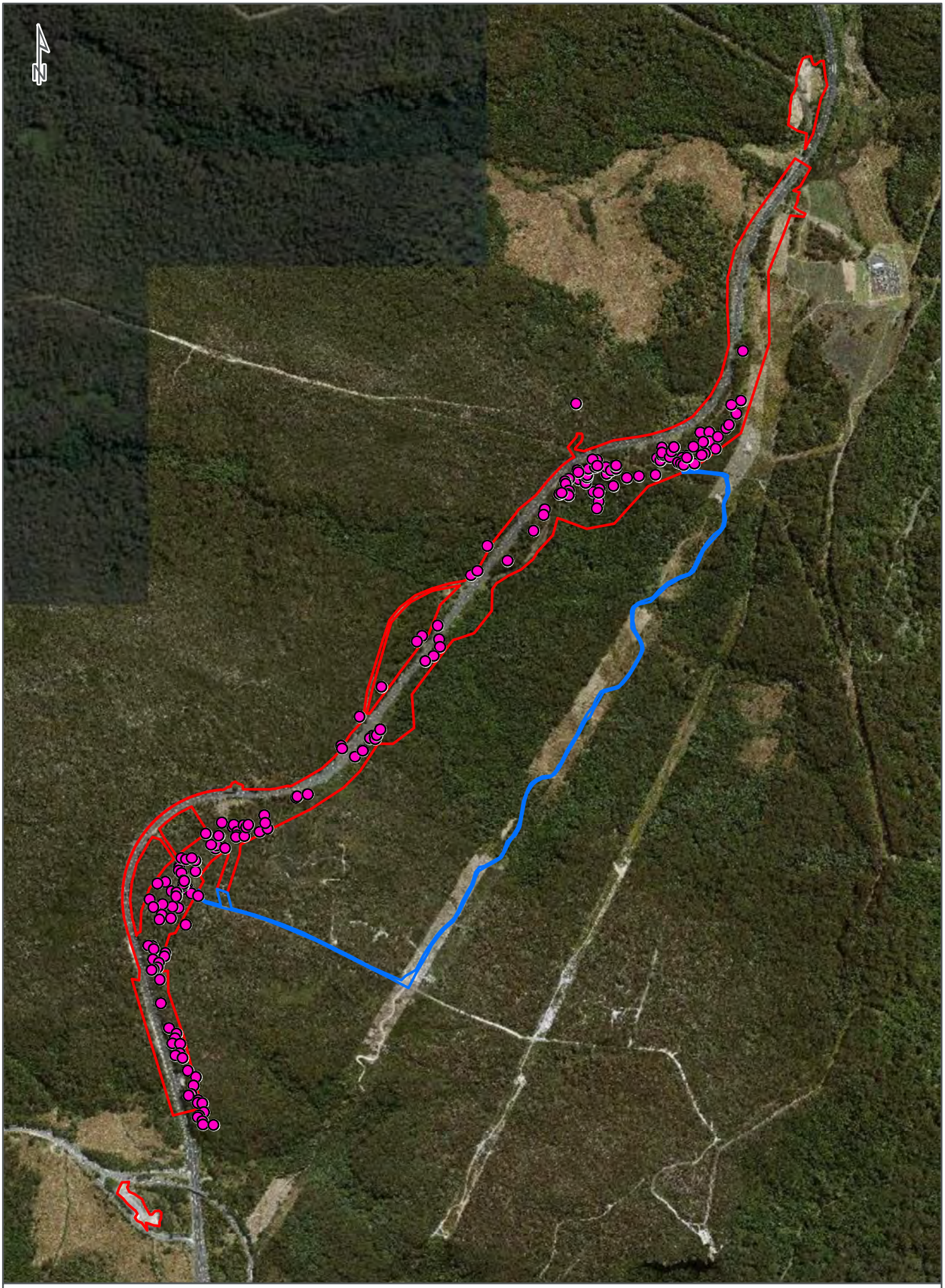

FIG NO. 8

FIGURE TITLE Hollow Bearing Tree locations

Hollow Bearing Tree Survey (Oct 2015)
Construction Footprint
Construction Vehicle Access Track

0 0.375 0.75
Km
1:15,000

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure8_Hollow Bearing Tree locations_01.mxd

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3.6.2 Fauna survey results October 2015

A total of 33 vertebrate fauna species were recorded during the 19-23 October 2015 survey.

A summary of the fauna results for the study area is provided below and a full fauna species list is provided in Table 10 in Appendix B.

The study area includes the fauna survey Sites 2A, 3, 4 and 5.

Birds

Twenty bird species were observed/heard. This included:

- Gang Gang Cockatoo (Site 3) listed as vulnerable under the TSC Act; and
- Black-faced Monarch was also recorded in (Sites 3), which is listed as migratory under the EPBC Act (Table 3).

Mammals

Eight native mammal species were captured/observed during the surveys including five bat species, and one introduced Rusa Deer. Numerous scats, including from wombats and either kangaroos or wallabies were observed. Native mammal species recorded were:

- Swamp Wallaby *(Wallabia bicolor);*
- Eastern Pygmy-possum (*Cercartetus nanus*)
- Greater Glider (*Petauroides volans*);
- White-striped Freetail Bat *(Tadarida australis);*
- Eastern Horseshoe Bat *(Rhinolophus megaphyllus);*
- Unidentified long-eared bat *(Nyctophilus sp.);*
- Large Forest Bat *(Vespadelus darlingtoni); and*
- Two probable recordings of Eastern Bentwing-Bat *(Miniopterus schreibersii oceanensis)*

Amphibians

Six frog species were identified throughout the study area.

- Common Eastern Froglet *(Crinia signifera)*
- Striped Marsh Frog *(Limnodynastes peronii)*
- Blue Mountains Tree Frog *(Litoria citropa)*
- Leaf Green Tree Frog *(Litoria phyllochroa)*
- Tyler's Tree Frog *(Littana tyleri)*
- Brown Toadlet *(Pseudophryne bibronii)*

Crustaceans

One crustacea, Common Yabby (*Cherax destructor*) was observed at Site 4.

Reptiles

Four reptile species were recorded throughout the study area including Tiger Snake *(Notechis scutatus*), Delicate Skink (*Lampropholis delicata*), Yellow-Bellied Water skink (*Eulamprus heatwolei*) and Mountain Dragon (*Rankinia diemensis*).

3.6.3 Eastern Pygmy-possum survey results autumn 2016

Nestboxes installed in January 2016 were checked during April and May 2016 and trap surveys were conducted targeting Eastern Pygmy-possum.

One capture of Eastern Pygmy-possum was recorded during the first survey period (11-15 April 2016). This was a male found as the sole occupant of Nest Box 2 (Figure 4 and Figure 9). This individual was determined to be a sub-adult based on weight (8g), morphological measurements and undescended testes. It is likely he would have been born early to mid-summer of 2016. The capture occurred on the eastern boundary of the proposed clearing footprint. *Banksia ericifolia* occurred at moderate to high density throughout most of the area targeted for nestboxes and was flowering profusely during the survey period.

Other species recorded in the traps were Bush Rat (*Rattus fuscipes*), Brown Antechinus (*Antechinus stuartii*) and Sugar Glider (*Petaurus breviceps*).

3.6.4 Threatened fauna

Five threatened fauna species including a probable recording of the vulnerable Eastern Bentwing-bat and one migratory species were identified (Table 4) within the study area. Locations of the threatened fauna species are shown in Figure 9.

Table 4: Threatened or migratory fauna species recorded in the study area during field surveys

Scientific name	Common name	TSC Act	EPBC Act	Confidence	Survey
Callocephalon fimbriatum	Gang Gang Cockatoo	V	-	confirmed	19-30 October 2015
Monarcha melanopsis	Black-faced Monarch	-	M	confirmed	19-30 October 2015
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Probable	19-30 October 2015
Cercartetus nanus	Eastern Pygmy-Possum	V		confirmed	11-15 April 2016
Petauroides volans	Greater Glider	-	V	confirmed	19-30 October 2015

V = vulnerable, M = Migratory

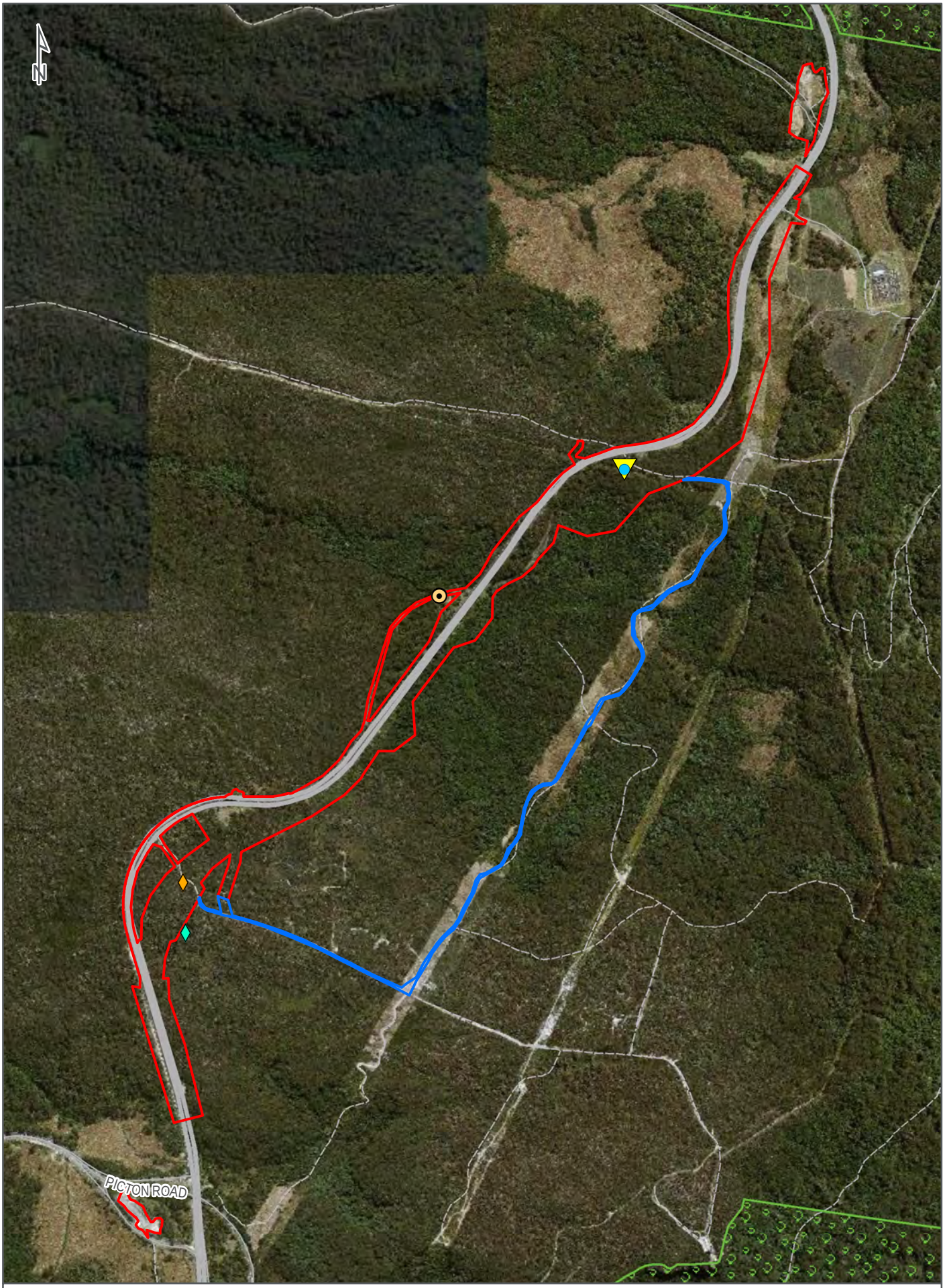

FIG NO. 9 **FIGURE TITLE** Locations of Threatened and migratory Fauna recorded

0 250 500
1:15,000 Metres

- NPWS Estates
- Eastern Bentwing-bat (probable)
- Black-faced Monarch (Migratory species)
- Gang-gang Cockatoo
- Greater Glider
- Eastern Pygmy-Possum
- Construction Footprint
- Construction Vehicle Access Track

Location: \\AUSYFP01\Group\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure9_Locations of Threatened Fauna recorded.mxd

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3.7 Migratory Species

The results of the 10 kilometre database searches included numerous migratory species. Many of these species have not been considered in this study due to the low likelihood that the terrestrial environment would provide necessary habitat requirements. Species that may be affected offsite by the proposal have been retained. Species removed include pelagic seabirds (eg albatross and petrel spp.), migratory wetland specialists and marine species.

Threatened fauna surveys conducted on 19-23 October 2015 recorded one migratory species, Black-faced Monarch (*Monarcha melanopsis*) at Site 3 in the study area. This species was also previously recorded along with Rufous fantail (*Rhipidura rufifrons*) by Lesryk Environmental Consultants (2010).

3.8 Critical habitat

The subject site is not registered as critical habitat under NSW or Commonwealth legislation.

3.9 Wildlife connectivity corridors

The study area is within a Regional Biodiversity Corridor identified in DECC (2007) Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region. These corridors take into account the key pathways, fauna linkages and landuse of the region to provide a network of longitudinal, latitudinal and altitudinal links and connections between the key landscapes of the area.

The study area is within the Illawarra Escarpment Moist Forest corridor (DECC 2007). This corridor links a narrow band of moist escarpment forests, including wet sclerophyll forests and rainforest, which run along a latitudinal expanse from the Royal National Park to south of Kangaroo Valley. This corridor also covers an altitudinal gradient of several hundred meters linking the coastal lowlands to the sandstone plateaux. The same corridor is identified in the Hawkesbury Nepean Catchment Management Authority's Catchment Action Plan (2013) as a priority for investment in native vegetation management.

The Illawarra Biodiversity Strategy Volume 2 (Illawarra Councils 2011) also identifies this corridor as continuing *the length of the Illawarra Escarpment from the Royal National Park in the north*, *and continues to the south along the Escarpment through Shellharbour and Kiama LGAs, south to the Shoalhaven, where it ends at Cambewarra in the south*. It is the largest continuous core conservation area in the Illawarra region, with the eucalypt forests providing quality habitat for bird, arboreal mammal, and reptile and bat assemblages.

The majority of the proposal falls to the west of the corridor where it extends north to Bulli. The very southern section of the proposal footprint itself intersects with the corridor for approximately 300 metres with a maximum width of vegetation being removed up to about 50 m. This same area is also shown to occur within a mapped fauna linkage of the Wollongong LGA which is shown on either side of the current Mt Ousley Road in the Wollongong LGA Bioregional Assessment Study (Map 8 in NPWS 2002a). The proposal is likely to have a minor reduction to the corridor which is already inscised by the existing road alignment.

3.10 Koala Habitat

SEPP 44 concerns the protection of core Koala habitat, with evidence of Koala usage, or areas of native potential habitat. Potential Koala habitat within the Wollongong LGA is defined as any area that has at least 15 per cent of trees in the upper and lower strata comprised of Schedule 2 feed tree species; Forest Red Gum (*Eucalyptus tereticornis*), Tallowwood (*Eucalyptus microcorys*), Grey Gum (*Eucalyptus punctata*), Manna Gum (*Eucalyptus viminalis*), River Red Gum (*Eucalyptus camaldulensis*), Broad-leaved Scribbly Gum (*Eucalyptus haemastoma*), Scribbly Gum (*Eucalyptus signata*), White Box (*Eucalyptus albens*), Poplar Box (*Eucalyptus populnea*) and Swamp Mahogany (*Eucalyptus robusta*).

No characteristic scratching or scats were identified during the field surveys and the study area has not been identified in previous regional surveys as having a resident Koala population. Therefore, it is unlikely that the study area would be classified as core Koala habitat. None of the feed tree species were found within the study area, and as such the site is not considered to be potential Koala habitat under SEPP 44.

The study area does not contain habitat critical to the survival of the Koala according to the Draft EPBC referral guidelines for the vulnerable Koala (DoE, 2013).

4 Potential impacts

4.1 Flora

The proposal will result in the removal of native vegetation recorded within the construction footprint, deemed to be a direct impact. The proposal also has the potential to result in the following indirect impacts to retained vegetation adjoining the construction footprint:

- Altered hydrology which may in turn result in changes to the species composition and areal extent of groundwater dependent ecosystems such as the upland swamps that adjoin the proposed road alignment
- The discharge of untreated runoff from construction and operation has the potential to introduce weeds and pathogens into retained habitats
- Movement of sediment downslope of the construction zone which has the potential to smother retained vegetation
- An increase in biotic and abiotic edge effects
- Dust deposition on vegetation and soils during construction.

Direct and indirect flora impacts predicted for the proposal are outlined below.

4.1.1 Loss of vegetation/habitat

The proposal would result in the removal of up to 28.29 hectares of remnant native vegetation and 20 ha of highly modified vegetation (including roadside plantings,18.7 ha of cleared areas and 1 ha of exotic dominated vegetation). Of the 28.29 ha of remnant native vegetation 2.27 ha is moderate to good condition EEC (Coastal upland swamp habitat) and the remaining 26.02 ha is moderate to good condition native vegetation. Roads and Maritime are committed to offsetting impacts associated with the proposal in line with its biodiversity offsetting guidelines (RMS, 2011) and in general accordance with the OEH principles for the use of biodiversity offsets in NSW. A Biodiversity Offset Strategy (BOS) will be produced following approval of the proposal.

The approximate extent of each vegetation community proposed for removal as a result of the proposal is listed in Table 5 below.

Table 5: Summary of native vegetation to be cleared in Stage 1

Vegetation community	Plant Community Type	TSC Act	EPBC Act	Area to be cleared[1]
Coachwood Warm Temperate Rainforest	HN517	-	-	3.69 ha
Escarpment Edge Silvertop Ash Forest	SR629	-	-	1.58 ha
Exposed Sandstone Scribbly Gum Woodland	SR513	-	-	8.50 ha

Vegetation community	Plant Community Type	TSC Act	EPBC Act	Area to be cleared[1]
Moist Blue Gum - Blackbutt Forest	SR516	-	-	4.13 ha
Tall Open Blackbutt Forest	SR516	-	-	6.93 ha
Sandstone Gully Peppermint Forest	SR658	-	-	1.19 ha
Upland Swamps: Tea-tree Thicket	HN662;	Endangered	Endangered	1.54 ha
Upland Swamps: Fringing Eucalypt Woodland	HN560;	Endangered	Endangered	0.16 ha
Upland Swamps: Sedgeland-Heath Complex	HN662;	Endangered	Endangered	0.51 ha
Upland Swamps: Banksia Thicket	HN662;	Endangered	Endangered	0.06 ha
Total				**28.29* ha**

1 Area to be cleared based on construction footprint. * sum of areas with each area rounded up to 2 decimal places.

4.1.2 Loss of Rare Flora

The proposal will result in the removal of three clusters of the ROTAP species, *Darwinia grandiflora*, a prostrate shrub recorded in the Scribbly Gum Woodlands and Coastal Upland Swamp communities within the construction footprint. While this is not a listed threatened species under the TSC Act or EPBC Act, this species is considered rare chiefly due to its restricted distribution to the Woronora Plateau and the Illawarra.

4.1.3 Altered Hydrology

The Coastal Upland Swamps situated within and adjoining the proposed footprint may be subject to potential changes in hydrology as a result of the proposal. The size of swamps and the ecological and hydrological functions of swamps are dependent on groundwater. The floristic composition of swamps is also highly correlated with a gradient of soil moisture.

Surface run-off discharges during construction and operation has the potential to increase nutrient concentrations being discharged into waterbodies, which in turn, may result in an increase in weed recruitment and dispersal into retained vegetation without adequate treatment.

SMEC understands that the proposed works are not anticipated to have a significant overall effect on recharge to the underlying aquifer, stream baseflow or stream water quality where the currently temporary aquifers seep into local catchments (Geoterra 2016). The upper Hawkesbury Sandstone regional aquifer is located at or deeper than 13 metres below surface in the Brokers Nose area, which is below the proposed excavation depth of the M1 re-alignment works. As a result, it is not anticipated that the proposed roadworks will adversely affect the regional groundwater system (Geoterra 2016).

4.1.4 Habitat Fragmentation

Habitat fragmentation has the potential to adversely impact upon retained native vegetation adjoining the construction footprint through a reduction in patch size. Fragmentation can reduce species richness and can alter interactions between species, such as pollination, seed dispersal and herbivory. A reduction in patch size can result in the loss of species that are area sensitive, meaning they demonstrate significant decreases in probability of occurrence as habitat area decreases because they have certain minimum physical area requirements that are not met in smaller patches. Some of these area sensitive species may also be 'edge sensitive'.

Linear infrastructure such as roads can also result in the genetic isolation of existing populations of some plant species that comprise a particular ecosystem. Populations that become isolated, both physically and genetically, may face an increased risk of extinction. Genetic isolation of plant populations can occur if the 'gap' resulting from road easements limits or prevents normal pollination and seed dispersal mechanisms from taking place. Easements, may, for example, limit myrmecochory dispersal mechanisms on some species of Acacia where in some particular types of forest, ants are unwilling to cross easement gaps. It should be noted, however, that there is a general paucity of existing scientific literature on the potential isolation impacts to temperate Australian sclerophyllous vegetation from linear infrastructure.

It is considered that the plant species that may become isolated or subject to a reduced gene flow between fragments (by the proposed easement), are few in number, given:

- The pollination and dispersal mechanisms that are known to operate in the dry and moist sclerophyll forests (recorded in the study area). For example, bird (eg honeyeater) and insect pollinators of temperate eucalypt forests are mobile and would not likely view relatively small easement gaps (<100 metres) as significant barriers to movement
- Field observations on the floristics of forested habitats already subject to existing fragmentation adjoining the existing road alignment exhibited similar species composition and numbers along both forest edges and interiors, suggesting no significant barrier effects had occurred.

Recommended measures to minimise the fragmentation impact and maintain wildlife connectivity are provided in Section 5. These include undertaking post construction revegetation and restoration in accordance with Roads and Maritime Biodiversity Guidelines (RTA 2011). Batters, embankments, verges and redundant areas should be planted out, where practicable, with indigenous species in accordance with a Revegetation sub-plan as part of the Construction Flora and Fauna Management Plan. In addition ridge line habitat is to be retained where possible during construction.

4.1.5 Edge Effects

Murcia (1995) identifies both abiotic and biological edge effects. Abiotic edge effects are those that relate to changed environmental conditions within the remnant and include changes to air moisture and temperature, solar radiation levels, soil moisture and temperature as well as changes to wind speed and pattern. Biological edge effects involve changes in species abundance and distribution, either directly due to changed environmental conditions at the

forest edge or indirectly through changes in species interactions such as pollination and seed dispersal (Murcia 1995).

Whilst forest edges are sometimes associated with high species diversity (grassland/forest habitats), it is now understood that edge effects are detrimental to a wide range of flora and fauna (Murcia 1995). Linear infrastructure such as roads and powerline easements typically allow more sunlight and wind into the near edge forested habitats and it has been found that these effects penetrated up to 150 metres into a forested community from the easement edge, ultimately resulting in a denser shrub understorey and vine components. Murcia (1995) and Laurance (2000) also note that edge effects vary considerably in the distances of penetration, depending on such factors as the type of edge effect measured, the vegetation community being affected, the characteristics of the surrounding environment (eg. pasture, cropland, urban) and the age of the remnant edge (time since edge was created).

It is often difficult to attribute a sole factor such as edge effects to vegetation disturbance such as weed invasion and changes in species abundance and composition (I. Mamott *pers. obs.*). Often additional contributing factors play a role in vegetation disturbance, in particular, grazing, slashing, fire regimes and increased human disturbance.

Based on SMEC's field investigations, weed invasion and other edge effects appear generally restricted to the first 10-20 metres from the edge of the existing road alignment. This weed zone is not expected to increase as a result of the proposal, assuming the mitigation measures proposed in Section 5 of this report are implemented.

4.1.6 Erosion and Sedimentation

Vegetation clearing and major earthworks associated with the proposal have the potential to result in erosion and sedimentation of downslope creeklines and upland swamps without adequate management. Sedimentation can smother and kill vegetation and can act to reduce creekline flows.

These risks will be minimised by the implementation of a Site Erosion and Sediment Control Plan and the Soil and Water Management Plan in accordance with the Blue Book (Landcom 2004) during construction. In addition adequate stormwater management is to be in place prior to vegetation clearing and construction.

4.1.7 Dust Deposition

The proposal has the potential to smother and damage vegetation through windborne deposition of dust generated from major earthworks (construction) activity in the absence of adequate management. Measures including staged vegetation clearing can minimise the area and time that surfaces are exposed and exposed surfaces are to be stabilised using practical site specific measures for short term exposure or longer term exposure, ie water carts, geofrabrics, hydromulch or revegetation. Construction activities and the timing of earthworks should be modified, reduced or controlled during unfavourable wind conditions if soil is too dry.

4.2 Fauna

4.2.1 Wildlife connectivity and habitat fragmentation

The study area has been identified as part of an important Regional Biodiversity Corridor – Illawarra Escarpment Moist Forests (DECC 2007, HNCMA 2008 & Illawarra Councils 2011). The removal of vegetation to accommodate the realignment and widening of the motorway would inevitably affect connectivity to some degree. Based on the relative size of the regional corridor and the proposal area this impact is expected to be negligible for most species.

The existing road includes a central concrete wall throughout the length of the alignment which currently constitutes a barrier to east-west fauna movement, particularly for ground-dwelling and arboreal mammals such as the Eastern Pygmy-possum and Greater Glider. The proposed widening and realignment is unlikely to significantly increase the barrier effect of the existing motorway for the majority of the alignment. The exception to this is in the southern-most section where the realignment results in an 'island' of habitat remaining between the old and new sections of road. In this location the quality of the island is likely to be reduced by virtue of edge effects from all sides effectively increasing the overall width of the east-west barrier for ground-dwelling and arboreal mammals.

Existing culverts running underneath the motorway may support some cross highway movement. These structures are likely to provide opportunity for movement and breeding of some native species such as reptiles, rodents and frogs. Most culverts are considered to be too long however to provide meaningful connectivity for most ground-dwelling mammals.

All realigned sections of the road occur over ridgelines running perpendicular to the road direction. As such connectivity within habitats limited to these ridgelines is likely to be relatively more disrupted. Such barriers will be up to 225 metres in width. Measures to address fauna connectivity across the upgraded road would be proposed as part of a fauna connectivity strategy including wildlife connectivity structures such as fauna underpasses, rope canopy bridges and fauna fencing and retention of large glide trees for Glider species adjacent to the road.

The construction of the proposed cutting would result in the reduction in aereal extent of the Upland Swamp vegetation situated on the eastern side of the existing Mount Ousley Road and would further isolate retained swamp habitat in the central smaller swamp similarly situated. Given that this location includes some of the only Coastal Upland Swamp habitat for several kilometres north or south, the probability of regular ecological interaction with other areas of upland swamp habitat is low and disruption to connectivity in this location is unlikely to have significant implications on local ground-dwelling populations.

The proposal would result in the fragmentation (ie reduction in extent) and isolation of the preferred Eastern Pygmy-possum preferred habitat mapped within and adjoining the proposed footprint namely, the Banksia and Proteaceae-rich upland swamps ie, Upland Swamp – Banksia thicket and Upland Swamp – Fringing Eucalypt woodland and the Scribbly gum heathy woodlands. (Note: Areas of Upland swamp -Tea-tree thicket and Upland Swamp - sedgeland heath are intermingled within the other upland swamp communities and are included in the habitat map, See Figure 10). Bladon, Dickman and Hume (2002), in their study of habitat fragmentation effects on the species in northern NSW, found that even modest

preferred habitat clearing resulted in markedly reduced Eastern Pygmy-possum capture rates (in traps), population sizes and juvenile/sub adult recruitment (into an existing population).

The proposal will involve the clearing of 173 hollow bearing trees (Figure 8). Hollows are an important habitat requirement for a number of threatened species including Little Lorikeets, Powerful Owl; Barking Owl, various microbats, Greater glider and Eastern Pygmy-possum. Approximately 70 hollows were located in the scribbly gum woodland and upland swamp areas providing breeding habitat for these species and Eastern Pygmy-possum. A Nest box Management Plan would be prepared to mitigate loss of suitable habitat for threatened species including Eastern Pygmy-possum in accordance with the Roads and Maritime Biodiversity Guidelines (RTA, 2011).

The potential for wildlife connectivity structures such as fauna underpasses within the realignment will be investigated. Any such structures would be developed during detailed design in consultation with a suitably qualified and experienced ecologist, OEH and Roads and Maritime as part of a fauna connectivity strategy.

4.2.2 Injury and mortality

Habitat clearing to accommodate the climbing lanes may lead to incidences of fauna injury or mortality through interactions with vehicles and machinery. Although the existing motorway already poses a threat to native fauna for injury and mortality, it is likely that the risk would be higher during construction, particularly during habitat removal when fauna will be forced to relocate. Given the proposal would involve habitat clearing directly adjacent to the existing motorway, this may result in an increase in ground-dwelling mammals being injured or killed by cars in the short-term. As such, recommendations for clearance supervision have been included in the mitigation measures to minimise the impact of this. This involves a suitably qualified fauna ecologist/spottercatcher to be present during clearing of native vegetation to capture any injured fauna or fauna that does not naturally relocate.

A total of 173 hollow-bearing trees would require removal from within the Stage 1 construction footprint. It is recommended to undertake staged habitat removal of hollow-bearing trees in accordance with the Roads and Maritime Biodiversity Guidelines (RTA 2011) to minimise the impacts to resident fauna. In addition, lost hollows shall be replaced by the installation of nest boxes in suitable habitats at a 1:1 ratio prior to their felling.

4.2.3 Noise, vibration and light

For the majority of the road widening, it is unlikely the proposal would result in changes to existing levels of noise, vibration and light from the existing M1 Princes Motorway. The exception to this would be in the southern section where the road is realigned to the east of the existing road to provide six lanes from north of Picton Road for about one kilometre and again at 2.7 kilometres north of Picton Road to 70 metres south of Bellambi Creek bridge.

These realigned sections will potentially impact resident native fauna in particular nocturnal woodland bird and mammal species such as those recorded during fauna surveys eg Greater Glider, Eastern Pygmy-possum, Owlet-nightjar and bat species. Bat species are particularly sensitive to any change in lighting. Considering the availability of adjacent and surrounding

habitat, the impact is unlikely to be significant and during construction there is potential for some resident native fauna to temporarily avoid habitats directly adjacent to the proposal.

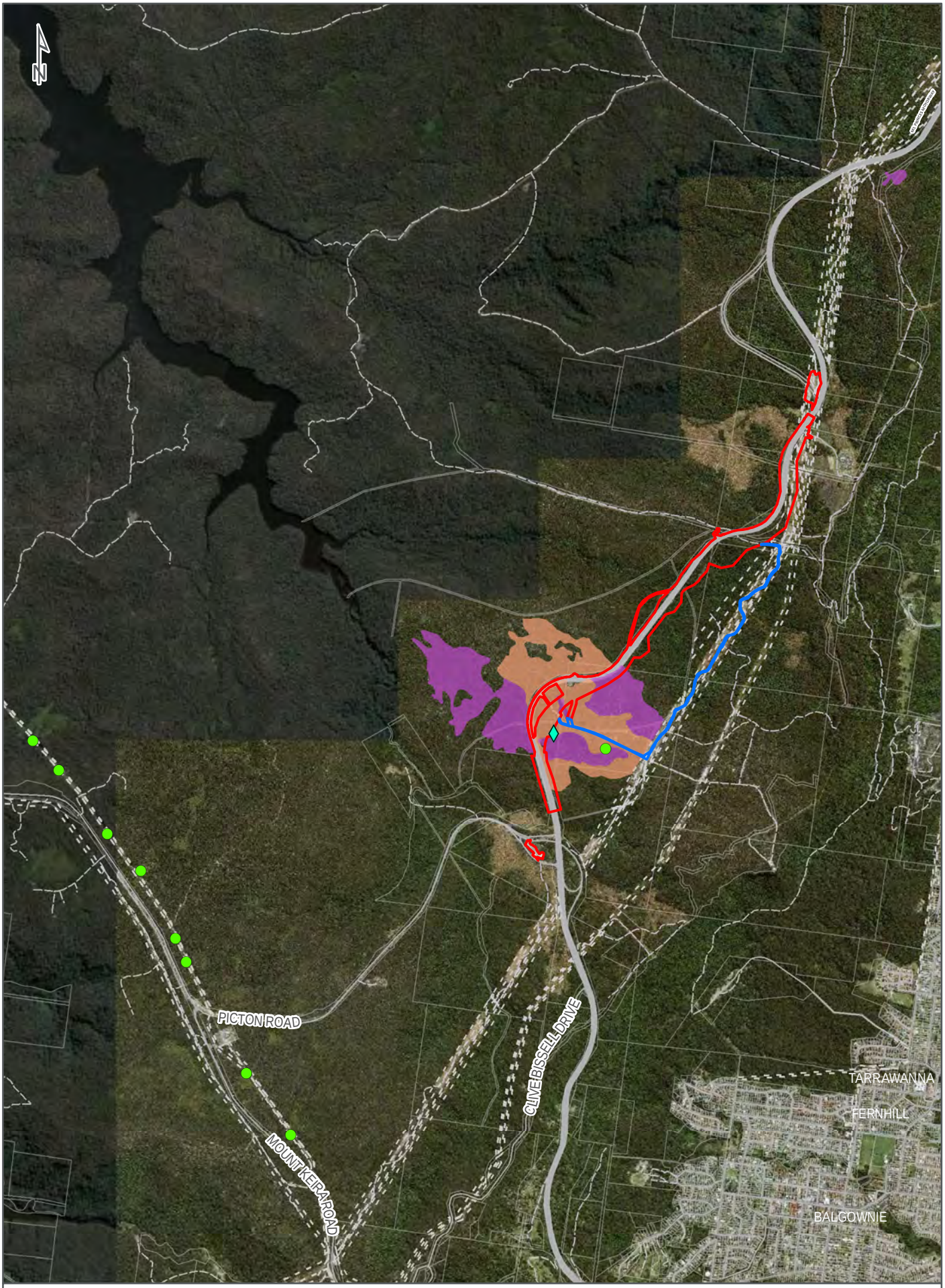

FIG NO. 10

FIGURE TITLE Preferred Eastern Pygmy-Possum habitat

0 0.5 1
1:36,000 Km

Woronora VIS mapping (NPWS, 2003)

- Eastern Pygmy-Possum capture
- BIONET Eastern Pygmy Possum Atlas records
- Construction Footprint
- Construction Vehicle Access Track
- Preferred Eastern Pygmy-Possum habitat (Upland Swamp)
- Preferred Eastern Pygmy-Possum habitat (Scribbly Gum Woodlands)

Location: I:\projects\30012264 - Mount Ousley Climbing Lanes REF\008 DATA\03 GIS\Maps\Env Reporting Maps\Stage 1 BAR figures_Oct 2016\Figure10_Pygmy Possum Habitat_V2.mxd

Last updated by: AB12541 on 25/10/2016 at 16:42

4.2.4 Impacts from relevant key threatening processes

The following ten Key Threatening Processes (KTPs) listed under the TSC Act are considered potentially relevant to the proposal:

- Bushrock removal
- Clearing of native vegetation
- Competition and habitat degradation by feral goats (*Capra hircus*)
- Herbivory and environmental degradation caused by feral deer
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread on Lantana (*Lantana camara*)
- Invasion of native plant communities by exotic perennial grasses
- Loss of hollow-bearing trees
- Removal of dead wood and dead trees.

These are discussed further in the relevant Section 5A Assessments for those subject threatened species provided as Appendix D.

4.2.5 Significance Assessment Summary

Section 5A assessments have been undertaken for a total of 23 fauna species, seven flora species and one EEC listed under the TSC Act that have been recorded or predicted to occur within the study area and that have the potential to be affected by the proposal.

EPBC assessments have also been undertaken for a total of one EEC and seven fauna species (including two migratory species) listed under the EPBC Act that have been recorded or predicted to occur within the study area and that have the potential to be affected by the proposal.

A list of those species and EEC subject to the Section 5A and EPBC Assessments as well as the assessment conclusions is provided in Tables 5 and 6 below.

Table 6: Summary of the findings of significance assessments under TSC Act.

Threatened species, population or communities	Likely significant impact?
Threatened ecological community	
Coastal Upland Swamp Endangered Ecological Community	No
Threatened flora species	
Cryptostylis hunteriana (Leafless Tongue-orchid)	No
Acacia bynoeana (Bynoe's Wattle)	No
Epacris purpurascens var. *purpurascens*	No

Threatened species, population or communities	Likely significant impact?
Grevillea parviflora subsp. parviflora (Small-flower Grevillea)	No
Pultenaea aristata (Prickly Bush-pea)	No
Daphnandra johnsonii (Illawarra Socketwood)	No
Pomaderris adnata	No
Threatened fauna species	
Calyptorhynchus lathami (Glossy Black-cockatoo)	No
Daphoenositta chrysoptera (Varied Sittella)	No
Glossopsitta pusilla (Little Lorikeet)	No
Petroica boodang (Scarlet Robin)	No
Petroica phoenicea (Flame Robin)	No
Callocephalon fimbriatum (Gang Gang Cockatoo)	No
Hieraaetus morphnoides (Little Eagle)	No
Ninox strenua (Powerful Owl)	No
Tyto tenebricosa (Sooty Owl)	No
Tyto novaehollandiae (Masked Owl)	No
Miniopterus schreibersii oceanensis (Eastern Bentwing Bat)	No
Mormopterus norfolkensis (Eastern Freetail Bat)	No
Scoteanax rueppellii (Greater Broad-nosed Bat)	No
Myotis macropus (Southern Myotis)	No
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	No
Cercartetus nanus (Eastern Pygmy-possum)	No
Pteropus poliocephalus (Grey-headed Flying-fox)	No
Petaurus australis (Yellow-Bellied Glider)	No
Heleioporus australiacus (Giant Burrowing Frog)	No
Pseudophryne australis (Red-crowned Toadlet)	No
Litoria littlejohni (Littlejohn's Tree Frog)	No
Varanus rosenbergi (Rosenberg's Goanna)	No
Hoplocephalus bungaroides (Broad-headed Snake)	No

Table 7: Summary of the findings of significance assessments under EPBC Act.

Threatened species, or communities	Likely significant impact?
Threatened ecological community	
Coastal Upland Swamp Endangered Ecological Community	No
Threatened fauna species	
Litoria littlejohni (Littlejohn's Tree Frog)	No
Heleioporus australiacus (Giant Burrowing Frog)	No
Pteropus poliocephalus (Grey-headed Flying-fox)	No
Petauroides volans (Greater Glider)	No
Hoplocephalus bungaroides (Broad-headed Snake)	No
Migratory species	
Monarcha melanopsis (Black-faced Monarch)	No
Rhipidura rufifrons (Rufous Fantail)	No

5 Mitigation Measures

5.1 Introduction

The following mitigation measures in Table 8 have been prepared to address the specific direct and potential indirect impacts outlined in Section 4. In line with the hierarchy of avoid, minimise, mitigate and offset, the proposed mitigation measures seek to minimise and mitigate the predicted impacts, generally in accordance with the RMS Biodiversity Guidelines (RTA 2011). The relevant stage of implementation has been noted for all mitigation measures. This includes whether the measure is relevant to one or more of the three stages: pre-construction, construction or post construction.

Table 8. Mitigation Measures

Impact	Mitigation measures		Timing
General biodiversity impacts	A1	A Flora and Fauna Management Plan (FFMP) will be prepared in accordance with Roads and Maritime's *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas (a map showing the Coastal Upland Swamp EEC and other native vegetation to be retained) • Management strategies for pre-construction and construction activities including control measures for the pre-clearing process • Requirements set out in the *Landscape Guideline* (RTA, 2008) • Pre-clearing survey requirements including specific requirements for protected fauna (Ecological pre-clearing surveys to be undertaken prior to the commencement of the clearing, comprising searches for nest sites, maternal roosting sites for microchiropteran bats, and breeding sites for large forest birds such as Owls and the Glossy Black-Cockatoo) by a suitably qualified ecologist in accordance with the *Roads and Maritime Biodiversity Guidelines* (Pre-clearing process) (RTA, 2011) • Procedures for unexpected threatened species finds and fauna handling • Fauna rescue and release procedure • Protocols to manage weeds and pathogens • Proposed strategies for re-use of coarse woody debris and bushrock	Pre-construction
General biodiversity impacts	A2	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Detailed design/Pre-construction

Impact	Mitigation measures		Timing
Minimise impacts to retained native vegetation adjoining the construction footprint	B1	Detailed design will seek to minimise the construction footprint to the extent possible. A Clearing Limits Report (or similar) will be prepared which identifies reduced clearing limits achieved by detailed design, compared to the original planned clearing limits. The report will clearly explain / justify the proposed clearing limits at any locations that a reduction cannot be achieved, or only minor reductions can be achieved. The report will be approved by the Roads and Maritime Environment Manager.	Detailed design/Pre-construction
	B2	Ensure exclusion zones areas are established prior to vegetation clearing through fencing and signage. Management of exclusion zones should address the following matters: • Ensure that any trees to be felled to establish exclusion zones are felled away from the exclusion zone and not into retained bushland habitats • Signs should be clearly visible from a distance of at least 20 metres and be general in nature, such as 'Exclusion Zone' or 'Environmental Protection Zone' • No clearing, stockpiling of plant and material shall take place in the established exclusion zones • Regular inspections of exclusion zones boundaries and repairs to fencing should be undertaken. Additional checks should be undertaken following storms where there is a higher risk of material falling on fencing. Where possible, inspections of exclusion zones should form part of regular site environmental checks • Communication of the locations and purpose of the exclusion zones should be provided to all site staff (eg in toolbox talks and formal inductions).	Pre-construction
	B3	Investigate options for salvage of the ROTAP species *Darwinia grandiflora*. Consultation with the local botanic gardens and council would be undertaken to investigate opportunities to collect seed from the plant or accepting individual plants that can be salvaged.	Pre-construction/construction

Impact	Mitigation measures		Timing
	B4	Landscape and Urban Design Plan to be prepared following project approval. This is to include: • Areas that are to be revegetated • Areas that are to be stabilised • Procedures for progressive stabilisation of cleared areas • Topsoil requirements for revegetation • Ensure plant species used for revegetation are suitable for the habitat and where practicable indigenous species may be used.	Detailed Design/construction/post-construction
	B5	Management of access into the project area through gating/fencing of existing tracks is to be implemented to reduce the impacts of human disturbance and dumping on the retained vegetation adjacent to the site.	Construction
Minimise risk of establishment and spread of invasive species and pathogens	C1	The Site Erosion and Sediment Control Plan will be implemented in accordance with the Blue Book (Landcom 2004) during construction to minimise the movement of the soil borne organism, *Phytophthora cinnamomi* and weed seeds.	Construction
	C2	A weed management plan (WMP) will be developed for the site as part of the CEMP and in accordance with the *Biodiversity Guidelines- Guide 6* (RTA 2011). It will include, but not be limited to: • A procedure for stockpile management • Requirements for the use of pesticides • Wash down procedure for vehicles to prevent the spread of weeds Undertake weed management and control in accordance with the *Roads and Maritime Biodiversity Guidelines* (RTA, 2011) during and post-construction. Stockpiling of topsoil from cleared areas for re-use in site revegetation is only to be sourced from areas classified as 'weed free' by a site ecologist.	Construction

Impact	Mitigation measures		Timing
	C3	Establish a protocol to prevent introduction or spread of *Phytophthora cinnamomi* and Myrtle Rust consistent with Roads and Maritime *Biodiversity Guidelines - Guide 7 (Pathogen Management)* (RTA, 2011) during construction. The protocols used should be either the Sydney Region Pest Management Strategy or Best Practice Guidelines for Phytophthora cinnamomi (DECC, 2008) and the DPI handout prepared for Myrtle rust response 2010–11: *Preventing spread of Myrtle Rust in bushland* or the OEH Interim management plan for Myrtle rust in bushland (2011).	Construction
Maintenance of habitat corridor and wildlife connectivity.	D1	Produce a fauna connectivity strategy in consultation with Roads and Maritime environmental staff and an experienced fauna consultant to investigate and determine what types of wildlife connectivity structures will be included in the detailed design and facilitate the movement of threatened species. Target species include forest owls, Glossy Black Cockatoo, Little Lorikeet, Gang-gang Cockatoo, microchiropteran bats, Greater Glider, Yellow-bellied Glider and Eastern Pygmy-possum. The fauna connectivity strategy will consider: • Enhancing the likelihood of culvert use with fauna exclusion fencing to funnel wildlife towards culvert openings and promote tree growth near entrances to encourage use of culverts as wildlife underpasses and reduce barrier effect of the motorway. • Retention of large glide trees adjacent to the road to facilitate Glider movement. • The location of the fauna exclusion fencing to be determined and shown on the detailed design.	Detailed design
	D2	A monitoring program will be designed and implemented to assess the effectiveness of any fauna connectivity measures installed (once determined).	Detailed design/post-construction

Impact	Mitigation measures		Timing
Minimise impact on native fauna and their habitat.	E1	Undertake staged habitat removal of hollow-bearing trees in accordance with the *Roads and Maritime Biodiversity Guidelines* (RTA, 2011). All habitat trees proposed for removal shall be tagged in the field with surveyors flagging tape and spray paint and clearly mapped for clearing Contractors. Felled habitat trees should be relocated into suitable retained habitats, where practicable, under the supervision of the project ecologist. Lost hollows shall be replaced by the installation of nest boxes in suitable habitats at a 1:1 ratio prior to their felling in accordance with the Nest Box Management Plan.	Pre-construction/construction

Impact	Mitigation measures		Timing
	E2	A Nest Box Management Plan would be prepared in accordance with the *Roads and Maritime Biodiversity Guidelines- Guide 8 (Nestboxes)* (RTA 2011) and in consultation with a suitably experienced Fauna ecologist, to ameliorate the reduction in habitat features and loss of tree hollows. Target species for nest boxes would include forest owls, Glossy Black Cockatoo, The Little Lorikeet and the Gang-gang Cockatoo, microchiropteran bats and Greater Glider, Yellow Bellied Glider and Eastern Pygmy-possum. The Nest Box Management Plan is to ensure no net loss of suitable Eastern Pygmy-possum habitat occurs as a result of hollow-bearing tree removal. Eastern Pygmy-possum nest boxes would be installed in suitable habitats at a frequency of one every 30-50 metres. Undertake post-construction nest box installation maintenance and monitoring checks in accordance with the prepared Nest Box Management Plan and Roads and Maritime Biodiversity Guidelines (RTA, 2011).	Pre-construction/during construction/post construction
	E3	In the unlikely event any nest sites of the larger sized birds such as the Square-tailed Kite and other raptors, Powerful Owl, and Masked Owl are located within the clearing area, the clearing contractor will move the nest from the construction site to the nearest suitable area outside of the construction site under direction of an ecologist.	Construction

It is understood that RMS would be incorporating additional, proven mitigation measures to minimise the direct impacts to Upland Swamps EEC and Eastern Pygmy-possum habitat. These will be as follows:

Impact	Mitigation measures	Timing
Coastal Upland Swamps EEC	An Upland Swamp Management Plan will be developed that will incorporate measures to minimise the impacts on Upland Swamps. This will include: • Identification of impacts to upland swamps • Methods to minimise impacts on upland swamps • Undertake a monitoring program at upland swamp locations prior to, during and for 12 months following, construction.	Pre-construction/construction/post-construction

Impact	Mitigation measures	Timing
	As part of an Upland Swamp Management Plan, post construction checks in line with the Roads and Maritime Biodiversity Guidelines (RTA, 2011) will be implemented and will consider but not be limited to: • Assessing the effectiveness of bunding revegetation and ensure no indirect impacts on surrounding Upland Swamps have occurred as a result of the works. • Should indirect impacts be encountered, remedial actions will be investigated and if practicable implemented.	Pre-construction/construction/post-construction
	Batters between the new road cuttings and remaining swamps will be established to minimise impacts to the remaining Upland Swamps by preventing draining of the dissected Upland Swamps.	Construction
	Spill management policy / guidelines to be followed to protect the retained Coastal Upland Swamp vegetation from any spills during construction of batters	Construction
	The Landscape and Urban Design Plan is to incorporate progressive construction revegetation and restoration of cleared areas of Coastal Upland Swamp EEC in accordance with *Roads and Maritime Biodiversity Guidelines* (RTA, 2011). In particular, revegetating the batters installed with species associated with that particular swamp to prevent drainage of the Coastal Upland Swamps Stockpiled topsoil and/or tubestock planting will be used where appropriate.	Construction

Impact	Mitigation measures	Timing
Eastern Pygmy-possum	The Fauna Connectivity Strategy plan within the Construction FFMP will incorporate all of the mitigation measures, monitoring and control measures specific to Eastern Pygmy-possum in line with the *Roads and Maritime Biodiversity Guidelines* (RTA, 2011). These are to include: • Measures to mitigate habitat fragmentation: including removal of concrete barriers on the old road alignment at the southern end of the project to provide additional connectivity for the existing Eastern Pygmy-possum population to the wider locality. • Enhance likelihood of culvert use with fauna fencing to funnel wildlife towards culvert openings and promote tree growth near entrances to encourage use of culverts as wildlife underpasses and reduce barrier effect of the motorway. The Nest Box Strategy will incorporate specific measures to ensure no net loss of suitable Eastern Pygmy-possum habitat as a result of hollow-bearing tree removal within their habitat in accordance with the *Roads and Maritime Biodiversity Guidelines - Guide 8* (nestboxes) (RTA, 2011). And in consultation with a suitably experienced Fauna ecologist Twenty five EPP nestboxes are currently installed within the study area within suitable habitat and those not within the construction footprint can be retained. Undertake post-construction nest box installation maintenance and monitoring checks in accordance with the prepared nest box strategy and Roads and Maritime Biodiversity Guidelines (RTA, 2011).	Pre-construction/construction

5.2 Compensatory strategies

5.2.1 Biodiversity offsets and supplementary measures

Roads and Maritime is committed to offsetting impacts associated with the proposal in line with its biodiversity offsetting guidelines (RMS, 2011) and in general accordance with the OEH principles for the use of biodiversity offsets in NSW.

In order to offset to impacts to 28.29 hectares of native vegetation, specifically the impacts to 2.27 hectares of Coastal Upland Swamp EEC and 26.02 hectares of other native vegetation with the potential to support threatened species, a Biodiversity Offset Strategy (BOS) will be produced following approval of the proposal. The BOS will detail the quantity and mechanism that these impacts will be offset with the use of the OEH BioBanking Credit Calculator v4.0 to calculate the number ecosystem credits for each PCT required to be acquired and subsequently retired.

6 Conclusion

6.1 Overview of key findings

The key findings of this report are as follows.

Flora:

- The proposal would result in vegetation clearing, with a 'worst case assessment' of a loss of approximately 29.6 hectares of vegetation (of varying quality) for road widening and construction of which 28.29 hectares is remnant native vegetation including 2.27 ha of Coastal Upland Swamp EEC.
- No threatened flora species have been found within the study area.
- The proposal will result in the removal of three clumps of a nationally rare (ROTAP) prostrate shrub, *Darwinia grandiflora*, which was recorded in the Scribbly Gum Woodland and upland swamp habitats within the study area.
- A series of mitigation measures have been recommended to minimise impacts to retained vegetation adjoining the footprint, including the establishment of a groundwater monitoring program to assess impacts to the retained upland swamp EEC.
- Incorporation of all of the proposed mitigation measures and post-construction monitoring of the mitigation measures will ensure that there are no significant impacts as a result of the project and ensure the long term viability of the Coastal Upland Swamp EEC and other vegetation within the project area.
- Roads and Maritime is committed to offsetting impacts associated with the proposal in line with its biodiversity offsetting guidelines (RMS, 2011) and in general accordance with the OEH principles for the use of biodiversity offsets in NSW.
- In order to offset to impacts to 28.29 hectares of native vegetation, specifically the impacts to 2.27 hectares of Coastal Upland Swamp EEC and 26.02 hectares of other native vegetation with the potential to support threatened species, a Biodiversity Offset Strategy (BOS) will be produced following approval of the proposal. The BOS will detail the quantity and mechanism that these impacts will be offset with the use of the OEH BioBanking Credit Calculator v4.0 to calculate the number ecosystem credits for each PCT required to be acquired and subsequently retired.

Fauna:

- The study area contains a diverse and good quality range of fauna habitat, with a combination of moist and dry eucalypt forest and rainforest, as well as sclerophyll and swamp habitats. The study area is part of an identified regional wildlife corridor along the Illawarra Escarpment and beyond.
- Potential foraging or roosting habitat is available within the study area for 23 threatened fauna species including Littlejohn's Tree Frog, Red-crowned Toadlet, Giant Burrowing Frog, Gang Gang Cockatoo, Glossy Black-Cockatoo, Scarlet Robin, Flame Robin, Varied

Sittella, Little Lorrikeet, Little Eagle, Powerful Owl, Sooty Owl, Masked Owl, Grey-headed Flying-fox, Southern Myotis, Eastern False Pipistrelle, Eastern Bentwing-bat, Eastern Freetail Bat, Greater Broad-nosed Bat, Broad-headed Snake, Rosenberg's Goanna, Yellow bellied glider and Eastern Pygmy-possum.

- Four threatened species listed under the TSC Act were recorded in the study area, Gang Gang Cockatoo, Eastern Pygmy-possum, a probable Eastern Bentwing-bat and the Greater Glider.
- Two migratory species, the Black-faced Monarch and Rufous Fantail, have also been identified to occur within the study area.
- Mitigation strategies have been recommended to reduce impacts on native fauna that include pre-clearance assessments, clearance supervision, connectivity strategy and nest box installation.
- Incorporation of all of the proposed mitigation measures and post-construction monitoring of the mitigation measures will ensure that there are no significant impacts on the threatened fauna present in the project area.

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Appendix A: Flora species recorded within the Stage 1 study area

Table 9: Flora species recorded during field survey in Stage 1 Study Area

			Abundance Rating											
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Acacia binervata	Two-Veined Hickory											1	3	
	Acacia elongata	Swamp wattle										10			
	Acacia stricta	Straight Wattle		4											
	Acacia suaveolens	Sweet Wattle									3				
	Acacia ulicifolia	Prickly Moses											2	2	
	Acmena smithii	Lillypilly					10+								3
	Actinotus minor	Lesser Flannel Flower	80	>100	20+	5					50+	500			
	Allocasuarina littoralis	Black She-oak										2		5	
	Amperea xiphoclada	Broom Spurge								1	10	1		4	
	Anisopogon avenaceous	Oat Speargrass		150	30+						30+				
	Aotus ericoides			5		1					20+				
	Asplenium australasicum						3								
	Asplenium flabellifolia	Necklace Fern					1								5
	Arthropteris tenella						4								
	Baloskion gracile		500	5	100+			200+	20+		5				
	Banksia ericifolia	Heath-leaved Banksia	20	15	5	30+		4	2		6	10			
	Banksia oblongifolia				5			20+	20+						
	Banksia serrata	Old-man Banksia		10	1	2					10+	10			
	Banksia spinulosa	Hairpin Banksia			10								10		
	Bauera microphylla					1			20+						

			Abundance Rating											
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Baumea sp.										10+				
	Baumea teretifolia		50												
	Billardiera mutabilis	Climbing Apple Berry											2		
	Blechnum cartilagineum	Gristle Fern					10+					5			50
	Blechnum patersonii						10+								
	Bossiaea heterophylla	Variable Bossiaea		1							1				
	Burchadia umbellata				3	2		20+							
	Calochilus campestris							2							
	Calochilus sp.										1				
	Calochlaena dubia	Rainbow Fern								5			50		50
	Callistemon citrinus	Crimson Bottlebrush										1			
	Cassytha glabella	Slender Devil's Twine	5		5				10		2				
	Cassytha pubescens	Devil's Twine										10			
	Caustis flexuosa	Curly Wig		150							10				
	Ceratopetalum apetalum	Coachwood					30+								40
	Choretrum sp.							2		1	3				
	Cissus antarctica	Kangaroo Vine, Water Vine	2	4											10
	Cissus hypoglauca					2						2			
	Citriobatus pauciflorus						2			1					
	Clematis aristata	Old Man's Beard											3	4	
	Conospermum ellipticum		15												

			Abundance Rating											
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Conospermum tenuifolium				4										
	Coronidium elatum												3		
	Corymbia gummifera	Red Bloodwood		1	4			2		1			1		
	Cryptocarya glaucescens	Jackwood					5								15
	Cryptostylis sp.	Tongue Orchid											1		
	Cyathea australis	Rough Tree Fern					6								1
	Cynodon dactylon	Couch Grass	20												
	Dampiera stricta	Dampiera	4	6	2	5		20+	20+						
	Darwinia grandiflora			50		20+					50+				
	Desmodium rhytidophyllum									2					
	Dianella caerulea	Blue Flax-lily	1	3	5	3				10+	10	10	2	5	
	Doryphora sassafras	Sassafras					20+						1		15
	Drosera binata								10						
	Drosera spatulata		1												
	Elaeocarpus reticulatus	Blueberry Ash		1											
	Empodisma minus	Spreading Rope-rush	>500					500+	100+						
	Entolasia marginata	Bordered Panic	10			5		30+	20+	10+			10	2	
	Entolasia stricta	Wiry Panic	20		20+			20+		10	20	20	50	100	
	Epacris microphylla				4	2		10							
	Epacris pulchella	Wallum Heath						3			4			3	
	Eucalyptus pilularis	Blackbutt								3			3		

			Abundance Rating											
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Eucalyptus piperita	Sydney Peppermint								12			1	4	
	Eucalyptus racemosa	Scribbly Gum		4	12	2		1			5	4			
	Eucalyptus sieberi	Silvertop Ash		10		1					10				
	Eurychorda complanata					10+		20+	50+			20			
	Eustrephus latifolius	Wombat Berry					3								
	Gahnia melanocarpa	Black-fruit Saw-sedge												3	
	Gahnia sieberiana									2					
	Geitonoplesium cymosum	Scrambling Lily											2		1
	Gleichenia dicarpa	Pouched Coral Fern	500		2				20+						
	Gleichenia microphylla	Scrambling Coral Fern	500												
	Gonocarpus teucrioides	Germander Raspwort	4							5	20+			3	
	Goodenia heterophylla									2					
	Goodenia ovata	Hop Goodenia											1	3	
	Gymnoschoenus spaerocephalus					1			200+						
	Hakea dactyloides	Finger Hakea			3			5	3						
	Hakea laevipes			3											
	Hakea sericea	Needlebush		10	2	2									
	Hakea teretifolia	Needlebush						6				1			
	Hibbertia aspera	Rough Guinea Flower											2	1	
	Hibbertia dentata	Trailing Guinea Flower											8	2	
	Imperata cylindrica	Blady Grass		25									20	20	

			Abundance Rating												
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Isopogon anemonifolius	Broad-leaf Drumsticks		1	2	5			10			20			
	Isopogon anethifolius	Narrow-leaf Drumsticks		5											
	Kunzea ambigua				2	5				2					
	Lambertia formosa	Mountain Devil		2	5								2		
	Lastreopsis decomposita						20+								
	Lastreopsis microsora	Creeping Shield Fern													1
	Laxmannia sp.										20+				
	Lepidosperma laterale	Variable Sword-sedge	200							10+			1		
	Lepidosperma limicola								100+						
	Lepidosperma sp.									20+					
	Lepyrodia scariosa			100	20+	20+			30+		50+	500+			
	Lepyrodia sp.					20+									
	Leptocarpus tenax				100+			500+	500+		40+	500+			
	Leptospermum arachnoides								2						
	Leptospermum juniperinum	Prickly Tea-tree	50					20+							
	Leptospermum polygalifolium	Yellow Tea-tree	>100		4	10+		20+		5		20	3	20	
	Leptospermum squarrosum					8									
	Leptospermum trinervium	Flaky-barked Tea-tree		7	10+			30+			4	50			
	Leptospermum rotundifolium					1		20+	2						
	Leucopogon lanceolatus		>10	3	20+	10+				4	5	10	2	20	
	Lindsaea linearis	Screw Fern		10	5	5		30+		1	20+				

			Abundance Rating											
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Livistona australis	Cabbage Tree Palm			1		6			1				2	3
	Lomandra brevis					500+									
	Lomandra cylindrica	Needle Mat-rush		10	5	10+		20+		10+	30+				
	Lomandra filiformis	Wattle Mat-rush		>100	10+					10+	10	10			
	Lomandra glauca	Pale Mat-rush		200	50+						30+				
	Lomandra longifolia	Spiny-headed Mat-rush	50	5	10+	10+		10		50+	4	10	50	50	
	Lomandra obliqua	Mat-rush		50	30+					30+	50+			5	
	Lomatia silaifolia	Crinkle Bush												1	
	Lycopodium deuterodensum	Bushy Clubmoss			200+						2				
	Melaleuca squarrosa	Scented Paperbark						10+							
	Microlaena stipoides	Weeping Grass											10		
	Microsorum scandens						20+								
	Mirbelia rubiifolia							30+	20+						
	Mitrasacme polymorpha				2							1			
	Morinda jasminoides	Sweet Morinda					10								30
	Notelaea longifolia	Large Mock-olive								2			4	3	8
	Notelaea venosa	Veined Mock-olive													15
	Opercularia aspera	Coarse Stinkweed											1		
	Oplismenus imbecillis	Creeping Beard Grass								5			20		
	Pandorea pandorana	Wonga Wonga Vine								2			2		
	Panicum simile	Two-colour Panic	10												

			Abundance Rating											
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Parsonsia straminea	Common Silkpod	1	3											3
	Patersonia glabrata	Leafy Purple-flag		100						2	4			5	
	Patersonia sericea	Silky Purple-flag		2											
	Pellaea falcata	Sickle Fern													25
	Persoonia lanceolata	Lance Leaf Geebung	10	2											
	Persoonia levis	Broad-leaved Geebung	1		2							5			
	Persoonia linearis	Narrow-leaved Geebung			10							5			
	Persoonia mollis subsp nectens				10+	2		1		1	1	10			
	Petrophile pulchella					1									
	Petrophile sessilis	Conesticks										20			
	Phyllota grandiflora										2				
	Platysace linearifolia			4		3		26+	10+		5	10			
	Poa sp.											20			
	Pseuderanthemum variabile	Pastel Flower					10+			20+			5		10
	Pteridium esculentum	Bracken	70							3	5	50	200	20	
	Pyrrosia rupestris	Rock Felt Fern													2
	Rytidosperma tenuius												10		
	Schoenus brevifolius	Zig-zag Bog-rush	1000			10+									
	Selaginella uliginosa	Swamp Selaginella	5	20	4	3					500+				
	Smilax australis	Lawyer Vine					5								1
	Smilax glyciphylla	Sweet Sarsaparilla			4					3			3	3	

			Abundance Rating												
Exotic	Species name	Common name	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	SE10	SW1	SW2	SW3
	Sowerbaea juncea							20+	10		1				
	Sphaerolobium vimineum								20+						
	Stackhousia nuda								3						
	Stephania japonica	Snake Vine											20		
	Syncarpia glomulifera	Turpentine								12			40	3	
	Synoum glandulosum	Scentless Rosewood											2		4
	Syzygium oleosum						2								
	Tasmannia insipida	Brush Pepperbush					20+								8
	Tetrarrhena juncea	Wiry Ricegrass	50												
	Tetrarrhena turfosa								500+						
	Trochocarpa laurina	Tree Heath	1				3			1				1	20
	Tylophora barbata	Bearded Tylophora											2		
	Veronica plebeia	Trailing Speedwell											5		
	Wilkiea huegeliana						5								
	Wurmbea dioica										1				
	Xanthorrhoea resinifera	Grass tree		4	10						10+				
	Xanthosia tridentata	Rock Xanthosia								3					
	Xylomelum pyriforme	Woody Pear	2												
	Zieria pilosa	Hairy Zieria		1							2				
	Zieria smithii	Sandfly Zieria								6					
	Zieria laevigata	Smooth Zieria												1	

* Introduced species

Appendix B: Fauna species recorded within the study area

Table 10: Fauna species recorded during field surveys (2014, 2015 and 2016)

Scientific Name	Common Name
Amphibian	
Crinia signifera	Common Eastern Froglet
Limnodynastes peronii	Striped Marsh Frog
Litoria citropa	Blue Mountains Tree Frog
Litoria phyllochroa	Leaf Green Tree Frog
Littana tyleri	Tyler's Tree Frog
Pseudophryne bibronii	Brown Toadlet
Aves	
Acanthiza pusilla	Brown Thornbill
Acanthorhynchus tenuirostris	Eastern Spinebill
Aegotheles cristatus	Owlet Nightjar
Alectura lathami	Brush Turkey
Alisterus scapularis	King Parrot
Anthochaera carunculata	Red Wattlebird
Cacatua galerita	Sulphur-Crested Cockatoo
Cacomantis flabelliformis	Fantail Cuckoo
Cacomantis variolosus	Brush Cuckoo (Stage 2 area)
Callocephalon fimbriatum	Gang-gang Cockatoo
Calyptorhynchus funereus	Yellow-tail Black Cockatoo
Coracina novaehollandiae	Black-faced Cuckooshrike (Stage 2 area)
Cormobates leucophaea	White Throated Tree Creeper
Corvus coronoides	Australian Raven (Stage 2 area)
Dacelo novaeguineae	Kookaburra
Eopsaltria australis	Eastern Yellow Robin (Stage 2 area)
Hieraaetus morphnoides	Little Eagle (Stage 2 area)
Lichenostomus chrysops	Yellow-faced Honey Eater (Stage 2 area)
Menura novaehollandiae	Superb Lyrebird (Stage 2 area)
Monarcha melanopsis	Black-faced Monarch
Ninox boobook	Southern Boobook (Stage 2 area)
Pachycephala pectoralis	Golden Whistler
Phalacrocorax varius	Pied Cormorant (Stage 2 area)

Scientific Name	Common Name
Philemon corniculatus	Noisy Friarbird
Platycercus elegans	Crimson Rosella
Psophodes olivaceus	Eastern Whipbird
Rhipidura albiscapa	Grey Fantail
Sericornis frontalis	White-Browed Scrubwren
Strepera sp.	Currawong
Trichoglossus moluccanus	Rainbow Lorikeet
Mammalia	
Antechinus stuartii	Brown Antechinus
Cercartetus nanus	Eastern Pygmy-possum
Cervus timorensis	Rusa Deer (Stage 2 area)
Miniopterus schreibersii oceanensis	Eastern Bentwing-Bat
Nyctophilus sp.	Unidentified long-eared bat
Petauroides volans	Greater Glider
Petaurus breviceps	Sugar Glider
Pseudocheirus peregrinus	Ringtail Possum (Stage 2 area)
Rattus fuscipes	Bush Rat
Rhinolophus megaphyllus	Eastern Horseshoe Bat
Tadarida australis	White-Striped Freetail Bat
Vespadelus darlingtoni	Large Forest Bat
Vombatus ursinus	Wombat (Stage 2 area)
Wallabia bicolor	Swamp Wallaby
Crustacea	
Cherax destructor	Common Yabby
Reptilia	
Eulamprus heatwolei	Yellow-Bellied Water skink
Lampropholis delicata	Delicate Skink
Notechis scutatus	Tiger snake
Rankinia diemensis	Mountain Dragon

Appendix C: Likelihood of Occurrence Table

Note: The following list of threatened species, populations, or ecological communities with potential to occur, which may be affected directly or indirectly by the project, is derived from searches of the following databases as well as the on ground survey conducted on the M1 Princes Motorway Climbing Lanes Project:

- Likelihood of occurrence is based on the risk matrix below.
- NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database and Threatened Species Profiles (March 2016).
- Protected Matters Report that documents all Matters of National Environmental Significance (NES) within 10 km of site (Department of Sustainability, Environment, Water, Population and Communities) (March 2016).
- NSW Flora Online Search – Rare or Threatened Australian Plants (ROTAP) species (PlantNET 2016)
- Department of Primary Industries: Fishing and Aquaculture – Profiles for species, populations and ecological communities (NSW Government, 2005)

Table 11: Threatened species with potential to occur and assessment of likelihood of occurrence

Note: E = Endangered; CE = Critically Endangered; V = Vulnerable; P = Protected

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Threatened Ecological Communities						
Coastal Upland Swamp in the Sydney Basin Bioregion	E	E	Coastal Upland Swamp includes open graminoid heath, sedgeland and tall occurring primarily on impermeable sandstone plateaux with shallow groundwater aquifers in the headwaters and impeded drainage lines of streams, and on sandstone benches with abundant seepage moisture. Generally associated with acidic soils. Elevations 20-600m asl.		Yes	Community mapped as occurring in the study area. Risk High: highly likely to occur **Further assessment required**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Turpentine-Ironbark Forest in the Sydney Basin Bioregion*	CE	CE	A transitional community, between Cumberland Plain Woodland in drier areas and Blue Gum High Forest on adjacent higher rainfall ridges. Occurs in moderately wet areas, with annual rainfall of 800-1100 mm/year, on shale ridge caps on sandstone plateaux. Clay soils derived from Wianamatta Shale. Occurs on relatively high fertility soils.		No	Habitat not present. Risk Low: unlikely to occur
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion*	-	E	Tall open eucalypt forests with a sparse to dense layer of shrubs and vines, and a diverse understorey of native grasses, forbs, twiners and ferns. Found on basalt and basalt-like substrates usually at elevations between 650 m and 1050 m above sea level. Dominant canopy species are most often *Eucalyptus fastigata* (brown barrel), *E. viminalis* (ribbon gum) and *E. radiata subsp. radiata* (narrow-leaved peppermint).		No	Habitat not present. Risk Low: unlikely to occur
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia*	CE	CE	A complex of rainforest and coastal vine thickets, including some that are deciduous. Occurs within two kilometres of the coast or adjacent to a large salt water body on a range of landforms derived from coastal processes in warm temperate, sub-tropical or tropical climatic zones.		No	Habitat not present. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Threatened Flora						
Acacia baueri subsp. *aspera*	V	-	Mainly confined to Kings Tableland in the central Blue Mountains with sporadic occurrences on the Woronora Plateau. Occurs in low, damp heathlands often on exposed rocky outcrops, appears to prefer open conditions and early successional habitats following fire.	9	No	No suitable habitat present. Risk Low: unlikely to occur.
Acacia bynoeana (Bynoe's Wattle)	E	V	Occurs mainly in heath and dry sclerophyll forest on sandy soils or sandy clay. Appears to prefer open, sometimes slightly disturbed sites such as trail margins, recently burnt areas.	1	No	Some suitable habitat present. Risk Medium: could possibly occur. **Further assessment required.**
Allocasuarina glareicola	E	E	Grows in Castlereagh woodland on lateritic soil. Found in open woodland with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla* and *Melaleuca decora*.	0	No	No suitable habitat present. Risk Low: unlikely to occur
Arthropteris palisotii (Lesser Reeping Fern)	E	-	Occurs in rainforest, mainly on tree trunks. May be extinct in NSW.	1	No	Highly restricted distribution. Lack of suitable habitat. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Caladenia tessellata (Thick-lipped Spider Orchid, Daddy Long-legs)	E	V	Generally grows in low, dry sclerophyll woodland with a heathy or sometimes grassy understorey on clay loams or sandy soils, specifically in dry, low Brittle Gum (*Eucalyptus mannifera*), Inland Scribbly Gum (*E. rossii*) and Allocasuarina spp. woodland with a sparse understorey and stony soil.	0	No	No suitable habitat present. Risk Low: unlikely to occur
Callitris endlicheri – endangered population	EP	-	Woronora Plateau population restricted to a single outcrop of sandstone approx. 2 ha in area near Darkes Forest.	Pop'n	No	Outside of known distribution of population. Risk Low: unlikely to occur
Chorizema parvifolium	EP	-	Population recorded from between Austinmer and Albion Park on coastal headland.	Pop'n	No	Outside of known distribution of population. Risk Low: unlikely to occur
Cryptostylis hunteriana (Leafless Tongue-orchid)	V	V	Known to occur in a range of communities, including swamp heath and woodland.	0	No	Some suitable habitat present but no local records. Risk Medium: could possibly occur **Further assessment required**
Cynanchum elegans (White-flowered Wax Plant)	E	E	Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree – Coastal Banksia coastal scrub; Forest Red Gum aligned open forest and woodland; Spotted Gum aligned open forest and woodland; and Bracelet Honeymyrtle scrub to open scrub.	8	No	No suitable habitat present. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Daphnandra johnsonii (Illawarra Socketwood)	E	E	Occupies rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Associated vegetation includes rainforest and moist eucalypt forest on loams and clay loam derived from volcanic and fertile sedimentary rock.	1	No	Some suitable habitat present, unlikely to extend up above escarpment. Risk Medium: could possibly occur. **Further assessment required.**
Epacris purpurascens var. *purpurascens*	V	-	Occurs in a range of habitat types, most of which have a strong shale soil influence, including sclerophyll forest, scrubs and swamps. The largest known populations occur within Sydney Catchment Authority areas, west of Wollongong.	2	No	Some suitable habitat present. Risk Medium: could possibly occur. **Further assessment required.**
Gossia acmenoides *(Scrub Ironwood)*	E	-	The population of Gossia acmenoides in the Sydney Basin Bioregion south of the Georges River is found in the local government areas of Wollongong, Shellharbour, and Kiama. Found in subtropical and dry rainforest on the ranges and coastal plain of eastern Australia. Estimated to be less than 100 plants, through approximately 30 sites.	2	No	No suitable habitat Risk Low: unlikely to occur in warm temperate rainforest.
Grevillea parviflora subsp. parviflora (Small-flower Grevillea)	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests Often occurs in open, slightly disturbed sites such as along tracks.	0	No	No local records but suitable habitat available within study area. Risk Medium: could possibly occur **Further assessment is required**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Haloragis exalata subsp. exalata (Square Raspwort)	V	V	Appears to require protected and shaded damp situations in riparian habitats. Disjunctly distributed in the Central Coast, South Coast and North Western Slopes.	0	No	Marginal habitat present within study area. Risk Low: unlikely to occur.
Leucopogon exolasius (Woronora Beard-heath)	V	V	Found along the upper Georges River and in Heathcote National Park in woodland on sandstone.	6	No	Study area outside of species known distribution. Risk Low: unlikely to occur
Melaleuca biconvexa (Biconvex Paperbark)	V	V	The species may occur in dense stands forming a narrow strip adjacent to watercourses, in association with other Melaleuca species or as an understorey species in wet forest. Scattered and dispersed populations found in Jervis Bay and the Gosford-Wyong area on alluvial soils of low slopes or sheltered aspects.	0	No	No suitable habitat present and study area outside of species known distribution. Risk Low: unlikely to occur.
Melaleuca deanei (Deane's Melaleuca)	V	V	Endemic to Sydney Basin region in two distinct areas, Ku-ring-gai/Berowra and Holsworthy/Wedderburn. Grows in heath on sandstone or flat broad ridge tops. Strongly associated with sandy loam soils that are low in nutrients, sometimes with ironstone present.	0	No	Study area outside of species known distribution. Risk Low: unlikely to occur.
Pelargonium sp. Striatellum (Omeo Stork's-bill)	E	E	Normally located in habitat just above high water mark of ephemeral lakes and can colonise exposed lake beds. Known from only 3 locations in NSW in the Monaro Plains and Lake Bathurst.	0	No	No suitable freshwater habitat available within study area. Outside area of known species distribution. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Persoonia acerosa (Needle Geebung)	V	V	Occurs in dry sclerophyll forest, scrubby low woodland and heath on low fertility soils. Only recorded from the Central Coast and Blue Mountains.	1	No	Study area outside of species known distribution. Risk Low: unlikely to occur.
Persoonia hirsuta (Hairy Geebung)	E	E	*Persoonia hirsuta* has a scattered distribution around Sydney from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	7	No	No suitable habitat present. More likely to be present on transition forest soils on western edge of SCA lands at Wedderburn and Holsworthy. Risk Low: unlikely to occur
Pimelea spicata (Spiked Rice-flower)	E	E	Found on well-structured clay soils, and in the Illawarra is associated with Coast Banksia open woodland with a better developed shrub and grass understorey. Coastal headlands and hilltops are favoured sites.	0	No	No suitable habitat present and no records within a 10km radius. Risk Low: unlikely to occur
Pomaderris adnata – known population at Sublime point	E	-	Known from only one site at Sublime Point, north of Wollongong. Occurs near the edge of the plateau behind the Illawarra escarpment. Associated with *Eucalyptus sieberi, Corymbia gummifera* forest with occasional *Hakea salicifolia*.	27	No	Some suitable habitat present, highly restricted distribution. Risk Medium: could possibly occur. **Further assessment required.**
Pomaderris brunnea (Rufous Pomaderris)	V	V	Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	0	No	No suitable habitat present. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Pterostylis saxicola (Sydney Plains Greenhood)	E	E	Restricted to Western Sydney between Freemans Reach and Picton. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation is sclerophyll forest or woodland on shale/sandstone transition or shale soils.	0	No	Study area outside of species known distribution. No suitable habitat present. Risk Low: unlikely to occur.
Pultenaea aristata (Prickly Bush-pea)	V	V	Restricted to the Woronora Plateau between Helensburgh and Mt Keira. Occurs in dry sclerophyll woodland or wet heath on sandstone.	255	No	Suitable habitat present. Risk High: Highly likely to occur. **Further assessment required.**
Pultenaea glabra (Smooth Bush-pea, Swamp Bush-pea)	V	V	Restricted to the Blue Mountains. Grows in swamp margins, hillslopes, gullies and creek banks within dry sclerophyll forest and tall damp heath on sandstone.	0	No	Study area outside of species known distribution. Risk Low: unlikely to occur.
Senna acclinis (Rainforest Cassia)	E	-	Grows in or on the edges of subtropical and dry rainforest.	1	No	No suitable subtropical or dry rainforest habitat in study area. Risk low: unlikely to occur.
Solanum celatum	E	-	Restricted to an area from Wollongong to just south of Nowra. Most records are pre-1960 and majority of populations likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forests.	2	No	Local records are from 1900. Risk low: unlikely to occur.

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Syzygium paniculatum (Magenta Lilly Pilly)	E	V	On the south coast species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest.	2	No	No suitable habitat available within study area. Risk Low: unlikely to occur
Thelymitra sp. Kangaloon (Kangaloon Sun-orchid)	CE	CE	Only known to occur on the southern tablelands in the Moss Vale/Kangaloon/Fitzroy Falls area in upland swamps.	0	No	Study area outside of species known distribution. Risk Low: unlikely to occur.
Thesium australe	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (Themeda australis). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time	0	no	Nearestrecord is from 1911 fron ulladulla. Risk low: unlikelymto occur.
Birds						
Anthochaera phrygia (Regent Honeyeater)	CE	E	NSW the distribution is very patchy and mainly confined to the two main breeding areas at Capertee Valley and the Bundarra-Barraba region and surrounding fragmented woodlands. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak.	1	No	No suitable habitat present. Risk Low: unlikely to occur.

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Ardenna carneipes (Flesh-footed Shearwater)	V	-	Migratory species common to southern Australian waters of continental shelf/slope. Utilise island breeding burrows on sloping ground in coastal forest, scrubland, shrubland or grassland.	1	No	No suitable habitat present. Risk Low: unlikely to occur.
Botaurus poiciloptilus (Australasian Bittern)	E	E	Inhabits temperate freshwater wetlands and occasionally estuarine reedbeds, with a preference for permanent waterbodies with tall dense vegetation.	2	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur
Calidris alba (Sanderling)	V	-	Coastal migratory species with a NSW distribution from Hastings Point to Shoalhaven Heads. Found in open, sandy beaches with exposed sand bars and rocky outcrops. Rare use of near-coastal wetlands.	2	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur
Callocephalon fimbriatum (Gang-gang Cockatoo)	V	-	Occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests in winter and open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas in summer.	144	No	Habitat and foraging resources available on site. **Risk High**: highly likely to occur. **Further assessment required.**
Calyptorhynchus lathami (Glossy Black-Cockatoo)	V	-	Occupy coastal woodlands and drier forest areas, open inland woodlands or timbered watercourses where Casuarina are present.	12	No	Some suitable habitat present. **Risk Medium:** could possibly occur. **Further assessment required.**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Coracina lineata (Barred Cuckoo-Shrike)	V	-	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses.	2	No	Outside of known range. Risk Low: unlikely to occur.
Daphoenositta chrysoptera (Varied Sittella)	V	-	Inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland.	7	No	Some suitable habitat present. **Risk Medium:** could possibly occur. **Further assessment required.**
Dasyornis brachypterus (Eastern Bristlebird)	E	E	Requires dense, low vegetation with a heathy understorey. Age of habitat since fire influences population density, with highest density in areas that have been unburnt for at least 15 years. Feeds primarily on insects and nests on or near ground in dense vegetation.	0	No	Some suitable habitat present. Risk Low: unlikely to occur
Ephippiorhynchus asiaticus (Black-necked Stork)	E	-	Restricted to coastal and near-coastal habitat. Inhabits wetlands, floodplains and deeper permanent water bodies.	1	No	No suitable habitat present. Risk Low: unlikely to occur.
Esacus magnirostris (Beach Stone-curlew)	CE	-	Inhabits undisturbed beaches, islands, reefs and estuarine intertidal sand and mudflats.	1	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Glossopsitta pusilla (Little Lorikeet)	V	-	Mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes.	1	No	Foraging, habitat and nesting resources available on site. **Risk Medium:** could possibly occur. **Further assessment required.**
Grantiella picta (Painted Honeyeater)	V	-	Inhabits box-gum woodlands and box-ironbark forests and is a specialist feeder on mistletoe fruits growing in acacia and eucalypt trees. Nests within outer canopy of eucalypt, she-oak, paperbark and mistletoe branches.	1	No	No suitable habitat present. Risk Low: unlikely to occur.
Haematopus fuliginosus (Sooty Oystercatcher)	V	-	Occurs on rocky shorelines and headlands, stony beaches, offshore islands and exposed reefs and only occasionally on sandy beaches.	25	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur
Haematopus longirostris (Pied Oystercatcher)	E	-	Inhabits marine littoral habitats, including islands. It occupies muddy, sandy, stony or rocky estuaries, inlets and beaches, particularly intertidal mudflats and sandbanks in large marine bays.	3	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur
Hieraaetus morphnoides (Little Eagle)	V	-	Distributed throughout the Australian mainland except the most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland.	5	No	Suitable habitat present. **Risk High**: Known to occur **Further assessment required**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Ixobrychus flavicollis (Black Bittern)	V	-	Occurs below 200 m above sea level and inhabit both terrestrial and estuarine wetlands, with a preference for permanent water bodies and dense vegetation.	5	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur.
Lathamus discolor (Swift Parrot)	E	E	In NSW mostly occurs on the coast and south west slopes, occurring in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*.	6	No	No suitable habitat present. Favoured feed trees not present. Risk Low: unlikely to occur.
Limicola falcinellus (Broad-billed Sandpiper)	V	-	Migratory species. Favour estuarine mudflats, saltmarshes and reefs as feeding and roosting habitat throughout Australian distribution.	1	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur.
Lophoictinia isura (Square-tailed Kite)	V	-	Inhabits a range of dry woodlands and open forests, with a preference for timbered watercourses. This specialised hunters preys on passerine and insects in the outer foliage of tree canopies. Large hunting range of over 100 km2. Nests in forks or large horizontal limbs, generally along watercourses.	2	No	No suitable habitat present. Risk Low: unlikely to occur.

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Monarcha melanopsis (Black-faced Monarch)		M	mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical rainforest, subtropical rainforest, mesophyll thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.		No	Some suitable habitat present. Recorded during previous survey (Lesryk 2010)
Neophema chrysogaster (Orange-bellied Parrot)	CE	CE	Migrates from Tasmania to mainland in autumn to overwinter. Inhabits sheltered coastal vegetation, within 3km of the coast. Forage in coastal shrubland and herbland, with diet consisting primarily of seeds and fruits.	0	No	No suitable habitat present. Risk Low: unlikely to occur.
Neophema pulchella (Turquoise Parrot)	V	-	Inhabits the periphery of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Forage on ground for seeds, grasses and herbaceous plants. Requires tree hollows for nesting, but can utilise other hollow types if required (logs, posts).	2	No	No suitable habitat present. Risk Low: unlikely to occur.
Ninox connivens (Barking Owl)	V		Occurs throughout NSW, where it inhabits dry open sclerophyll forests and woodlands, favouring dense riparian stands of eucalypts or casuarinas along watercourses or around wetlands, where there are many large trees suitable for roosting or breeding.	2	No	Some suitable habitat present. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Ninox strenua (Powerful Owl)	V		Is endemic to eastern and south-eastern Australia, being widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains in NSW. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. They require large tracts of forest or woodland habitat but can occur in fragmented landscapes as well.	17	No	Some suitable habitat present. **Risk Medium:** could possibly occur. **Further assessment required**.
Oxyura australis (Blue-billed Duck)	V	-	Preference for deep water in large permanent wetlands and swamps with dense aquatic vegetation. This species is completely aquatic and feed on bottom of swamps.	1	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur.
Pachycephala olivacea (Olive Whistler)	V	-	Inhabits wet forests above 500 m and can move to lower altitude during winter. Nests in low forks of shrubs and forage for berries and insects in trees, shrubs and ground.	2	No	Some suitable habitat present. Risk Low: unlikely to occur
Petroica boodang (Scarlet Robin)	V	-	In NSW it occupies open forests and woodlands from the coast to the inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat.	5	No	Foraging and nesting habitat available on site. **Risk Medium:** could possibly occur. **Further assessment required.**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Petroica phoenicea (Flame Robin)	V	-	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes Nests are often near the ground and are built in sheltered sites, such as shallow cavities in trees, stumps or banks.	2	No	Some potential habitat available on site. **Risk Medium:** could possibly occur. **Further assessment required.**
Petroica rodinogaster (Pink Robin)	V	-	Inhabits rainforest and tall, open eucalypt forest with a preference for densely vegetated gullies. Forages on ground for spiders and insects. Nests in tree forks in deep undergrowth.	1	No	Some suitable habitat present. Risk Low: unlikely to occur
Polytelis anthopeplus monarchoides Regent Parrot (Eastern Subspecies)	E	V	The eastern subspecies is restricted to areas around the Murray River in South Australia, Victoria and NSW. The species nests within River Red Gum forests along the Murray, Wakool and lower Murrumbidgee Rivers, and possibly the Darling River downstream of Pooncarie.	1	No	No suitable habitat present. Risk Low: unlikely to occur.
Ptilinopus magnificus (Wompoo Fruit-Dove)	V	-	Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula. It is rare south of Coffs Harbour. Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. It used to occur in the Illawarra, though there are no recent records.	1	No	No suitable habitat present. Risk Low: unlikely to occur.

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Ptilinopus regina (Rose-crowned Fruit-Dove)	V	-	Occurs primarily in sub-tropical and dry forests, and occasionally in moist eucalypt and swamp forests. Diet consists entirely of fruit from a range of plants and the species can be locally nomadic in response to food availability and fruit ripening.	3	No	Some suitable habitat present. Risk Low: unlikely to occur
Ptilinopus superbus (Superb Fruit Dove)	V	-	Inhabits rainforests and similar closed forest at all altitudes.	2	No	Some suitable habitat present. Risk Low: unlikely to occur
Rostratula australis (Australia Painted Snipe)	E	E	Occurs in the fringes of freshwater habitats, including swamps, dams and marshes. Prefers grasses, low scrub or open timber habitats and nest on ground amongst tussocks, reeds and tall vegetation. Forages on mud flats and shallows on worms, insects and molluscs.	0	No	No suitable habitat present. Risk Low: unlikely to occur.
Sternula albifrons (Little Tern)	E	M	Exclusively coastal species requiring estuarine and coastal beaches for nesting and feeding. Prefer open habitat with access to vegetation to provide shelter for young.	3	No	No suitable habitat present. Risk Extremely Low: extremely unlikely to occur.
Tyto novaehollandiae (Masked Owl)	V	-	Occurs throughout NSW, roosting and nesting in heavy forest. Hunts over open woodland and farmland. The main requirements are tall trees with suitable hollows for nesting and roosting and adjacent areas for foraging.	4	No	Some suitable habitat present. **Risk Medium:** could possibly occur. **Further assessment required.**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Tyto tenebricosa (Sooty Owl)	V	-	Inhabits subtropical and warm temperate rainforest, and moist eucalypt forest with a well-developed mid-storey of trees or shrubs. Roost and nest sites for the species occur in gullies. Utilise hollows for nesting and prey on other hollow dependent species.	25	No	Some suitable habitat present. **Risk High:** likely to occur. **Further assessment required.**
Rhipidura rufifrons (Rufous Fantail)		M	In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests;		No	Some suitable habitat present. Recorded during previous survey (Lesryk 2010) **Risk Medium:** could possibly occur. **Further assessment required.**
Mammals						
Cercartetus nanus (Eastern Pygmy-possum)	V	-	In New South Wales the species is found in coastal areas and at higher elevation. Inhabit shrubby vegetation in a wide variety of habitats, from open heathland or shrubland to sclerophyll or rain forest. Require flowering plants and shrubs for foraging and access to hollows/nesting vegetation.	37	Yes	Some suitable habitat present. **Risk High:** highly likely to occur. **Further assessment required.**
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Require extensive cliffs and caves with adjacent higher fertility sites, particularly box gum woodlands or river/rainforest corridors. Found in sandy escarpments in the Sydney Basin. Distribution from Rockhampton in Queensland through to Ulladulla, NSW in the south.	0	No	No suitable habitat present. Risk Low: unlikely to occur.

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Dasyurus maculatus (Spotted-tailed quoll)	V	E	It is found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Uses a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	6	No	Some suitable habitat present. Risk Low: unlikely to occur
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	V	-	Occurs in moist habitats with tall trees (>20m). Roost in eucalypt hollows primarily but can utilise loose bark for roosting. Prey on small insects near the tree canopy.	5	No	Potential roosting habitat available on site. **Risk Medium:** could possibly occur. **Further assessment required.**
Isoodon obesulus obesulus (Southern Brown Bandicoot, Eastern)	E	E	NSW distribution almost exclusively restricted to coastal fringe. Habitats including heathland, shrubland, sedgeland, heathy open forest and woodland and are usually associated with infertile, sandy and well drained soils, but can be found in a range of soil types. Within these vegetation communities they typically inhabit areas of dense ground cover.	0	No	Foraging and breeding resources available on site. Risk Low unlikely to occur
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	V	-	Occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	64	No	Foraging habitat available on site. **Risk High**: likely to occur **Further assessment required**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Mormopterus norfolkensis (Eastern Freetail-bat)	V	-	Habitats preference includes dry eucalypt forest and coastal woodlands but also include riparian zones in rainforest and wet sclerophyll forest. Forages above forest canopy or forest edge and requires roosts including tree hollows.	32	No	Foraging habitat and some roosting resources available on site. **Risk Medium:** could possibly occur. **Further assessment required**.
Myotis macropus (Southern Myotis)	V	-	Found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10-15 close to water in caves, mine Shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	26	No	Some potential roosting habitat available on site. **Risk Medium**: could possibly occur. **Further assessment required.**
Petauroides volans (Greater Glider)	-	V	Occupy relatively small home ranges (1-4 ha) in tall, moist eucalypt forests and woodlands with old trees and abundant hollows	-	No	Some potential roosting habitat available on site. **Risk High**: recorded during SMEC 2015 surveys. **Further assessment required.**
Petaurus australis (Yellow-Bellied Glider)	V	-	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	5	No	Some suitable habitat present. **Risk Medium**: could possibly occur. **Further assessment required.**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Petrogale penicillata (Brush-tailed Rock Wallaby)	E	V	Habitats occupied include: loose piles of large boulders containing subterranean holes and passageways; cliffs (usually over 15 m high) with mid-level ledges and with some caves and/or ledges covered by overhangs; and isolated rock stacks, usually sheer-sided and often girdled with fallen boulders.	0	No	No suitable habitat present. Risk Low: unlikely to occur
Phascolarctos cinereus (Koala)	V	V	Inhabits a range of eucalypt forest and woodland communities. Adequate floristic diversity, availability of feed trees (primarily *Eucalyptus tereticornis* and *E. viminalis*) and presence of mature trees very important.	13	No	No suitable feed trees present. Risk Low: unlikely to occur
Potorous tridactylus (Long-nosed Potoroo	V	V	Occurs in coastal heath and dry and wet sclerophyll forests. An essential component of the habitat is dense understorey with occasional open areas. Preference for sandy loam soils. Diet consists of hypogeal fungi, roots, tubers and insects with digs in open areas.	0	No	Some suitable habitat present. Risk Low: unlikely to occur
Pseudomys novaehollandiae (New Holland Mouse)	-	V	In NSW, the New Holland Mouse is known from Royal National Park (NP) and the Kangaroo Valley; Ku-ring-gai Chase NP; and Port Stephens to Evans Head near the Queensland border. Coastal heath vegetation undergoing early to mid-successional regeneration, as a result of habitat disturbances (eg fire, mining, clearing) appears to be preferred habitat in many areas.	0	No	No suitable breeding habitat present. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	Found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Forages on fruit trees including Figs and nectar trees including Eucalypts and Melaleuca.	32	No	Some foraging habitat but no roosting camps present. **Risk Medium:** could possibly occur. **Further assessment required.**
Scoteanax rueppellii (Greater Broad-nosed Bat)	V	-	Occur in a variety of habitats including rainforest, dry and wet sclerophyll forest and eucalypt woodland. Large hollow bearing trees required for roosting.	2	No	Foraging resources and limited roosting resources available on site. **Risk Medium:** could possibly occur. **Further assessment required.**
Reptiles						
Hoplocephalus bungaroides (Broad-headed Snake)	E	V	Confined to the Sydney basin within a radius of approximately 200 km of Sydney. Preferred habitat of sandstone outcrops with woodland, open woodland and/or heath vegetation. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges and tree hollows.	26	No	Some suitable habitat present. **Risk Medium:** could possibly occur **Further assessment required**
Varanus rosenbergi (Rosenberg's Goanna)	V	-	Utilise sandstone outcrops and crevices as important shelter and over wintering habitat. Occurs in sandstone woodlands, heath and upland swamps. Also shelters in hollows, burrows and logs.	15	No	Some suitable habitat present. **Risk Medium:** could possibly occur. **Further assessment required.**

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Frogs						
Heleioporus australiacus (Giant Burrowing Frog)	V	V	Distributed through the Sydney Basin sandstone country in woodland, open woodland and heath vegetation, breeding habitat is generally soaks or pools within first or second order streams, but also 'hanging swamp' seepage lines and where small pools form from the collected water.	28	No	Habitat resources available on site. **Risk Medium:** could possibly occur **Further assessment required.**
Litoria aurea (Green and Golden Bell Frog)	E	V	Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast. It Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.)	62	No	No suitable habitat present. Risk Low: unlikely to occur
Litoria littlejohni (Littlejohn's Tree Frog)	V	V	Restricted to sandstone woodland and heath communities at mid to high altitude. It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats.	65	No	Some suitable habitat present. **Risk Medium:** could possibly occur **Further assessment required.**
Mixophyes balbus (Stuttering Frog)	E	V	Inhabits rainforest, Antarctic beech and wet sclerophyll forests. The species depends on freshwater streams and riparian vegetation for breeding and habitation, and do not inhabit disturbed riparian areas.	0	No	No suitable habitat present. Riparian areas present are disturbed. Risk Low: unlikely to occur

Scientific name (Common name)	TSC Act	EPBC Act	Habitat requirements	Number of records in locality (10 km radius)	Influenced by off-site impacts	Likelihood of occurrence
Pseudophryne australis (Red-crowned Toadlet)	V	-	Confined to the Sydney Basin and north east margin of the South Eastern highlands. Shelters under flat sandstone rocks, either resting on bare rock or damp loamy soils. They have also been found under logs on soil, beneath thick ground litter and in horizontal rock crevices near the ground.	31	No	Habitat resources available on site. **Risk Medium:** could possibly occur **Further assessment required.**
Fish						
Macquaria australasica (Macquarie Perch)	E (FM Act)	E	Found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. Occupies both river and lake habitats, especially the upper reaches of rivers and their tributaries.	-	No	No suitable habitat present. Risk Low: unlikely to occur
Maccullochella macquariensis (Trout Cod)	E	E	Endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central NSW. Found close to cover and in relatively fast currents, especially in fairly deep water close to the bank, and often congregate around large woody debris (snags).	-	No	No suitable habitat present. Risk Low: unlikely to occur
Prototroctes maraena (Australian Grayling)	V	V	Occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The species is found in fresh and brackish waters of coastal lagoons.	-	No	No suitable habitat present. Risk Low: unlikely to occur

Note: E = Endangered; CE = Critically Endangered; V = Vulnerable; P = Protected

Risk Matrix – likelihood of occurrence based on desktop and ground-truthing

	Likelihood of Occurrence based on further investigations eg on-ground						
	Descriptions	**Species not identified and suitable habitat occurs > 10 km away from the Study area**	**Species not identified but suitable habitat occurs within 1 km of the Study area**	**Species not identified and no suitable habitat occurs within the Study area**	**Species not identified but partially disturbed or degraded habitat occurs within the Study area**	**Species not identified but suitable habitat occurs within the Study area**	**Species identified and suitable habitat occurs within the Study area**
Likelihood of Occurrence - based on desktop assessments		F	E	D	C	B	A
Expected to occur during the Project or beyond the Project (ie recent records exist in high numbers)	A	M	M	H	H	H	H
Could occur during the Project or beyond the Project (ie recent records exists)	B	L	M	M	H	H	H
Possible under exceptional circumstances (ie recent records exists but low in number)	C	L	L	M	M	H	H
Unlikely to occur during the Project (ie old records but low in number)	D	L	L	L	M	M	H
Very unlikely to occur during the Project (ie only old records)	E	EL	L	L	L	M	M
Extremely rare or previously unknown to occur (ie no records)	F	EL	EL	L	L	L	M

Risk extremely Low (EL): extremely unlikely to occur	Risk Low (L): unlikely to occur	Risk Medium (M): could possibly occur	Risk High (H): Highly likely to occur/does occur

Appendix D: Section 5A EP&A Act assessments of significance

The following seven part tests associated with the assessment of significant effect on threatened species, populations or ecological communities, or their habitats have been undertaken in accordance with the requirements of Section 5A of EP&A Act.

These assessments, under Section 5A of the Act, may have been undertaken with prescribed designated mitigation measures that form part of the 'Action Proposed[1]' for the 'Development[2]'. The effect of which is that these mitigation measures become a mandatory obligation based on Consent Authority approval to proceed.

The following definitions apply to the assessment of significance:

Subject site means the area directly affected by the proposal = construction footprint.

Study area the subject site and any additional (adjoining) areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account. For the purposes of the following assessments, the study area refers to the area subject to both direct and potential indirect impacts and was thus defined as the area within approximately 50 metres of the edge of the design extent in most areas. The construction footprint and wider study area are shown in Figure 2.

Direct impacts are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.

Indirect impacts occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.

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1 Action Planned is as detailed in Section 5A of the *Environmental Planning and Assessment Act 1979*

2 'Development' has the same meaning as determined under Section 4 of the *Environmental Planning and Assessment Act 1979*

Risk of extinction: similar to the meaning set out in factor (a), this is the likelihood that the local occurrence of the ecological community will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the ecological community, and includes changes to ecological function.

Composition: both the plant and animal species present, and the physical structure of the ecological community. Note that while many ecological communities are identified primarily by their vascular plant composition, an ecological community consists of all plants and animals as defined under the TSC and FM Acts that occur in that ecological community.

Coastal Upland Swamp EEC

The following definitions apply:

Study area the subject site and any additional (adjoining) areas which are likely to be affected by the proposal, either directly or indirectly. This would include those areas of upland swamp that immediately adjoin or are proximate to the proposed construction footprint.

Local occurrence: the ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated. Hence, local occurrence is defined as those upland swamps that occur within and adjoin the proposed construction footprint.

Proposal Assumptions

The following Section 5A assessment provided is based on SMEC's understanding of the proposed scope of works. It has been assumed that all mapped upland swamp habitat situated within the construction footprint would be directly impacted by the proposal. SMEC understands that the proposed works are not anticipated to have a significant overall effect on recharge to the underlying aquifer, stream baseflow or stream water quality where the currently temporary aquifers seep into local catchments (Geoterra 2016). The upper Hawkesbury Sandstone regional aquifer is located at or deeper than 13m below surface in the Brokers Nose area, which is below the proposed excavation depth of the M1 re-alignment works. As a result, it is not anticipated that the proposed roadworks will adversely affect the regional groundwater system (Geoterra 2016).

We have also made an assumption that the upland swamps adjoining the footprint have the potential to be indirectly impacted from a series of biotic and abiotic edge effects due to their proximity to the footprint.

It is noted that substantial areas of the upland swamps adjoining the construction footprint have been mapped by NPWS (2003) as Upland Swamp - Fringing Eucalypt Woodland. During the course of our investigations, we have found that some areas mapped as Upland Swamp - Fringing Eucalypt Woodland (eg within and surrounding biobank plots SE1 and SE6) supports Upland Swamp – Tea Tree Thicket. Adjustments to the NPWS (2002)

vegetation linework were subsequently made following the completion of the flora surveys and were generally limited to those areas that were ground truthed by SMEC botanists (this being the vicinity of the Biobank plots within the study area). The need for these adjustment is not unexpected as regional vegetation mapping is always likely to yield inaccuracies relative to sites that have been subject to detailed ground truthing. Consequently, it is likely that some of this Upland Swamp - Fringing Eucalypt Woodland is actually one of the other swamp ecotypes, particularly in areas of upland swamp adjoining the proposed footprint that have not been ground truthed as part of our current investigations. Further ground truthing in these upland swamps adjoining the proposed footprint would be required to produce finer scale swamp ecotype mapping, although this is unlikely to change the overall conclusions of this assessment.

Criterion	**(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.**
Response	Not Applicable
Conclusion	Not Applicable
Criterion	**(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:**
Response	Not applicable
Conclusion	Not Applicable
Criterion	**(c) In the case of an endangered ecological community or critically 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**
Response	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,** The local occurrence of Coastal Upland Swamp EEC proximate or adjoining the footprint is 55.8 hectares according to Woronora VIS regional vegetation mapping linework (NPWS 2002). The local occurrence being the area of Coastal Upland Swamp within the project area and Coastal Upland Swamp outside the project area but contiguous with Coastal Upland Swamp in the study area. The proposal will result in the removal of 2.27 hectares of upland swamp EEC habitat within the proposed construction footprint, comprised of:

	• 0.06 hectares of Banksia Thicket; • 1.54 hectares of Tea tree Thicket; • 0.51 hectares of Sedgeland-Heath; plus • 0.16 hectares of Fringing Eucalypt Woodland Clearing of up to 2.27 hectares for the project is approximately 4.1% of the local occurrence of the EEC. The proposal would result in the retention of a total of 53.59 hectares of upland swamp EEC habitat that adjoin the construction footprint and extends beyond the study area as contiguous vegetation (local occurrence), comprising: • 28.14 hectares of Banksia Thicket; • 1.06 hectares of Tea tree Thicket; • 13.25 hectares of Sedgeland-Heath; plus • 11.14 hectares of Fringing Eucalypt Woodland. SMEC understands that the proposed works are not anticipated to have a significant overall effect on recharge to the underlying aquifer, which is located below the proposed excavation depth of the M1 re-alignment works. As a result, it is not anticipated that the proposed roadworks will adversely affect the regional groundwater system (Geoterra 2016). As such, the proposal is not expected to adversely affect the extent or composition of the upland swamp community due to hydrological changes. It is expected that the upland swamps adjoining the footprint have the potential to be indirectly impacted from a series of biotic and abiotic edge effects due to their proximity to the footprint, such as weed and pathogen invasion, rubbish dumping, erosion and sedimentation, changes to micro-climate and light regimes as well as a possible increase in risk of higher fire frequencies. With the implementation of appropriate mitigation measures, including a Site Erosion and Sediment Control Plan or Soil Water Management Plan in accordance with the Blue Book, these edge effects are not expected to affect the extent or composition of the Upland Swamp EEC to the extent such that its local occurrence is likely to be placed at risk of extinction. It is recommended that groundwater and soil chemistry monitoring (through installation of piezometers and soil sampling) be undertaken within the retained swamp habitats to determine any changes to water table levels, soil moisture and chemistry as a result of the proposal. OEH (2012) state that groundwater and soil chemistry monitoring is the quickest way to determine likely changes to the swamp habitats. OEH (2012) note that monitoring change in species composition, which is often done by the mining industry on the Woronora Plateau, typically requires decades before any changes are noticeable, relative to groundwater monitoring. An upland swamp monitoring program should be detailed in the Flora and Fauna Management Plan for the proposal and should include finer scale mapping of the swamps adjoining the proposed footprint, as these areas typically support complex mosaics of different swamp ecotypes which cannot be accurately mapped from regional vegetation mapping.
Conclusion	It is not anticipated that the proposed roadworks will adversely affect the regional groundwater system and the proposal is not expected to adversely affect the

	extent or composition of the upland swamp community due to hydrological changes such that its local occurrence is likely to be placed at risk of extinction
Criterion	**(d) In relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	Refer (c)
Criterion	**(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,**
Response	The proposal would result in the fragmentation (ie reduction in extent) of the two upland wetland swamps situated on the eastern side of the existing Mount Ousley Road and would isolate retained swamp habitat in the third, central smaller swamp similarly situated on the eastern side of the existing Mt Ousley Road.
Criterion	**(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**
Response	It is unlikely that the 3 'larger' swamps within and adjoining the proposed footprint of the proposed alignment would be classified as 'swamps of special significance' based on the following criteria prescribed in OEH (2012): • Swamps having an areal extent >7.4 hectares; • Swamps being part of defined (mapped) clusters of swamps; • Swamps having map units listed in the EEC Final Determination (ie MU42 Banksia Thicket, MU43 Tea Tree Thicket, MU44 Sedgeland-Heath); and • Swamps of unusual complexity having all three EEC-listed swamp ecotypes in the one swamp; and • Swamps subject to scientific research. OEH (2012) note that swamps of special significance typically support a variety of swamp ecotypes along a moisture gradient, from permanently wet through to fringing vegetation, providing a greater diversity of habitats for a wider variety of plants and animals. OEH (2012) note that only 10% of the swamps on the Woronora Plateau would be classified as swamps of special significance and that in a larger context, the Woronora Plateau holds the greatest concentration of upland wetland swamps on the mainland of Australia. The Woronora plateau accounts for the majority (about 83%) of known swamps in the ecological community (NSW Scientific Committee, 2012).
Conclusion	The upland wetland swamps situated within the proposed footprint that would be subject to direct impacts are not considered of special importance relative to the remaining swamps on the Woronora Plateau. SMEC understands that the proposed works are not anticipated to have a significant overall effect on recharge to the underlying aquifer. As a result, the habitat removed is not anticipated to affect the long term survival of the community in the locality.

Criterion	**(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**
Response	Not applicable. No critical habitat is listed on the register of Critical Habitat kept by the Director- General, DECCW or DPI within the study area.
Criterion	**(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**
Response	No recovery or threat abatement plans have been prepared for coastal upland wetland swamps. However, the priority actions relevant to the recovery of Coastal Upland Swamp according to OEH include: • Protect remnants from further clearing. • Prevent incursion of weeds into the community. • Retain old trees as a source of hollows. The management action statement for the Saving our Species program aims to maximise the extent of occurrence and condition of this ecological community across NSW via positive management consistent with catchment Action Plans, water management plans, and by regulating clearing.
Criterion	**(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.**
Response	The proposal will result in the removal of 2.27 hectares of vegetation that meets the determination of Coastal Upland Swamp EEC along the proposed Stage 1 footprint. The proposal would contribute to the following two Key Threatening Processes (KTPs) listed under the TSC Act: • Clearing of native vegetation • Removal of dead wood and dead trees. With the presence of a number of proposed mitigation measures, the proposal is unlikely to contribute to the additional KTPs associated with Coastal Upland Swamps: • Invasion, establishment and spread of Lantana • Infection of native plants by *Phytophthora cinnamomi* • High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition • Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family *Myrtaceae* • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
Final conclusion	Based on the above assessment, it is concluded that the proposal will result in the removal of 2.27 hectares of Coastal Upland Swamp EEC within the proposed construction footprint. The proposal would result in the fragmentation (ie reduction in extent) of the two larger upland wetland swamps situated on the eastern side

	of the existing Mt Ousley Road and would isolate retained swamp habitat in the third, central smaller swamp similarly situated on the eastern side of the existing Mt Ousley Road. It is expected that the upland swamps adjoining the footprint have the potential to be indirectly impacted from a series of biotic and abiotic edge effects due to their proximity to the footprint, such as weed and pathogen invasion, rubbish dumping, erosion and sedimentation, changes to micro-climate and light regimes as well as a possible increase in risk of higher fire frequencies. With the implementation of appropriate mitigation measures, these impacts are not expected to affect the extent or composition of the upland swamp EEC to the extent such that its local occurrence is likely to be placed at risk of extinction. An upland swamp monitoring program should be detailed in the Flora and Fauna Management Plan for the proposal. No further assessment is required.
Limitations	The swamps located within and adjoining the construction footprint form a complex mosaic of swamp ecotypes and thus the vegetation mapping linework that accompanies this assessment is considered somewhat simplified as it, for the most part, has been reliant on the regional scale Woronora VIS vegetation mapping dataset. Much finer scale mapping using differential GPS would be needed to capture the complex mosaic of swamp ecotypes within and adjoining the construction footprint.

Cryptostylis hunteriana (Leafless Tongue Orchid)

Criterion	**(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**
Response	Though not prescribed to have a well-known habitat, the Leafless Tongue Orchid is known to occur in a range of habitat types including woodland and swamp vegetation communities. Being leafless it likely depends on fungal associations to meet its nutritional needs. It produces an upright flower-stem to 45 cm tall, bearing five to 10 flowers between November and February. There are no records of sightings within the vicinity (AVH 2015). The Scribbly gum woodland in the Study area may provide potential habitat for this species. The proposal will result in the removal of up to 8.5 hectares of scribbly gum woodland habitat: This species was not found in the study area during targeted field surveys carried out in November 2014.
Conclusion	Given that no individuals of these species will be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of these species.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	The species does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland (OEH 2014). Extensive areas of known and potential habitat for these species occur in the region (>10,000 ha of woodland and swamp vegetation). About 8.5 hectares of potential habitat will be removed as part of the proposal; however, no individuals were identified during targeted survey within the study area.

Conclusion	A small area of potential habitat will be removed as a result of the proposed action.
Criterion	**(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**
Response	Potential habitat for this species has been identified in the study area, however no individuals were identified during detailed targeted survey. Clearing or disturbance of potential habitat, up to 8.5 ha of scribbly gum woodland, may be required in vegetated areas. The proposed activity will marginally increase the distance between remaining potential habitat areas on either side of the M1 Princes Motorway.
Conclusion	The proposed activity will marginally increase the distance between remaining habitat areas.
Criterion	**(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.**
Response	Other extensive areas of good condition potential habitat (>10,000 ha) for these species occur in the locality. Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey. The proposal will remove about 8.5 ha of potential scribbly gum woodland habitat for the species.
Conclusion	It is unlikely the habitat to be removed is important to the long-term survival of the Leafless Tongue Orchid.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	No critical habitat has been declared for this species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	No recovery plan has been developed for Leafless Tongue Orchid, three activities have been identified to aid its recovery, including: Co-operatively develop (local governments and OEH) guidelines for survey and assessment, to be followed by developers, consultants and approval authorities. Alert road maintenance staff to the presence of this species. Monitor populations to determine the most appropriate timing and frequency of burning.
Conclusion	The proposed activity is not inconsistent with these priority actions.
Criterion	**(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.**
Response	Potential habitat removal is permanent, yet no individuals or populations have been identified. The proposed action constitutes the Key Threatening Process ‘Clearing of native vegetation”.

Conclusion	The proposed activity involves clearing of about up to 8.5 hectares of remnant native vegetation of which there is potential habitat for this species constituting the KTP 'Clearing of native vegetation'.

Overall Conclusion

No individual species were identified during survey and targeted searches for threatened flora. While the proposed activity will permanently remove approximately 28.3 ha of remnant native vegetation that includes areas 8.5 hectares of potential habitat, the species is not considered to be present nor affected.

No further assessment is required.

Shrubs: Acacia bynoeana (Bynoe's Wattle), Epacris purpurascens var. purpurascens, Grevillea parviflora subsp. parviflora (Small-flower Grevillea), Pultenaea aristata (Prickly Bush-pea).

Reason for grouping: similar habitat requirements

Criterion	**(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**
Response	The study area contains sclerophyll forest and woodland communities that provide potential habitat for these species. Removal of vegetation and habitat is permanent. *Acacia bynoeana* prefers an open habitat particularly disturbed sites including trail margins, edges of roadsides and power easements, which are present within the study area. *Epacris purpurascens var. purpurascens* is found in a range of habitats. It is more likely to be found in the Sydney Catchment areas within the study area and areas with a strong shale influence, rather than the plateaux or escarpment areas, the nearest record is from Picton Road near Corrimal Colliery. *Grevillea parviflora* subsp*. parviflora* grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. It is not considered likely to occur as it does not have suitable habitat within the study area. *Pultenaea aristata* has potential habitat within all 4 upland swamp community variants within the study area. There are a number of local records for the Woronora Plateau and was recorded as part of the Russell Vale Mine expansion investigations (ERM 2013). It is found to occur in the driver fringing habitat of the upland swamp vegetation. Approximately 2.27 ha of potential habitat will be removed None of these species were identified during field surveys and targeted searches undertaken in November 2014.
Conclusion	The project will result in the removal of up to 28.3 ha of vegetation including potential habitat for some of these species. Given that no individuals of these species will be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of these species.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.

Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	Other areas of known and potential habitat for these species occur in the region (>10,000 ha). The proposed activity will remove up to 28.3 hectares of potential habitat for these species, however no populations or individuals of these species have been recorded on the site.
Conclusion	The proposed action will result in removal of a small area of potential habitat for these species.
Criterion	**(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**
Response	Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey. Clearing or disturbance of potential habitat, up to 28.3 ha, may be required in vegetated areas along the road verge. The proposed activity will marginally increase the distance between remaining potential habitat areas.
Conclusion	The proposed activity will marginally increase the distance between remaining potential habitat areas on either side of the M1 Princes Motorway.
Criterion	**(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.**
Response	Other areas of good quality known and potential habitat for these species occur in the locality (>10,000 ha). Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey. About 28.3 ha of good condition potential habitat will be removed along the existing M1 Princes Motorway.
Conclusion	Given that no individuals of these species are present on site and the extensive areas of potential habitat in the locality, it is unlikely the potential habitat to be removed is important to the long-term survival of these species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	No critical habitat has been declared for any of these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	No recovery plan has been developed for *Acacia bynoeana* (Bynoe's Wattle), nine actions have been identified to aid its recovery, including:

	• Control threatening weeds where necessary. • Investigate appropriate fire regime for the species. • Alert road and track maintenance staff to the presence of a threatened species. • No recovery plan has been developed for *Epacris purpurascens var. purpurascens*, but six (6) priority actions have been identified, including: • Understanding the relationship with fire (interval and intensity). • Weed removal, limiting plant pathogens and bush regeneration. No recovery plan has been developed for *Grevillea parviflora* subsp*. parviflora* (Small-flower Grevillea), but eight activities have been identified to assist in its recovery, including: • Ensure that personnel planning and undertaking road maintenance are able to identify the species and are aware of its habitat. • Ensure that this species is considered in all planning matters on land that contains or may contain populations. • Conduct searches in potential habitat for new populations. No recovery plan has been developed for *Pultenaea aristata* (Prickly Bush-pea), but three activities have been identified to assist in its recovery: • Erect on-site markers to alert road maintenance staff to the presence of this species. • Conduct further surveys in an effort to locate more individuals. • Mark Prickly Bush-pea sites and potential habitat onto maps used for planning road maintenance work.
Conclusion	The proposed action will result in the clearing of up to 28.3 hectares of potential habitat. The proposed action is not inconsistent with the other identified recovery activities.
Criterion	**(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.**
Response	Potential habitat removal is permanent, yet no individuals or populations have been identified. The proposed action constitutes the Key Threatening Process 'Clearing of native vegetation'.
Conclusion	The proposed action involves clearing of 28.3 ha of native vegetation that is potential habitat for these species and constitutes the Key Threatening Process 'Clearing of native vegetation'.

Overall Conclusion

No individual species were identified during survey and targeted searches for threatened flora. While the proposed activity will permanently remove approximately 28.3 ha of native vegetation that identifies as potential habitat, these species are not considered to be present nor affected.

No further assessment is required.

Daphnandra johnsonii (Illawarra Socketwood).

Criterion	**(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**
Response	*Daphnandra johnsonii* is a rainforest tree restricted to the Illawarra region which occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. The study area contains moist eucalypt forest and rainforest communities that provide potential habitat for these species. Removal of vegetation and habitat is permanent. About 3.7 ha of potential habitat (Coachwood Warm Temperate rainforest) will be removed as part of the proposal. However the habitat is considered marginal as the species occurs mainly in the lowlands rather than higher in the escarpment. No individuals of this species was identified during field surveys and targeted searches.
Conclusion	Given that no individuals of these species will be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of this species.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	Other areas of known and potential habitat for this species occur in the region (about 2,000 ha). The proposed activity will remove about 3.7 ha of potential habitat for this species; however, no populations or individuals of these species have been recorded on the site.

	The habitat is considered marginal as the species occurs mainly in the lowlands rather than higher in the escarpment.
Conclusion	The proposed action will result in clearing of about 3.7 ha of marginal habitat for the species.
Criterion	**(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**
Response	Potential habitat for this species has been identified in the study area, however no individuals were identified during detailed targeted survey. Clearing or disturbance of potential habitat, up to 3.7 ha, may be required in vegetated areas along the road verge. The proposed activity will marginally increase the distance between remaining potential habitat areas.
Conclusion	The proposed activity will marginally increase the distance between remaining potential habitat areas on either side of the M1 Princes Motorway.
Criterion	**(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.**
Response	Other areas of known and potential habitat for this species occur in the locality (about 2000 ha). Potential habitat for this species has been identified in the study area, however it is considered marginal as the species occurs mainly in the lowlands rather than higher in the escarpment. No individuals were identified during detailed targeted survey.
Conclusion	Given that no individuals of these species are present on site and the extensive areas of potential habitat in the locality, it is unlikely the potential habitat to be removed is important to the long-term survival of this species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	No critical habitat has been declared for this species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	A recovery plan has been developed for the Illawarra Socketwood (January 2005) and 25 priority actions have been identified to aid in its recovery, including: Councils and the Department of Planning will assess developments and activities with reference to this recovery plan, environmental impact assessment guidelines and any future advice from the OEH regarding the distribution, threats, biology and ecology of the species. The OEH will undertake surveys to determine the status and extent of sites located on freehold land. Public authorities will inform the OEH of decisions that may affect the species, in accordance with statutory requirements.
Conclusion	About 3.7 hectares of marginal habitat will be removed as part of the proposal.
Criterion	**(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.**

Response	Potential habitat removal is permanent, yet no individuals or populations have been identified. The proposed action constitutes the Key Threatening Process 'Clearing of native vegetation'.
Conclusion	The proposed action involves clearing of about 3.7 hectares of native vegetation that is potential habitat for this species and constitutes the Key Threatening Process 'Clearing of native vegetation'.

Overall Conclusion

No individual species were identified during survey and targeted searches for threatened flora. While the proposed activity will permanently remove approximately 28.3 ha of remnant vegetation, 3.7 ha of which is potential habitat, the species is not considered to be present nor affected.

No further assessment is required.

Endangered Population: Pomaderris adnata (Sublime Point Pomaderris).

Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(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**
Response	Known only from one site at Sublime Point, north of Wollongong, This species occurs near the edge of the plateau behind the Illawarra escarpment. It is associated with *Eucalyptus sieberi* (Silver-top Ash) - *Corymbia gummifera* (Red Bloodwood) forest with occasional *Hakea salicifolia* (Willow-leaved Hakea). About 1.6 ha of potential habitat (Escarpment edge Silvertop Ash Forest) will be cleared as part of the proposal. Removal of vegetation and habitat is permanent. The known endangered population is not located within the study area. No individuals of this species were identified during field surveys and targeted searches carried out in November 2014.
Conclusion	Given that no individuals of this species will be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of this species that constitutes the endangered population.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	Other areas of potential habitat for this species occur in the region (>10,000 ha). The proposed activity will remove about 1.6 ha of potential habitat for this species, however no populations or individuals of this species have been recorded in the study area.

Conclusion	The proposed action will result in clearing of about 1.6 ha of potential habitat for the species.
Criterion	**(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**
Response	Potential habitat for this species has been identified in the study area, however no individuals were identified during detailed targeted survey. The proposed action will result in clearing of about 1.6 ha of potential habitat for the species. The proposed activity will marginally increase the distance between remaining potential habitat areas.
Conclusion	The proposed activity will marginally increase the distance between remaining potential habitat areas on either side of the M1 Princes Motorway.
Criterion	**(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.**
Response	Other areas of good condition known and potential habitat for this species occur in the locality (>10,000 ha). About 1.6 ha of potential habitat will be affected by the proposal. The known endangered population is not located within the study area. Potential habitat for this species has been identified in the study area, however no individuals were identified during detailed targeted survey.
Conclusion	Given that no individuals of these species are present on site and the extensive areas of potential habitat in the locality, it is unlikely the potential habitat to be removed is important to the long-term survival of these species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	No critical habitat has been declared for this species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	No recovery plan has been developed for Sublime Point Pomaderris, but four activities have been identified to aid in recovery of the endangered population, including: • Support and provide information to land managers and road maintenance staff regarding appropriate management. • Determine and apply an appropriate fire regime. • Install barrier to prevent vehicular access to site. • Undertake weed removal where required.
Conclusion	No individuals or populations have been identified on the site. The objectives of recovery or threat abatement plans/or priority actions identified are not applicable.
Criterion	**(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.**
Response	Potential habitat removal is permanent, yet no individuals or populations have been identified. The proposed action constitutes the Key Threatening Process 'Clearing of native vegetation'.

Conclusion	The proposed action involves clearing of about 28.3 ha of native vegetation and constitutes the Key Threatening Process 'Clearing of native vegetation'.

Overall Conclusion

No individual species were identified during survey and targeted searches for threatened flora. While the proposed activity will permanently remove approximately 28.3 ha of remnant vegetation, 1.6 ha of which that has been identified as potential habitat, the species is not considered to be present nor affected.

No further assessment is required.

Calyptorhynchus lathami (Glossy Black-cockatoo)

Criterion	**(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**
Response	The Glossy Black-cockatoo is listed as 'Vulnerable' under the TSC Act. This species is dependent upon tree hollows for nesting and incubation of eggs. They feed almost exclusively on *Allocasuarina* and *Casuarina* species. This species is locally nomadic, moving to suitable nesting and feeding areas and gregarious groups of 10 or more individuals.
Conclusion	Despite extensive bird surveys, this species was not detected within the study area. Due to the species' habitat requirements it is unlikely that a local viable population would persist within the study area. As such it is unlikely the actions proposed will place a local population at risk of extinction.
Criterion	**(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**
Response	Not applicable
Conclusion	Not applicable
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable
Conclusion	Not applicable
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable
Conclusion	Not applicable
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	The preferred feed tree of this species, *Allocasuarina littoralis* (Black She-oak) is present on site in low numbers. Approximately 1.6 ha of Escarpment edge Silvertop Ash forest which includes *Allocasuarina* sp. would be removed by the proposed action.
Conclusion	A small portion of cockatoo feeding habitat would be removed by the proposed action.
Criterion	**(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**

Response	The study area is connected to a wildlife corridor with potential habitat for this cockatoo species. This species is highly mobile and nomadic, and capable of moving across the study area and beyond in search of suitable feeding/nesting habitat.
Conclusion	The relatively minor degree of clearing associated with the project is unlikely to cause Glossy Black-cockatoo habitat to become fragmented or isolated as a result of the proposed action.
Criterion	**(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.**
Response	The proposal will include the removal of selected large hollow-bearing trees. The number likely to be removed relative to alternative habitat in the local area indicates that the affected habitat would not be vital to the long term survival of the species in the locality.
Conclusion	The habitat to be removed is unlikely to be important to the long-term survival of a local population of this species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for either of these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	A recovery plan has not been prepared for the Glossy Black-cockatoo. However priority actions have been developed to abate threats, including increasing public awareness and further research into these species' ecology.
Conclusion	The proposed action is not inconsistent with the threat abatement strategies for this species.
Criterion	**(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.**
Response	Native species constitute more than 70% of vegetation cover within the study area. Key threatening processes highlighted as having a negative effect on this species are: • Clearing of native vegetation • Loss of hollow-bearing trees
Conclusion	The proposed action constitutes the key threatening processes 'Clearing of native vegetation' and 'Loss of hollow-bearing trees'.

Overall Conclusion

Given the study area contains sub-optimal nesting habitat, only a small amount of suitable feeding habitat and this species has not been detected on site, it is unlikely that that the area is important habitat for the Glossy Black-cockatoo. However, mitigation strategies will ensure any potential impact will be reduced.

No further assessment is required.

Woodland/forest birds: Daphoenositta chrysoptera (Varied Sittella), Glossopsitta pusilla (Little Lorikeet), Petroica boodang (Scarlet Robin), Petroica phoenicea* (Flame Robin), *Callocephalon fimbriatum (Gang-gang Cockatoo).

Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. These species are highly mobile and capable of dispersing over a wide area.
Conclusion	It is unlikely that the action proposed will have an adverse effect on any of these species such that any potential viable local population would be placed at risk of extinction.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance.

Conclusion	A narrow linear strip of habitat will be removed or modified as a result of the proposal.
Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. These species are highly mobile and capable of dispersing over a wide area. Large areas of high quality potential habitat occur immediately adjacent to the study area.
Conclusion	It is unlikely that the proposed actions will result in the fragmentation or isolation of woodland bird habitat.
Criterion	**(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.**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. These species are highly mobile and capable of dispersing over a wide area. The Little Lorikeet and the Gang-gang Cockatoo require hollow-bearing trees for nesting. The Scarlet Robin requires abundant logs and coarse woody debris as part of its habitat. Mitigation measures include the retention of hollow bearing trees throughout the study area where possible as well as the retention of logs.
Conclusion	The habitat to be removed is unlikely to be important to the long term survival of these three bird species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	No recovery plan has been developed for these species, however recovery strategies recommended by OEH which may be relevant to the proposal include: • Encourage retention of hollow-bearing threes and old-growth Eucalypts. • Encourage retention of canopy cover, shrub cover, native ground cover, logs, fallen branches and leaf litter. • These recovery actions can be achieved through: • The retention of hollow bearing trees throughout the study area where possible. • The retention of bush rock and logs.
Conclusion	With the implementation of the above mitigation measures, the proposal is consisted with recovery strategies set by OEH.

Criterion	**(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.**
Response	The following are key threatening processes which may be relevant to the proposal: • Loss of hollow-bearing trees • Clearing of native vegetation.
Conclusion	The proposed action constitutes the Key Threatening Process 'Clearing of native vegetation'.

Overall Conclusion

Due to the mobile nature of these woodland birds and extensive high quality habitat adjacent the study area, should trees with hollows and bushrock be retained where possible, it is unlikely that the proposed actions will negatively impact any of these species to the extent they will be placed at risk of localised extinction.

No further assessment is required.

Hieraaetus morphnoides *(Little Eagle)*

Criterion	**(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**
Response	The Little Eagle is distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. At least 5 isolated records exist within the locality. No nesting sites were recorded during field surveys. The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance
Conclusion	It is unlikely that the action proposed will have an adverse effect on any of these species such that any potential viable local population would be placed at risk of extinction.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**

Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland.
Conclusion	A narrow linear strip of habitat will be removed or modified as a result of the proposal.
Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance These species are highly mobile and capable of dispersing over a wide area. Large areas of high quality potential habitat occur immediately adjacent to the study area.
Conclusion	It is unlikely that the proposed actions will result in the fragmentation or isolation of Little Eagle habitat
Criterion	**(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.**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance These species are found throughout the Australian mainland except the most densly forested parts of the Dividing Range escarpment. Important habitat occurs on the NSW tablelands and western slopes. They are highly mobile and capable of dispersing over a wide area.
Conclusion	The habitat to be removed is unlikely to be important to the long term survival of Little Eagle species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	No recovery plan has been developed for this species: The Species Action statement includes management at the landscape scale rather than at distinct locations and recommends Protection and maintainance of high quality habitat, Improvement of prey availability through restoration of degraded remnants, particularly riparian areas. Nesting sites may also require specific management.

Conclusion	With the implementation of the mitigation measures including retention of hollow bearing trees, the proposed action is not inconsistent with the threat abatement strategies for this species.
Criterion	**(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.**
Response	The main threats to the Little Eagle are inferred to be clearing and degradation of its foraging and breeding habitat. Secondary poisoning from pindone used to control rabbits is listed as a possible threat. 'Clearing of native vegetation' is listed as a Key Threatening Process in NSW under the Threatened Species Conservation Act 1995. The following Key Threatening Process may be relevant to the proposal: • Loss of hollow-bearing trees • Clearing of native vegetation.
Conclusion	The proposed action constitutes the Key Threatening Process 'Clearing of native vegetation'.

Overall Conclusion

Due to the mobile nature of this species and extensive high quality habitat adjacent the study area, should trees with hollows be retained where possible, it is unlikely that the proposed actions will negatively impact any of these species to the extent they will be placed at risk of localised extinction.

No further assessment is required.

Forest owls: Ninox strenua (Powerful Owl), Tyto novaehollandiae (Masked Owl) and Tyto tenebricosa (Sooty Owl).

Criterion	**(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**
Response	The proposal will result in the removal of a narrow linear strip of vegetation adjacent to a highway; part of which has been disturbed for infrastructure such as access tracks and easement maintenance. These species are highly mobile and occupy large home ranges; 300-1500 ha for the Powerful Owl, 400-1000 ha for the Masked Owl and 200-800 ha for the Sooty Owl.
Conclusion	It is unlikely that the action proposed will have an adverse effect on any of these species such that any potential viable local population would be placed at risk of extinction.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. This habitat may lie within the home range of the forest owls and be utilised for hunting on occasion.

Conclusion	A narrow linear strip of habitat will be removed or modified as a result of the proposal.
Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas). These species are highly mobile and occupy large home ranges, often in fragmented landscapes. Large areas of high quality potential habitat occur immediately adjacent to the study area.
Conclusion	It is unlikely that the proposed actions will result in the fragmentation or isolation of forest owl habitat.
Criterion	**(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.**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas). These species are highly mobile and occupy large home ranges. Forest owls require hollow-bearing trees for nesting. Mitigation measures include the retention of hollow bearing trees throughout the study area where possible.
Conclusion	The habitat to be removed is unlikely to be important to the long term survival of these three species of forest owl.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	A recovery plan for the large forest owls, including the Powerful Owl, has been developed by DEC (2006). The recovery plan recommends: • Minimisation of vegetation removal to protect potential foraging habitat (including ground, understorey, logs and trees) • Retention of habitat (hollow bearing) trees • Protection of wildlife corridors and forest at a landscape level • Exclusion zones around known nest and roost sites.
Conclusion	With the implementation of the above mitigation measures, the proposal is consisted with recovery strategies set by OEH.
Criterion	**(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.**
Response	The following are key threatening processes which may be relevant to the proposal: • Clearing of native vegetation • Loss of hollow-bearing trees

Conclusion	The proposed action constitutes the Key Threatening Processes 'Clearing of native vegetation' and 'Loss of hollow-bearing trees'.

Overall Conclusion

Due to the mobile nature of these forest owls and extensive high quality habitat adjacent the study area, should trees with hollows be retained where possible, it is unlikely that the proposed actions will negatively impact any of these species to the extent they will be placed at risk of localised extinction.

No further assessment is required.

***Microbats: Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Mormopterus norfolkensis* (East-coast Free-tailed bat), *Myotis macropus* (Southern Myotis), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Scoteanax rueppellii* (Greater Broad-nosed Bat).**

Criterion	**(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**
Response	The Southern Myotis generally roost in close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. Caves are the primary roosting habitat for the Eastern Bentwing Bat, but it also use derelict mines, storm-water tunnels, buildings and other man-made structures. The Eastern Freetail Bat and Eastern False Pipistrelle and Greater Broad-nosed Bat roost in tree hollows. The study area contains some roosting and foraging habitat for these species. There are extensive areas of high quality habitat adjacent the study area and within the region.
Conclusion	The proposed actions are unlikely to have an adverse effect on the life cycle of these species such that a viable local population is placed at risk of extinction.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**

Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance This vegetation provides some suitable foraging and roosting habitat for these microbat species.
Conclusion	The actions proposed will result in a limited amount of microbat habitat to be removed.
Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. These species are highly mobile and capable of dispersing large distances.
Conclusion	It is highly unlikely the microbat habitat will become fragmented or isolated as a result of the proposed actions.
Criterion	**(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.**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. There will be some loss of foraging habitat for these species, but the sections of study area to be impacted are unlikely to provide significant foraging or roosting habitat for these bats given the presence of extensive areas of high quality foraging and roosting habitat adjacent to the study area. The Southern Myotis generally roost in close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. Caves are the primary roosting habitat for the Eastern Bentwing Bat, but it also uses derelict mines, storm-water tunnels, buildings and other man-made structures. These species have a range of roosting options which are not present in the study area.
Conclusion	It is unlikely the habitat to be modified or removed is important to the long-term survival of any of these bat species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for any of the five microbat species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	To date, no recovery plan has been developed for any of these species. However, the following threats have been identified for these species by OEH: Loss of food resources and indirect poisoning of individuals due to application of pesticides/ insecticides in or adjacent to foraging areas; and Loss of foraging habitat.

	Additionally, the following threats have been identified by OEH which are relevant to *Myotis macropus*: Reduction in stream water quality affecting food resources. Loss or disturbance of roosting sites. Clearing adjacent to foraging areas (ie riparian vegetation). OEH has identified the following actions to help recover the species from the above threats: Minimise the use of pesticides in foraging areas. Minimise pollution of waterways through pesticide/ herbicide leakage, run-off and thermal pollution. Promote roosting habitat in new artificial structures. Encourage recovery of natural hydrological regimes, including retention and rehabilitation of riparian vegetation.
Conclusion	There will be a small amount of disturbance to foraging and potential roosting habitats. Should appropriate mitigation measures be adopted, the proposal is considered to be consistent with recovery activities for these species.
Criterion	**(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**
Response	The following are key threatening processes which may be relevant to the proposal: Clearing of native vegetation. Loss of hollow-bearing trees. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
Conclusion	The proposed action constitutes the Key Threatening Process 'Clearing of native vegetation'.

Overall Conclusion

While the proposed works may impact on some potential foraging habitat, the small area of disturbance and the extensive areas of high quality habitat located nearby will ensure there is unlikely to be a significant impact on these species.

No further assessment is required.

Species: Eastern Pygmy-Possum (Cercartetus nanus)

Assessment Guidelines and Definitions

A Section 5A Assessment under the EP&A Act is provided below for the TSC-listed Eastern Pygmy-Possum (*Cercartetus nanus*) in relation to the Mt Ousley realignment proposal. The species is listed as 'Vulnerable' under the NSW *Threatened Species Conservation Act* 1995 (TSC Act).

The Section 5A Assessment has been prepared in accordance with the Assessment of Significance Guidelines (DECC 2007) which provide the following definitions for use in the assessment of significance:

Subject site means the area directly affected by the proposal (= proposed construction footprint).

Direct impacts are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.

Indirect impacts occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include habitat fragmentation, loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.

Life cycle: the series or stages of reproduction, growth, development, ageing and death of an organism.

Viable: the capacity to successfully complete each stage of the life cycle under normal conditions.

Local population: the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.

The local population of the Eastern Pygmy-possum is thus considered to be its occurrence or potential occurrence within its preferred habitats within and adjoining the proposed construction footprint.

The *local population* of *resident fauna* species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. In

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

Risk of extinction: the likelihood that the local population will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the viability of that population.

Eastern Pygmy-possum Ecology Summary

The following ecology summary of the Eastern Pygmy-possum has generally been taken from the OEH Threatened Species profile with supplementary edits drawn from the existing literature, SMEC's in house fauna ecologists who have particular expertise on the species and from discussions with Wollongong Council's biodiversity specialist, Brett Morrissey. Literature that has been drawn upon for this assessment includes Tulloch and Dickman (2006), Ward (1990), Bladon, Dickman and Hume (2002) and Harris and Goldingay (2005).

Description

Eastern Pygmy-possums are tiny (15 to 43 grams) active climbers, with almost bare, prehensile (capable of curling and gripping) tails, and big, forward-pointing ears. They are light-brown above and white below. Adults have a head and body length between 70-110 mm and a tail length between 75-105 mm.

Distribution

The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes.

Habitat and ecology

The preferred habitats of the species on the Illawarra include the Banksia and Proteaceae-rich upland swamps and Scribbly Gum heathy Woodlands which would provide suitable foraging resources (eg concentration of *Banksia* spp.) as well as *Eucalyptus* spp. and *Xanthorrhoea* spp. for sheltering and breeding. The species typically shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of Xanthorrhoea skirts.

Nest-building appears to be restricted to breeding females. Tree hollows are favoured for nesting but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Young can be born whenever food sources are available, however most births occur between summer and to early winter. The number of pouch young is reported to be around 3-5.

The species is predominantly nocturnal, mainly solitary, with males having non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares (although some of the literature indicates considerably smaller home range areas). The species frequently

spends time in torpor especially in winter, with body curled, ears folded and internal temperature close to the surroundings.

The literature suggests a combination of nest box installation and trapping in concert with the onset of the banksia flowering season (autumn/early winter) to increase the likelihood of species detection as part of a survey program.

Proposal Assumptions

The fauna habitat assessment conducted as part of baseline fauna surveys by SMEC in October 2015 identified preferred Eastern Pygmy-possum habitat within and adjoining the proposed construction footprint (Figure 10). The Bionet wildlife atlas also shows several records of the species proximate to the proposed footprint along Picton Road just south of the study area, including 1 record within the upland swamps immediately downstream of the proposed footprint on the eastern side of the road alignment. Sub-populations of the species are also well known in general within the Royal and Heathcote National Parks, the Illawarra escarpment and in Barren Grounds Nature Reserve at Wollongong.

Surveys targeting the TSC-listed Eastern Pygmy-possum have been undertaken as part of the current proposal investigations by SMEC. These were conducted during April and May 2016 (see section 2.3.3 for details). One capture of a sub-adult occurred on the eastern boundary of the proposed clearing footprint that is likely to represent the most westerly boundary of wider existing viable population to the east of the proposed works where higher quality habitat is mapped (NPWS, 2002).

The following Section 5A assessment provided is based on SMEC's understanding of the proposed scope of works. It has been assumed that all mapped Eastern Pygmy-possum preferred habitat situated within the proposed construction footprint would be directly impacted by the proposal (ie removed).

Criterion	**(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.**
Response	The proposal will result in the removal of 8.7 hectares of preferred Pygmy-possum habitat within the proposed construction footprint, comprised of: • 8.5 hectares of Scribbly Gum heathy Woodlands; • 0.16 hectares of Upland Swamp-Fringing Eucalypt Woodland; and • 0.06 hectares of Upland Swamp-Banksia Thicket. The proposal will result in the removal of approximately 70 hollow bearing trees recorded within Eastern Pygmy-possum preferred habitats (within the proposed footprint) based on results from the hollow bearing tree survey undertaken by SMEC. It is likely that a portion of these 70 trees would represent suitable denning habitat for the species and thus the proposal would result in a loss of such habitat for the species. Hollow-bearing trees outside the construction footprint have not been assessed, so it is not known what proportion of potential den trees within the study area would be removed. The local population of the Eastern Pygmy-possum is considered to be its occurrence and potential occurrence within its preferred habitats within and

	adjoining the proposed construction footprint. In this case, the preferred habitat extends beyond the study area as contiguous vegetation (Figure 10) comprising: • 48.9 hectares of Scribbly Gum heathy Woodland; • 28.2 hectares of Upland Swamp-Banksia Thicket; and • 12.6 hectares of Upland Swamp-Fringing Eucalypt Woodland. One capture of Eastern Pygmy-possum was recorded by SMEC during the April 2016 survey on the eastern boundary of the proposed clearing footprint (Figure 10). The presence of this individual indicates either a low density breeding population is present in the study area or the individual has dispersed into the study area either from the east or the west, where higher quality habitat to that found in the study area is present. The preferred habitat of the local population is mapped in the Wollongong Bioregional Assessment (NPWS, 2002) and shows the areas of preferred habitat for the local population of Eastern Pygmy-possum occurs away from the construction footprint. This is highlighted by the records (Bionet wildlife Atlas record) of Eastern Pygmy-possums within the retained habitat immediately downstream of the proposed footprint to the east of the SMEC capture. The proposal would result in the retention of all remaining preferred Pygmy-possum habitat for the above defined local population that adjoins the proposed construction footprint including habitat extending beyond the study area. The proposal will have the potential to indirectly impact areas of preferred Pygmy-possum habitat that immediately adjoin the construction footprint which may lead to a degradation of its preferred habitats through: • Weed and pathogen invasion, rubbish dumping, erosion and sedimentation, change in soil chemistry and human trampling within similarly corresponding reductions in the quality of foraging and breeding habitats available; and • Other abiotic effects such as changes to micro-climate and light regimes as well as a possible increase in risk of higher fire frequencies which may impact on the Proteaceae-rich understorey which the species relies on for foraging. • Other indirect impacts to the preferred habitats of the species that adjoin the proposed footprint include the further contribution to barriers to the east-west movement between sub-populations (including male dispersal) which can increase the risk of local extinctions, fragmentation and isolation of retained preferred habitats adjoining the proposed footprint and a possible increased risk to predation from foxes and cats, particularly during construction activity. Mitigation measures have been proposed to be implemented that will reduce the risk of indirect impacts occurring as a result of construction or operation phases of the proposal. Given that extensive higher quality habitat is present to the east of the study area with the incorporation of recommended mitigation measures into the project design including fauna connectivity strategy, nest box installation and mitigation monitoring would likely minimise the impacts to this species as a result of the proposal such that the viable local population will not be placed at risk of extinction.
Criterion	**(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:**
Response	Not applicable

Conclusion	Not applicable
Criterion	**(c) In the case of an endangered ecological community or critically 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**
Response	Not applicable
Conclusion	Not applicable
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community**
Response	Not applicable
Conclusion	Not applicable
Criterion	**(d) In relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	Refer (a)
Conclusion	Refer (a)
Criterion	**(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,**
Response	The proposal would result in the fragmentation (ie reduction in areal extent) and isolation of the preferred habitat mapped within and adjoining the proposed footprint. Bladon, Dickman and Hume (2002), in their study of habitat fragmentation effects on the species in northern NSW, found that even modest preferred habitat clearing resulted in markedly reduced eastern Pygmy-possum capture rates (in traps), population sizes and juvenile/sub adult recruitment (into an existing population).
Criterion	**(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**
Response	The preferred habitats within and adjoining the proposed footprint are isolated from other preferred habitat areas on the plateau and thus, as discussed in question (a), the life cycle characteristics of the species are such that a local (sub) population, should it be present, would be heavily reliant on these habitats for their survival. Therefore, the habitat to be removed and fragmented is of high importance to the local population.
Criterion	**(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**
Response	Not applicable. No critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH within the study area.
Criterion	**(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**
Response	No recovery or threat abatement plans have been prepared for the eastern Pygmy-possum.
Criterion	**(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.**

Response	The proposal will result in the removal of 8.7 hectares of preferred Eastern Pygmy-possum habitat located within the proposed footprint. An additional 90 ha of high quality habitat may be placed at risk of disruption through weed invasion, human interaction and edge effects. The proposal would contribute to the following two Key Threatening Processes (KTPs) listed under the TSC Act: • Clearing of native vegetation • Removal of dead wood and dead trees. • Loss of hollow-bearing trees. Through standard Roads and Maritime construction practices, it is unlikely that the proposal will contribute to the following additional KTPs: • Invasion, establishment and spread of Lantana • Infection of native plants by Phytophthora cinnamomi • High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition • Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
Conclusion	Based on the above assessment, it is concluded that the proposal will result in the removal of 8.7 hectares of Eastern Pygmy-possum habitat within the proposed construction footprint. Results of targeted Eastern Pygmy-possum surveys found the presence of one sub-adult individual indicating either a low density population within the study area or the westerly most extent of a wider, viable local population that exists in higher quality habitat that was mapped as part of the Wollongong Bioregional Assessment (NPWS, 2002) and as shown in Figure 10. The proposal may result in some fragmentation (ie reduction in extent) of the existing viable population. However, with the implementation of appropriate mitigation measures to prevent reduction of quality of surrounding habitat through weed invasion and edge effects, measures to improve fauna connectivity in the area, access management and the replacement of lost habitat through nest box installation, these impacts are not expected to affect the extent or composition of the existing Eastern Pygmy-possum population to the extent such that its local occurrence is likely to be placed at risk of extinction. A fauna connectivity strategy and nest box strategy that includes a monitoring program for each strategy should be detailed as sub-plans within the Construction Flora and Fauna Management Plan for the proposal. No further assessment is required.

Species: *Petaurus australis* (Yellow-Bellied Glider)

Criterion	**(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**
Response	The Yellow-bellied Gider is listed as 'Vulnerable' under the TSC Act. This species inhabit hollow-bearing trees as den sites and live in a small family unit. They require sap produce trees, winter flowering eucalypts and mature den trees. Breeding occurs between May and September, with young remaining in the pouch for 100 days and the nest for an additional 60 days. There are 5 records of Yellow bellied Gliders in the locality, from Brokers Nose, Mt Ousley road, and Picton Road Cordeaux Colliery in 2009 and 3 records from north and south of Cataract river Swamp in the Metropolitan Special Area in 2014 (OEH Scientific data licences). There were no records of Yellow-bellied Gliders recorded in the study area.
Conclusion	It is unlikely that the action proposed will have an adverse effect on this species such that a potential viable local population would be placed at risk of extinction.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation. This vegetation includes suitable foraging habitat for the Yellow bellied glider ie, tall Eucalypt gully forests whith known sap feed trees *Eucalyptus pilularis* (Blackbutt) and *Eucalyptus racemosa* (Narrow-leaved Scribbly Gum) and *Eucalyptus piperita* (Sydney Peppermint) (NPWS 2003b).
Conclusion	A narrow linear strip of habitat will be removed or modified as a result of the proposal.

Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition habitat and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. The section of road that deviates from the original road has a width of approximately 100 m. Any cleared area that is wider than the distance over which an individual can glide has the potential to act as a dispersal barrier. Although the species has been known to glide up to 140 metres, gliding distance is related to site conditions. Consequently, clearings or gaps considerably less than 140 metres can form a significant barrier to movement. Creation of such barriers can increasingly isolate populations or family groups. This can, in turn, reduce gene flow, decrease population viability and increase the risk of localised extinction due to random environmental and demographic events (NPWS 2003b).
Conclusion	It is unlikely that the proposed actions will result in the fragmentation or isolation of Yellow Bellied Glider habitat.
Criterion	**(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.**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition habitat and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. The Yellow Bellied Glider is very mobile and occupies a large home range between 20 to 85 ha to encompass dispersed and seasonally variable food resources. It inhabits a wide range of forest types but prefers resource rich forests where mature trees provide nesting hollows and tree species composition provides year-round continuity of food resources There are large expanses of potential foraging habitat in forested gullys adjacent to the study area in the Sydney Catchment lands and the forests of the escarpment.
Conclusion	The habitat to be removed is unlikely to be important to the long term survival of the Yellow Bellied Glider.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	NSW Parks and Wildlife Service developed a New South Wales recovery plan in 2006. Recovery onjectives include the conservation of Yellow-bellied Glider habitat, monitor populations, conduct ecological research and raise community awareness. Mitigation strategies including retention of hollow bearing trees where possible will ensure any potential impact will be reduced.
Conclusion	The proposed actions are unlikely to interfere with any of these recovery plan objectives.

Criterion	**(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.**
Response	The following are key threatening processes which may be relevant to the proposal: Clearing of native vegetation Mitigation strategies including pre-clearing surveys, retention of hollow bearing trees and known sap trees with signs of incisions where possible will ensure any potential impact will be reduced.
Conclusion	The proposed action constitutes the Key Threatening Processes 'Clearing of native vegetation'.

Overall Conclusion

The study area contains breeding and foraging habitat for the Yellow-Bellied Glider. The species has a sparse distribution and has not been recorded in Study area. There are 5 records of Yellow bellied Gliders in the locality, from Brokers Nose, Mt Ousley road, and Picton Road Cordeaux Colliery in 2009 and 3 records from north and south of Cataract river Swamp in the Metropolitan Special Area in 2014 (OEH Scientific data licences). There are large expanses of potential foraging habitat in forested gullys adjacent to the study area in the Sydney Catchment lands and the forests of the escarpment.

The proposal will result in the removal of up to 28.3 ha of moderate to good condition habitat which includes mature eucalypt forests which form potential foraging and habitat for the Yellow-Bellied Glider, however the habitat to be removed is unlikely to be important to the long term survival of Yellow Bellied Gliders.

Species: Pteropus poliocephalus (Grey-headed Flying-fox).

Criterion	**(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**
Response	It is expected that the Grey-headed Flying-fox forages on occasion within the study area when suitable species are in flower. There are additional food resources available in neighbouring reserves as well as streetscapes, parks and gardens in the locality. The proposal will not affect any breeding activities or camps of the Grey-headed Flying-fox. The proposal will result in the removal of a narrow linear strip of vegetation adjacent to a highway; part of which has been disturbed for infrastructure such as access tracks and easement maintenance.
Conclusion	It is unlikely that the action proposed will have an adverse effect on this species such that a potential viable local population would be placed at risk of extinction.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance.

	This vegetation may include suitable foraging habitat for the Grey-headed Flying-fox when Eucalypts are in flower. No Grey-headed Flying-fox camps will be disturbed.
Conclusion	A narrow linear strip of habitat will be removed or modified as a result of the proposal.
Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. The Grey-headed Flying-fox is a highly mobile species; capable of daily foraging movements of around 15km from permanent camps, but can exceed 50 km per night. This species is also capable of migrating between camps in response to the availability of foraging resources.
Conclusion	It is unlikely that the proposed actions will result in the fragmentation or isolation of Grey-headed Flying-fox habitat.
Criterion	**(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.**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. The study area does not support a permanent Grey-headed Flying-fox population, with no camps located within the study area. The Grey-headed Flying-fox does would not rely on food resources within the study area, but forages opportunistically within range of camps. There are large expanses of potential foraging habitat in the locality.
Conclusion	The habitat to be removed is unlikely to be important to the long term survival of these three species of forest owl.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	A draft recovery plan has been prepared for the grey-headed flying-fox (DECCW, 2009). The main objectives of the recovery plan are; reduce the impact of threatening processes, conserved their functional role as seed dispersers and pollinators, and improve information available to guide recovery plan.
Conclusion	With the implementation of the above mitigation measures, the proposal is consisted with recovery strategies set by OEH.
Criterion	**(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.**

Response	The following are key threatening processes which may be relevant to the proposal: Clearing of native vegetation
Conclusion	The proposed action constitutes the Key Threatening Processes 'Clearing of native vegetation'.

Overall Conclusion

Due to the highly mobile nature of the Grey-headed Flying-fox and extensive high quality habitat adjacent to the study area, it is unlikely that the proposed actions will negatively impact this species to the extent that it will be placed at risk of localised extinction.

No further assessment is required.

Frogs: Heleioporus australiacus (Giant Burrowing Frog), Pseudophryne australis (Red-crowned Toadlet) and Litoria littlejohni (Littlejohn's Tree Frog)

Criterion	**(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**
Response	The Giant Burrowing Frog breeds in soaks, pools and seepage lines. Non-breeding habitat for the Giant Burrowing Frog is located below the soil surface and leaf litter, particularly along sandstone ridge tops. The Littlejohn's Tree Frog breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground. The Red-crowned Toadlet inhabits periodically wet drainage lines below sandstone ridges and shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. The study area contains some suitable habitat for these species including areas of upland swamp habitat. There are extensive areas of high quality habitat adjacent the study area and within the region.
Conclusion	The proposed actions are unlikely to have an adverse effect on the lifecycle of the Giant Burrowing Frog, Red-crowned Toadlet or Littlejohn's Tree Frog.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**

Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance.
Conclusion	A minimal amount of habitat is likely to be removed by the proposed actions.
Criterion	**(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**
Response	The Giant Burrowing Frog breeds in soaks, pools and seepage lines. Non-breeding habitat for the Giant Burrowing Frog is located below the soil surface and leaf litter, particularly along sandstone ridge tops. The Littlejohn's Tree Frog breeds in the upper reaches of permanent streams and in perched swamps. Breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation. The Red-crowned Toadlet only has a small foraging area no more than 50m from its breeding habitat, which is ephemeral or intermittent low order drainage lines with a build-up of litter or other debris; within heath or eucalypt forest on sandstone. The proposal would result in the fragmentation of three upland wetland swamps situated on the eastern side of the existing Mt Ousley Road. A small area of retained swamp habitat in the central smaller swamp would become isolated.
Conclusion	The proposed action will cause a small amount of fragmentation or isolation of this habitat.
Criterion	**(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**
Response	Breeding habitat for the Littlejohn's Tree Frog is found within the upland swamp areas. There is additional upland swamp habitat extending to the east of the study area. Breeding habitat for the Giant Burrowing Frog and Red-crowned Toadlet occurs near sandstone rock ledges, which occur within small sections of the north-west and southern half of the study area. Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. They are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Due to this tendency for discrete populations to concentrate at particular sites, a relatively small localised disturbance may have a significant impact on a local population if it occurs on a favoured breeding or refuge site.
Conclusion	With appropriate mitigation measures, the habitat to be removed/modified as a result of the proposed actions is unlikely to be important to the long-term survival of these species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for these two species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**

Response	No recovery has been prepared, however OEH has identified the following actions to help recovery of these species, which are relevant to the project: Giant Burrowing Frog: Retain native vegetation and minimise ground disturbance where the species occurs. This is essential within 300 m of known breeding sites. Protect breeding sites from disturbance, sedimentation and pollution. Littlejohn's Tree Frog: Maintain hydrological regimes and protect water flows and water quality around the upper reaches of streams and perched swamps. Red-crowned Toadlet: Rehabilitating or augmenting habitat for the species; this might include provision of rock/log ground cover, diversion of water, provision of breeding/nesting sites and material. Buffer and protect important headwater/ridge top breeding sites from changes to water flow, flow regimes and water quality changes.
Conclusion	There will be a small amount of disturbance to habitat for these species. Appropriate mitigation measures should be adopted to ensure the proposal is consistent with recovery activities for these species.
Criterion	**(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.**
Response	The following are key threatening processes which may be relevant to the proposal: Clearing of native vegetation. Removal of bush rock. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
Conclusion	The proposed action constitutes the key threatening process 'Clearing of native vegetation'.

Overall Conclusion

Only a small amount of suitable habitat for these species is located within the study area. The proposed development is not considered to have a significant negative impact on these species, with the implementation of appropriate mitigation measures.

No further assessment is required.

Reptiles: Varanus rosenbergi (Rosenberg's Goanna) and Hoplocephalus bungaroides (Broad-headed Snake)

Reason for grouping: Reptiles with similar habitat requirements.

Criterion	**(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**
Response	The Broad-headed snake shelters in rock crevices and under flat sandstone rocks on exposed cliff edges but shelters in hollows in large trees within 200 m of escarpments in summer. Rosenberg's Goanna requires hollow logs, rock crevices and burrows and termite mounds, which are a critical habitat component. Some of these habitat components are found in the study area. Large areas of high quality habitat are found adjacent the study area and within the wider region.
Conclusion	It is unlikely that the proposed actions will decrease the availability or quality of habitat to the extent that it is placed at risk of extinction.
Criterion	**(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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(c) in the case of an endangered ecological community or critically 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**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
Response	Not applicable.
Conclusion	Not applicable.
Criterion	**(d) in relation to the habitat of a threatened species, population or ecological community:** **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance.

Conclusion	The proposal will result in the removal of a small area of potential habitat.
Criterion	**(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**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. The Broad-headed snake shelters in rock crevices and under flat sandstone rocks on exposed cliff edges but shelters in hollows in large trees within 200 m of escarpments in summer. Rosenberg's Goanna requires hollow logs, rock crevices and burrows and termite mounds, which are a critical habitat component. Some of these habitat components are found in the study area. Large areas of high quality habitat are found adjacent the study area and within the wider region.
Conclusion	Habitat is unlikely to become more fragmented or isolated as a result of the proposed actions.
Criterion	**(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.**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. The Broad-headed snake shelters in rock crevices and under flat sandstone rocks on exposed cliff edges but shelters in hollows in large trees within 200 m of escarpments in summer. Rosenberg's Goanna requires hollow logs, rock crevices and burrows and termite mounds, which are a critical habitat component. Some of these habitat components are found in the study area. Large areas of high quality habitat are found adjacent the study area and within the wider region.
Conclusion	The habitat to be removed is unlikely to impact on the long-term survival of this species.
Criterion	**(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).**
Response	To date, no critical habitat has been declared for these species.
Conclusion	Not applicable.
Criterion	**(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**
Response	No recovery plan has been developed for these species; however recovery strategies developed by OEH which may be relevant to the proposal include the retention of bush rock.
Conclusion	With retention of bushrock in the study area, the proposal is consistent with recovery strategies recommended by OEH.

Criterion	**(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.**
Response	The following are Key Threatening Processes which may be relevant to the proposal: • Removal of bush rock. • Clearing of native vegetation. • Loss of hollow bearing trees.
Conclusion	The proposed action constitutes the Key Threatening Process 'Clearing of native vegetation'.

Overall Conclusion

The proposed actions are unlikely to negatively impact Rosenberg's Goanna due to the sub-optimal nesting habitat requirements available within the study area, large areas of high quality habitat nearby and the large home range size of this species.

No further assessment is required.

Appendix E: EPBC Act assessments of significance

EPBC assessments have been undertaken for those EPBC listed species and communities that have been recorded in the study area during the present study.

NOTE:

In assessing matters of National Environmental Significance (NES) associated with impact or potential impact on:

- Wetlands of international importance[3]
- Listed threatened species and communities[4]
- Listed migratory species[5]

These assessments may have been undertaken with prescribed designated mitigation measures that form part of the 'Action[6]'. The effect of which is that these mitigation measures become a mandatory obligation based on Consent Authority approval to proceed.

[3] As detailed in Subdivision B, Division 1, Part 3 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

[4] As detailed in Subdivision C, Division 1, Part 3 of the EPBC Act

[5] As detailed in Subdivision D, Division 1, Part 3 of the EPBC Act

[6] Action is as detailed in Section 523 of the EPBC Act

Coastal Upland Swamps in the Sydney Basin Bioregion

Criterion	**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:** **i. reduce the extent of an ecological community**
Response	The NSW Scientific Committee Determination (2012) for the EEC states there is approximately 5360 hectares of the community remaining in NSW based on an amalgamation of best available mapping at the time. The majority of this is on the Woronora Plateau (about 83%). It is estimated that up to 10% of the historical distribution of Coastal Upland Swamp may have been destroyed by clearing. Approximately 2.27 hectares of Coastal Upland Swamp EEC would be removed due to the proposed works. This is comprised of: • 0.06 hectares of Banksia Thicket; • 1.54 hectares of Tea tree Thicket; • 0.51 hectares of Sedgeland-Heath; plus • 0.16 hectares of Fringing Eucalypt Woodland The proposal would result in the retention of a total of 53.59 hectares of upland swamp EEC habitat that adjoin or are proximate to the proposed construction footprint, comprising: • 28.14 hectares of Banksia Thicket; • 1.06 hectares of Tea tree Thicket; • 13.25 hectares of Sedgeland-Heath; plus • 11.14 hectares of Fringing Eucalypt Woodland.
Conclusion	The action will reduce the extent of the ecological community by 2.27 ha, reducing the extent of two larger swamp patches on the eastern side of Mt Ousley road. It will also fragment the central swamp similarly situated.
Criterion	**ii. fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**
Response	Approximately 2.27 hectares of Coastal Upland Swamp in moderate to good condition would be removed due to the proposed works. The vegetation to be cleared is a linear strip up to about 100 metres wide. The proposal would result in the fragmentation (ie reduction in areal extent) of three upland wetland swamps situated on the eastern side of the existing Mt Ousley Road and would also isolate retained swamp habitat in the central smaller of the three swamps.
Conclusion	The action will fragment and isolate the retained swamp habitat in the central smaller swamp situated on the eastern side of the existing Mt Ousley Road.
Criterion	**iii. adversely affect habitat critical to the survival of an ecological community**
Response	The EPBC Act conservation advice for this community (TSSC 2014) suggests that given the very specific set of circumstances required for the Coastal Upland

	Swamps to develop and persist, the areas currently occupied and the associated sub-catchment are considered to be areas critical to the survival of the community. Approximately 2.27 hectares of Coastal Upland Swamps in moderate to good condition would be removed due to the proposed works.
Conclusion	According to EPBC Act criteria, the proposed activity is likely to adversely affect 2.27 ha of habitat critical to the survival of the ecological community.
Criterion	**iv. 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**
Response	There is likely to be changes in surface water runoff to the receiving catchments as a result of the proposal. The proposal has the potential to impact water quality through increased sedimentation or pollution during construction works. A Site Erosion and Sediment Control Plan or Soil Water Management Plan, in accordance with the Blue Book, will be implemented for the proposal to manage impacts on abiotic factors adjacent the construction impact area.
Conclusion	SMEC understands that the proposed works are not anticipated to have a significant overall effect on recharge to the underlying aquifer, which is located below the proposed excavation depth of the M1 re-alignment works. As a result, it is not anticipated that the proposed roadworks will adversely affect the regional groundwater system (Geoterra 2016).
Criterion	**v. 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 and fauna harvesting**
Response	Approximately 2.27 hectares of Coastal Upland Swamp EEC in moderate to good condition would be removed due to the proposed works. The local occurrence of Coastal Upland Swamp EEC proximate or adjoining the footprint is about 55.85 hectares according to Woronora VIS regional vegetation mapping linework (NPWS 2002). The local occurrence being the area of Coastal Upland Swamp within the project area and Coastal Upland Swamp outside the project area but contiguous with Coastal Upland Swamp in the study area. Clearing of up to 2.27 hectares for the project is approximately 4.1% of the local occurrence of the EEC. Monitoring change in species composition, which is often done by the mining industry on the Woronora Plateau, typically requires decades before any changes are noticeable, relative to groundwater monitoring.
Conclusion	There are likely to be changes in surface water runoff to the receiving catchments as a result of the proposal. The proposal has the potential to impact water quality through increased sedimentation or pollution during construction works, if these are not adequately controlled, which may affect species composition.
Criterion	**vi. cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:** **a) assisting invasive species, that are harmful to the listed ecological community, to become established, or** **b) 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**
Response	a)

	Vegetation within the study area is already subject to the operation of edge effects and some minor weed incursion. The proposal has the potential to aid the spread of weeds due to the movement and/or introduction of soil, vehicles and equipment. Weed management works will be undertaken in accordance with RMS Biodiversity Guidelines – Protecting and Managing Biodiversity on RMS Projects (RTA, 2011). Implementation of machinery hygiene and weed control measures will prevent invasive species becoming established as a result of the proposal. The study area is potentially infected with *Phytophthora cinnamomi.* Habitat disturbance may aid the spread of *Phytophthora.* Protocols to prevent introduction or spread of *Phytophthora cinnamomi* will be implemented including controls on the movement of vehicles, and human traffic into native vegetation habitat. b) The use of herbicides would be restricted to controlling exotic species at the subject site and suitable application methods would be employed to ensure no impacts occur to surrounding areas of vegetation. Water quality controls will be implemented to mitigate against any increases in pollutant loads. A Site Erosion and Sediment Control Plan, in accordance with the Blue Book, is to be implemented for the proposal to minimise risk of impacts to areas of EEC adjoining the study area.
Conclusion	It is unlikely that the proposed action will cause a substantial reduction in the quality or integrity of an occurrence of an ecological community due to invasive species, chemicals or pollutants
Criterion	**vii. interfere with the recovery of an ecological community**
Response	No recovery plan or threat abatement plan exists for Coastal Upland Swamp EEC. However, a summary of threats to Coastal Upland Swamp EEC according to DoE include: • Clearing. • Altered hydrological processes. • Fracturing and draining of shallow groundwater aquifers as a result of subsidence • Changes in climatic conditions and fire frequenct associated with climate change • High frequency fire threatening structurally dominant species and low variability fire regimes • Localised disturbances, for example, those associated with unauthorised access by vehicles, trail bikes, mountain bikes and horses. It is recommended that groundwater and soil chemistry monitoring (through installation of piezometers and soil sampling) be undertaken within the retained swamp habitats to determine any changes to water table levels, soil moisture and chemistry as a result of the proposal.
Conclusion	Given the absence of any published critical thresholds of remnant sizes for coastal upland swamps and given the difficulty in predicting the degree of indirect impacts, the precautionary principle is to conclude that the proposal may substantially interfere with the recovery of this EEC.

Overall conclusion	The proposed activity will permanently remove approximately 2.27 hectares of Coastal Upland Swamp of the Sydney Basin Bioregion in moderate to good condition and will directly and potentially indirectly impact coastal upland wetland EEC habitat located within and adjoining the proposed footprint. The upland wetland swamps situated within and adjoining the proposed footprint are considered important relative to the remaining swamps on the Woronora Plateau. With the implementation of appropriate mitigation measures, these impacts are not expected to affect the extent or composition of the upland swamp EEC to the extent such that its local occurrence is likely to be placed at risk of extinction. An upland swamp monitoring program should be detailed in the Construction Flora and Fauna Management Plan for the proposal No further assessment is required.

Littlejohn's Tree Frog (Litoria littlejohni)

Criterion	**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:** **i. lead to a long-term decrease in the size of an important population of a species**
Response	Research has shown that the number of individuals of Littlejohn's Tree Frog is likely to be very small, with most populations containing four or fewer calling males. While the study area has not been identified as containing an Important Population of this species, habitat features exist for this species, including breeding habitat within the Coastal Upland Swamp EEC and other non-permanent and permanent waterbodies. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.
Conclusion	With appropriate mitigation measures in place, the proposed action is not likely to have a significant impact on the species leading to a long-term decrease in the size of a population.
Criterion	**ii. reduce the area of occupancy of an important population**
Response	While the study area has not been identified as containing an Important Population of this species, habitat features exist for this species, including breeding habitat within the Coastal Upland Swamp EEC and other non-permanent and permanent waterbodies. The proposal would result in the reduction of extent of upland swamp habitat. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground Areas of high quality habitat are found adjacent to the proposal to the east and within the wider region.
Conclusion	There will not be a significant reduction in the area of occupancy of an important population of this species as a result of the proposal.
Criterion	**iii. fragment an existing important population into two or more populations**
Response	While the study area has not been identified as containing an Important Population of this species, habitat is present within the study area.
Conclusion	The proposed activity is unlikely to fragment an existing population into two or more populations.
Criterion	**iv. adversely affect habitat critical to the survival of a species**
Response	No critical habitat has been declared for this species.
Conclusion	The proposed activity is unlikely to adversely affect habitat critical to the survival of the species.
Criterion	**v. disrupt the breeding cycle of an important population**

Response	Breeding habitat for this species exists within the Coastal Upland Swamp EEC, and other permanent and ephemeral waterbodies, including water in ditches. Mitigation strategies for the proposed works include a buffer zone around water bodies; avoid impacts on the Coastal Upland Swamp EEC.
Conclusion	With appropriate mitigation measures in place, the proposal is unlikely to disrupt the breeding cycle of a population of these species.
Criterion	**vi. modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
Response	A small amount of breeding and non-breeding habitat is present within the study area including breeding habitat within the Coastal Upland Swamp EEC and other non-permanent and permanent waterbodies. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground The proposal would result in the reduction of extent of a small amount of upland swamp habitat. The proposal would result in the fragmentation of three upland wetland swamps situated on the eastern side of the existing Mt Ousley Road. A small area of retained swamp habitat in the central smaller swamp would become isolated. Areas of high quality habitat are found adjacent to the proposal to the east and within the wider region
Conclusion	Although there will be some removal of potential habitat, with implementation of appropriate mitigation measures, it is unlikely to be to the extent that the species is likely to decline.
Criterion	**vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**
Response	The introduction of Mosquitofish (*Gambusia holbrooki*) and Yabby (*Cherax destructor*) into streams is known to be harmful to the recruitment success of this species. No other invasive species are known to be harmful to this species. It is highly unlikely that the proposal will result in the introduction of these species.
Conclusion	It is unlikely that the proposed action will result in invasive species that are harmful to this species becoming established in the habitat present within the study area.
Criterion	**viii. introduce disease that may cause the species to decline**
Response	Chytridiomycosis is an infectious disease affecting amphibians worldwide. A hygiene protocol exists to control the disease in frogs (DECC, 2008), aimed at people regularly dealing with frogs such as frog researchers. Mitigation strategies for the proposed works include the requirement that any staff required to handle frogs, such as wildlife rescuers and project ecologists should implement this hygiene protocol.
Conclusion	It is unlikely that the proposed action will introduce disease that may cause these species to decline.
Criterion	**ix. interfere substantially with the recovery of the species**
Response	The main identified threats to Littlejohn's Tree Frog are habitat disturbance, fragmentation and degradation (though the frogs' sensitivity to these factors is

	unclear); frequent fires; and Chytridiomycosis. The following threat abatement actions have been identified, which may be relevant to the proposal: Manage any disruptions to water flows. Develop and implement suitable hygiene protocols to protect further outbreaks of the Chytridiomycosis infection. Manage known sites to exclude/control introduced fish species, and the associated introduction of disease/parasites.
Conclusion	With adoption of appropriate mitigation strategies, the proposed activity is unlikely to interfere with the recovery of this species.

Overall Conclusion

The proposed activity may impact approximately 2.27 ha of potential habitat for this species. Mitigation measures have been proposed to protect potential habitat and reduce threats. The proposed activity is unlikely to have a significant impact on this vulnerable species.

Referral to Department of Environment is not required.

Giant Burrowing Frog (Heleioporus australiacus)

Criterion	**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:** **i. lead to a long-term decrease in the size of an important population of a species**
Response	The Giant Burrowing Frog breeds in soaks, pools and seepage lines. Non-breeding habitat for the Giant Burrowing Frog is located below the soil surface and leaf litter, particularly along sandstone ridge tops. While the study area has not been identified as containing an Important Population of this species, breeding habitat features exist for this species near sandstone rock ledges, which occur within a small section of the south-western and climbing lane. There are extensive areas of high quality habitat adjacent the study area and within the region.
Conclusion	With appropriate mitigation measures in place, the proposed action is not likely to have a significant impact on the species leading to a long-term decrease in the size of a population.
Criterion	**ii. reduce the area of occupancy of an important population**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. Areas of high quality habitat are found within the wider region. It is not expected that an important population of Giant Burrowing Frogs occurs in the study area.
Conclusion	There will not be a significant reduction in the area of occupancy of this species as a result of the proposal.
Criterion	**iii. fragment an existing important population into two or more populations**
Response	The Giant Burrowing Frog breeds in soaks, pools and seepage lines. Non-breeding habitat for the Giant Burrowing Frog is located below the soil surface and leaf litter, particularly along sandstone ridge tops. The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance.
Conclusion	The proposed activity is unlikely to fragment an existing population into two or more populations.
Criterion	**iv. adversely affect habitat critical to the survival of a species**
Response	No critical habitat has been declared for this species.
Conclusion	The proposed activity is unlikely to adversely affect habitat critical to the survival of the species.
Criterion	**v. disrupt the breeding cycle of an important population**

Response	The Giant Burrowing Frog breeds in soaks, pools and seepage lines. Breeding habitat for the Giant Burrowing Frog occurs near sandstone rock ledges, which occur within a small section of the south-western and north-western climbing lane.
Conclusion	With appropriate mitigation measures in place, the proposal is unlikely to disrupt the breeding cycle of a population of these species.
Criterion	**vi. modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. A small amount of breeding and non-breeding habitat is present within the study area.
Conclusion	Although there will be some removal of potential habitat, with implementation of appropriate mitigation measures, it is unlikely to be to the extent that the species is likely to decline.
Criterion	**vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**
Response	The introduction of Mosquitofish (*Gambusia holbrooki*) into streams is known to be harmful to the recruitment success of this species. No other invasive species are known to be harmful to this species. It is highly unlikely that the proposal will result in the introduction of this species.
Conclusion	It is unlikely that the proposed action will result in invasive species that are harmful to this species becoming established in the habitat present within the study area.
Criterion	**viii. introduce disease that may cause the species to decline**
Response	Chytridiomycosis is an infectious disease affecting amphibians worldwide. A hygiene protocol exists to control the disease in frogs (DECC, 2008), aimed at people regularly dealing with frogs such as frog researchers. Mitigation strategies for the proposed works include the requirement that any staff required to handle frogs, such as wildlife rescuers and project ecologists should implement this hygiene protocol.
Conclusion	It is unlikely that the proposed action will introduce disease that may cause these species to decline.
Criterion	**ix. interfere substantially with the recovery of the species**
Response	No recovery has been prepared for the Giant Burrowing Frog, the following actions have been identified to help recovery of these species, which are relevant to the project: Retain native vegetation and minimise ground disturbance where the species occurs. This is essential within 300 m of known breeding sites. Protect breeding sites from disturbance, sedimentation and pollution.
Conclusion	With adoption of appropriate mitigation strategies, the proposed activity is unlikely to interfere substantially with the recovery of this species.

Overall Conclusion

The proposed activity may impact approximately 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation including potential breeding and non-breeding habitat for this species. Mitigation measures have been proposed to protect potential habitat and reduce threats. The proposed activity is unlikely to have a significant impact on this vulnerable species. Referral to Department of Environment is not required.

Grey-headed Flying-fox (Pteropus poliocephalus)

Criterion	**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:** **i. lead to a long-term decrease in the size of an important population of a species**
Response	It is expected that the Grey-headed Flying-fox forages on occasion within the study area when suitable species are in flower. There are additional food resources available in neighbouring reserves as well as streetscapes, parks and gardens in the locality. The proposal will not affect any breeding activities or camps of the Grey-headed Flying-fox. The proposal will result in the removal of a narrow linear strip of vegetation part of which has been disturbed for infrastructure such as access tracks and easement maintenance.
Conclusion	The mature trees that are to be impacted as part of the proposed works are not considered to provide foraging resources suitable to sustain a local Grey-headed Flying-fox population. Therefore the extent of Flying-fox habitat to be removed or modified is minor. The proposed works will not lead to a long-term decrease in the size of an important population.
Criterion	**ii. reduce the area of occupancy of an important population**
Response	This species requires foraging resources and roosting sites. Suitable foraging resources occur within the study area but also in vegetation throughout the locality. Grey-headed Flying-foxes can travel up to 60-70 km per night in search of foraging resources and migrate in response to changes in amount and location of flowering vegetation.
Conclusion	There will not be a significant reduction in the area of occupancy of this species as a result of the proposal.
Criterion	**iii. fragment an existing important population into two or more populations**
Response	Grey-headed Flying-foxes can travel up to 60-70 km per night in search of foraging resources and migrates in response to changes in amount and location of flowering vegetation. The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance.
Conclusion	It is highly unlikely that the proposed actions will result in the fragmentation of an existing important population of Grey-headed Flying-foxes.
Criterion	**iv. adversely affect habitat critical to the survival of a species**
Response	No critical habitat has been declared for this species.
Conclusion	The proposed activity will not affect habitat critical to the survival of the species.
Criterion	**v. disrupt the breeding cycle of an important population**

Response	Following breeding, females relocate with young to maternal camps. No roosting sites or maternal camps were identified on site.
Conclusion	Given that important resources for breeding are not available on site, it is highly unlikely that the proposed actions will disrupt the breeding cycle of an important population.
Criterion	**vi. modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance.This habitat to be removed contains suitable foraging resources for this species. Grey-headed Flying-foxes can travel up to 60-70 km per night in search of foraging resources and migrates in response to changes in amount and location of flowering vegetation. No Grey-headed Flying-fox camps will be disturbed.
Conclusion	The proposed actions are highly unlikely to decrease the availability or quality of habitat to the extent that the species is likely to decline.
Criterion	**vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**
Response	The proposed works do not involve procedures that are likely to increase the potential for invasive species to be present if best practice techniques are employed.
Conclusion	It is unlikely that the proposed action will result in invasive species that are harmful to this species becoming established in the habitat present within the study area.
Criterion	**viii. introduce disease that may cause the species to decline**
Response	The proposed works do not involve procedures that are likely to increase the potential for introduced diseases to be present if best practice techniques are employed.
Conclusion	With adherence to best practice construction techniques and ongoing management, the project will not introduce disease that may cause the species to decline.
Criterion	**ix. interfere substantially with the recovery of the species**
Response	An action plan has been developed for the Grey-headed Flying-fox Recovery strategies include abatement of threats such as habitat loss and fragmentation, competition and hybridisation, pollutants and pathogens.
Conclusion	While a small amount of potential habitat will be cleared, It is unlikely that the actions proposed will interfere substantially with the recovery of the species.

Overall Conclusion

The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation including potential foraging habitat for the Grey-headed Flying-fox. No camps will be disturbed. Mitigation measures have been proposed to protect potential habitat and reduce threats. The proposed activity is unlikely to have a significant impact on this vulnerable species.

Referral to Department of Environment is not required.

Greater Glider (Petauroides volans)

Criterion	**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:** **i. lead to a long-term decrease in the size of an important population of a species**
Response	The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC 2016). The Greater Glider has a broad extent of occurrence from north Queensland to Central Victoria though its range and numbers have declined due to removal of habitat and den trees, predators and fire frequency/events (Maloney 2007). This is a well-reserved species with over eighty percent of the predicted high-quality habitat within conservation reserves, with Blue Mountains, Kanangra-Boyd and Nattai NPs being particularly important (DECC2007a). Though relatively widespread across the three coastal Bioregions, it is reported that Illawarra populations are in low numbers and of local conservation priority (TSSC 2016, Maloney 2007). Local extinctions have occurred in parts of the Royal National Park and the Woronora plateau due to fire (DECC2007a). The species is particularly susceptible to threats because of its slow life history characteristics, specialist requirements for large tree hollows (and hence mature forests), and relatively specialised dietary requirements. Local isolated populations occur in the Cordeaux and Cataract Catchments of the Metropolitan Special Area (NPWS ATLAS). Two occurrences of Greater Glider were recorded at Site 4 on the edge of the Cataract Catchment in the Stage 1 Study area during the current surveys in October 2015. The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation. This vegetation includes suitable foraging habitat including Eucalypt forest which also provides sheltering habitat with hollow bearing trees.
Conclusion	It is expected that the Greater Glider forages on occasion within the study area when suitable species are in flower. However there are extensive additional food resources and sheltering habitat available in adjacent neighbouring vegetation within the adjoining Cataract Catchment of the Metropolitan Special Area. The proposed works are unlikely to lead to a long-term decrease in the size of an important population.
Criterion	**ii. reduce the area of occupancy of an important population**
Response	This species requires foraging resources and sheltering habitat with a preference for large tree hollows in large trees. Home ranges for Greater Glider are typically relatively small (1−4 ha) somewhat larger in more open woodlands. Modelling suggests that they require native forest patches of at least 160 km^2 to maintain viable populations (TSSC 2016). The species is reported to be solitary with populations ranging from 0.01 to 5 individuals per hectare (Maloney 2007). The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation including tall Eucalypt forest. This provides both foraging and sheltering habitat with hollow bearing trees recorded in the Stage one construction footprint. However there are extensive additional food resources and sheltering habitat available in adjacent neighbouring vegetation within the adjoining Cataract Catchment of the Metropolitan Special Area.

	The proposed works are unlikely to reduce the area of occupancy of an important population.
Conclusion	There will not be a significant reduction in the area of occupancy of this species as a result of the proposal.
Criterion	**iii. fragment an existing important population into two or more populations**
Response	Home ranges for Greater Glider are typically relatively small (1−4 ha) somewhat larger in more open woodlands. Atlas records show the nearest populations are already isolated on the western side of the existing Mt Ousley Road, in the upper reaches of Lake Cataract and Lake Cordeaux. The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation. The majority of the tall Eucalypt forest potential habitat area proposed for removal is alongside the existing road in sections proposed for widening. Some sections proposed for re-alignment are located on the eastern side of the existing road where there are no records of Greater Glider, other than one record 15 km to the north near Helensburg.
Conclusion	Though the proposal will require the clearing of potential habitat for the Greater Glider, it is unlikely that the proposed actions will result in the fragmentation of an existing important population.
Criterion	**iv. adversely affect habitat critical to the survival of a species**
Response	No critical habitat has been declared for this species.
Conclusion	The proposed activity will not affect habitat critical to the survival of the species.
Criterion	**v. disrupt the breeding cycle of an important population**
Response	The Greater Glider is the only gliding possum that does not live in a family or social group. These animals only come together for mating, and usually only one young glider is born. The relatively low reproductive rate may render small isolated populations prone to extinction (TSSC 2016). Nesting dens may be present within the area in the form of hollow bearing trees proposed for clearing. Mitigation measures to ensure pre-clearance supervision of hollow bearing trees would be implemented in line with Roads and Maritime Biodiversity Guidelines – Guide 1 (Pre-clearing process) (RTA, 2011).
Conclusion	Mitigation measures to ensure pre-clearance supervision of hollow bearing trees would be implemented. The proposal is not considered likely to disrupt the breeding cycle of an important population.
Criterion	**vi. modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
Response	The Greater Glider is considered a hollow dependant species, favouring the larger trees in a forest. The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation which includes potential foraging resources and sheltering habitat for this species. Suitable habitat is available and accessible within the adjacent Cordeaux and Cataract catchments of the Metropolitan Special Area.
Conclusion	The proposed actions are highly unlikely to decrease the availability or quality of habitat to the extent that the species is likely to decline.
Criterion	**vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

Response	The proposal has the potential to aid the spread of weeds due to the movement and/or introduction of soil, vehicles and equipment. Weed management works will be undertaken in accordance with RMS Biodiversity Guidelines – Protecting and Managing Biodiversity on RMS Projects (RTA, 2011). Implementation of machinery hygiene and weed control measures will prevent invasive species becoming established as a result of the proposal.
Conclusion	It is unlikely that the proposed action will result in invasive species that are harmful to this species becoming established in the habitat present within the study area.
Criterion	**viii. introduce disease that may cause the species to decline**
Response	The study area is potentially infected with *Phytophthora cinnamomi* which is known to affect Eucalypts and other potential foodsource species. Habitat disturbance may aid the spread of Phytophthora. Protocols to prevent introduction or spread of *Phytophthora cinnamomi* and Myrtle Rust consistent with Roads and Maritime *Biodiversity Guidelines - Guide 7 (Pathogen Management)* (Roads and Maritime, 2011) will be implemented during construction including controls on the movement of vehicles, and human traffic into native vegetation habitat. A Site Erosion and Sediment Control Plan or Soil Water Management Plan, in accordance with the Blue Book will be implemented for the proposal.
Conclusion	With adherence to best practice construction techniques and ongoing management, the proposal is unlikely to introduce disease that may cause the species to decline.
Criterion	**ix. interfere substantially with the recovery of the species**
Response	There is no current recovery or threat abatement plan for the Greater Glider. Primary conservation Actions are: 1. Reduce the frequency and intensity of prescribed burns. 2. Identify appropriate levels of patch retention, habitat tree retention, and logging rotation in hardwood production. 3. Protect and retain hollow-bearing trees, suitable habitat and habitat connectivity. Additional relevant recommended management actions (TSSC2016) include: - avoid fragmentation and habitat loss due to development and upgrades of transport corridors. - Restore connectivity to fragmented populations
Conclusion	While some potential habitat will be cleared, the adjacent population is shown to be located to the west of the Mt Ousley proposal. It is unlikely that the actions proposed will interfere substantially with the recovery of the species.

Overall Conclusion

The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation including potential foraging and sheltering/nesting habitat for the Greater Glider. Two occurrences of Greater Glider were recorded at Site 4 on the edge of the Cataract Catchment in the Stage 1 Study area during the current surveys in October 2015. Extensive additional food resources and sheltering habitat is available in adjacent neighbouring vegetation within the adjoining Cataract Catchment of the Metropolitan Special Area. Mitigation measures have been proposed to protect potential habitat and reduce threats. The proposed activity is unlikely to have a significant impact on this vulnerable species.

Referral to Department of Environment is not required.

Broad-headed Snake (Hoplocephalus bungaroides)

Criterion	**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:** **i. lead to a long-term decrease in the size of an important population of a species**
Response	The Broad-headed snake shelters in rock crevices and under flat sandstone rocks on exposed cliff edges but shelters in hollows in large trees in summer. Habitat components are only found in part of the study area, and are likely to be found in habitat adjacent to the study area. Mitigation measures include the retention of bush rock, and the retention of hollow bearing trees throughout the study area where possible.
Conclusion	With appropriate mitigation measures in place, the proposed action is not likely to have a significant impact on the species leading to a long-term decrease in the size of a population.
Criterion	**ii. reduce the area of occupancy of an important population**
Response	An important population has not been identified as occurring within the Study Area, but potential habitat exists for this species. The proposal will result in the removal, up to 28.3 ha of native vegetation and 20 hectares of modified vegetation including areas already disturbed for infrastructure such as access tracks and easements. Areas of high quality habitat are found within the wider region.
Conclusion	There will not be a significant reduction in the area of occupancy of this species as a result of the proposal.
Criterion	**iii. fragment an existing important population into two or more populations**
Response	While the study area has not been identified as containing an Important Population of this species, habitat is present within the study area. The proposal will result in the removal, up to 28.3 ha of native vegetation and 20 hectares of modified vegetation including areas already disturbed for infrastructure such as access tracks and easements.
Conclusion	The proposed activity is unlikely to fragment an existing population into two or more populations.
Criterion	**iv. adversely affect habitat critical to the survival of a species**
Response	No critical habitat has been declared for this species.
Conclusion	The proposed activity is unlikely to adversely affect habitat critical to the survival of the species.
Criterion	**v. disrupt the breeding cycle of a population**
Response	Mating occurs from autumn to spring and females give birth between January and April to litters of between 4 and 12 young. Juvenile growth and maturation is very slow. Young only disperse short distances. Gravid females and juveniles remain in rocky habitat, using shaded rocks and crevices.

	Potential breeding habitat exists within part of the study area.
Conclusion	With appropriate mitigation measures in place, the proposal is unlikely to disrupt the breeding cycle of a population of these species.
Criterion	**vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
Response	The proposal will result in the removal of up to 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation (including roadside plantings, exotic dominated vegetation and cleared areas), part of which is already disturbed for infrastructure such as access tracks and easement maintenance. Some suitable habitat is present within the study area. There are also large areas of suitable habitat in the wider region.
Conclusion	Although there will be some removal of potential habitat, with implementation of appropriate mitigation measures, it is unlikely to be to the extent that the species is likely to decline.
Criterion	**vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**
Response	Foxes and cats are potential predators of the broad-headed snake. These invasive species are already likely to be established in the study area and adjoining bushland.
Conclusion	It is unlikely that the proposed action will result in invasive species that are harmful to this species becoming established in the habitat present within the study area.
Criterion	**viii. introduce disease that may cause the species to decline**
Response	No disease is known to cause the species to decline.
Conclusion	The project will not introduce disease that may cause the species to decline.
Criteria	**ix. interfere substantially with the recovery of the species**
Response	The disturbance and removal of rocks used as retreat sites has the greatest effect this species. Additionally, the removal of hollow-bearing trees is a potential threat. Threat abatement for this species relevant to this proposal therefore relates to retaining of rocks, and the retention of hollow bearing trees throughout the study area where possible, or the installation of artificial roosting structures to replace hollows.
Conclusion	With adoption of appropriate mitigation strategies, the proposed activity is unlikely to interfere with the recovery of this species.

Overall Conclusion

The proposed activity may impact approximately 28.3 ha of moderate to good condition native vegetation and 20 ha of highly modified vegetation including potential habitat for this species. Mitigation measures have been proposed to protect potential habitat and reduce threats. The proposed activity is unlikely to have a significant impact on this vulnerable species.

Referral to Department of Environment is not required.

Forest passerines: Black-faced Monarch (Monarcha melanopsis), Rufous Fantail (Rhipidura rufifrons)

Criterion	**An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:** **i. 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**
Response	The Black-faced Monarch is widespread in eastern Australia. It usually inhabits dense gullies of rainforest, sclerophyll forests and eucalypt woodlands. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests. These species have wide distributions and are highly mobile. The proposal will result in the removal of 28.3 hectares of remnant native vegetation and 20 hectares of modified veg including cleared areas being disturbed for infrastructure such as access tracks and easement maintenance.
Conclusion	The proposed actions are unlikely to substantially modify, destroy or isolate an area of important migratory species habitat.
Criterion	**ii. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**
Response	There are not many invasive species that are particularly harmful to these migratory species. No invasive species have been identified to pose a threat to these species.
Conclusion	The proposed actions are unlikely to result in an invasive species that is harmful to one of the migratory species becoming established in an area of important habitat for the migratory species.
Criterion	**iii. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**
Response	The Black-faced Monarch breeds in rainforest habitat. The Rufous Fantail breeds from about September to February, and is a common and secure species. The proposal will result in the removal of 28.3 hectares of remnant native vegetation and 20 hectares of modified veg including cleared areas being disturbed for infrastructure such as access tracks and easement maintenance.
Conclusion	The site is unsuitable to sustain populations of these migratory bird species and as such it is highly unlikely that the proposed actions will disrupt the lifecycle of an ecologically significant proportion of the population of these migratory species.
Overall Conclusion As the study site provides only intermittent suitable habitat it is considered that the proposal will not have a significant impact on these migratory species. Referral to Department of Environment is not required.	