

APPENDIX 7

Ecological Assessment



Aus-10 Rhyolite Pty Ltd

ECOLOGICAL ASSESSMENT

Proposed Expansion of Tinda Creek Sand Quarry

June 2014

Aus-10 Rhyolite Pty Ltd

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Proposed Expansion of Tinda Creek Sand
Quarry

June 2014

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Aus-10 Rhyolite Pty Ltd

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Report No. **1731/R17/FINAL**
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Executive Summary

A comprehensive assessment of potential ecological impacts has been undertaken for the Project. The assessment was prepared in accordance with relevant guidelines and legislation. This section provides a summary of the key findings of the ecological assessment.

Ecological Survey Methodology

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the floristics, vegetation and fauna characteristics of the Project area. The methods included a detailed literature review of relevant reports, databases and vegetation mapping which was then used to design a field survey program to map and survey vegetation communities, fauna and fauna habitat and to target threatened species, endangered populations, Threatened Ecological Communities (TECs), and their habitats across the Project area. The ecological surveys were undertaken with consideration of the relevant Office of Environment and Heritage (OEH) flora survey guidelines (DEC, 2004).

Flora surveys were undertaken on 18 June 2010, 17 and 18 November 2010, 7 to 10 February 2011, 11 and 12 August 2011 and 26 to 28 November 2012. The results of baseline ecological surveys of Tinda Creek undertaken in August 2007 were also used as a reference for assessing potential impacts on aquatic ecology and Groundwater Dependent Ecosystems. A total of 25 systematic vegetation quadrats (20 m by 20 m) were sampled in the Project area during the field surveys. Rapid assessments were completed at 21 locations across the Project area during June 2010. Extensive meandering transects were walked throughout the Project area targeting potentially occurring threatened flora species across the site particularly the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), Bynoes wattle (*Acacia bynoeana*), *Dillwynia tenuifolia* and *Olearia cordata*. Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

Fauna surveys were undertaken within the Project area during spring 2010, summer 2011, winter 2011 and spring 2012. During each of the fauna survey periods, a variety of survey techniques were employed including trapping surveys that targeted mammal, reptile and amphibian species including terrestrial Elliott A and B traps, arboreal Elliott B traps, terrestrial cage traps, terrestrial and arboreal hair funnels, harp traps and pitfall traps. Area searches targeted a range of species using nocturnal spotlighting, call playback sessions, diurnal and nocturnal reptile and amphibian searches, bird surveys and micro-bat echolocation recording. Targeted surveys for winter bird species, particularly regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*), and Rosensbergs goanna (*Varanus rosenbergi*) were also undertaken across the Project area. General habitat characteristics were noted and recorded including landscape slope, fire history, cut stump density, weed infestation levels, signs of feral animals, tree dieback levels, number of fallen logs, rock cover and loose bark on trees.

Existing Flora and Vegetation Communities

A total of 246 flora species were recorded within the Project area, of which 232 (94.3%) are native and 14 (5.7%) are introduced species. Five vegetation communities (with variants) were delineated across the Project area, being:

- Mellong Sandmass Dry Woodland:
 - Variation: Mellong Sandmass Dry Woodland Derived Native Grassland.

- Mellong Sandmass Swamp Woodland:
 - Variation: Mellong Sandmass Swamp Woodland (modified – overstorey absent).
- Hawkesbury Hornsby Plateau Exposed Woodland:
 - Variation: Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland.
- Stringybark – Ironbark Forest.
- Mellong Sandmass Sedgeland.

No endangered ecological communities (EECs) were identified within the Project area or the proposed disturbance area. One threatened flora species, small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) listed as vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was recorded during the field surveys undertaken for this assessment. A total of 849 individuals of this species were recorded in the Project area, of which three occur within the proposed disturbance area. An alternative biodiversity offset area to that proposed was identified at a site visit with National Parks and Wildlife Service (NPWS). The alternative area would result in changes to the quarry plan and would result in 91 small-flower grevillea being disturbed but would result in a larger and more contiguous offset area that would preserve 629 individuals in perpetuity and provide a larger biodiversity offset area increasing from 71.5 ha to 106.2 ha.

Existing Fauna

A total of 122 fauna species were recorded during surveys of the Project area. The 122 species comprised 69 bird, 9 reptile, 11 frog and 33 mammal species. Frequently observed species included noisy friarbird (*Philemon corniculatus*), white-checked honeyeater (*Phylidonyris niger*) the banjo frog (*Limnodynastes dumerilii*), common brushtail possum (*Trichosurus vulpecula*) and eastern grey kangaroo (*Macropus giganteus*).

A total of 15 threatened fauna species were recorded within the Project area comprising 4 birds, 1 reptile and 10 mammals (including 6 bat species). Fourteen of these species are listed as Vulnerable under the TSC Act, with two of these species, and one additional species, also listed as Vulnerable under the EPBC Act. In addition, the grey-headed flying fox (*Pteropus poliocephalus*) was recorded during surveys via its characteristic call in habitats adjacent to the Project area.

Ecological Impact Assessment

The Project will result in the loss of a small area of habitat for a range of woodland-dependent threatened fauna species recorded in the proposed disturbance area and wider Project area. The Project will result in the clearing of 18.7 ha of woodland/forest, 5.4 ha of swamp forest and sedgeland habitat and 20.7 ha of derived native grassland habitat.

The ecological values identified in the Project area that have been considered in determining the impact of the Project and the development of impact mitigation and biodiversity offsetting requirements include:

- the loss of native vegetation communities and fauna habitats;

- known threatened species habitat, including
 - identified habitat for one threatened terrestrial mammal species, the New Holland mouse, listed as Vulnerable on the EPBC Act;
 - core habitat for the koala (*Phascolarctos cinereus*), as described by SEPP 44 Koala Habitat Protection;
 - identified habitat of one threatened reptile species, Rosenberg's goanna, listed as Vulnerable on the TSC Act;
 - identified habitat for two forest owl species, the powerful owl (*Ninox strenua*) and masked owl (*Tyto novaehollandiae*), both listed as Vulnerable on the TSC Act;
 - a large population of the TSC Act and EPBC Act listed *Grevillea parviflora* subsp. *parviflora*, with approximately 849 plants recorded during surveys;
 - an area of woodland habitat for threatened woodland birds and micro-bats including (but not limited to) the varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*), east coast freetail-bat (*Mormopterus norfolkensis*) and large-eared pied bat (*Chalinolobus dwyeri*); and
 - potential winter flowering woodland foraging habitat for the endangered swift parrot (*Lathamus discolor*) and for the critically endangered regent honeyeater (*Anthochaera phrygia*);
- the presence of groundwater dependent ecosystems Mellong Sandmass Swamp Woodland and Mellong Sandmass Sedgeland; and
- the presence of hollow dependent fauna habitat, including known habitat of the squirrel glider (*Petaurus norfolcensis*) and the eastern pygmy possum (*Cercartetus nanus*) both listed under the TSC Act.

With respect to the Groundwater Dependent Ecosystems, as part of the field surveys, an inspection of the areas potentially affected by drawdown of groundwater (adjacent to the existing extraction area) was undertaken, in the context of extraction operations being on site for approximately 30 years. The inspection concluded that the condition and floristic/structural components of the vegetation community adjacent to the extraction area was similar to vegetation occurring further away, with no apparent impacts from potential drawdown at the time of the field survey. This is consistent with the findings of the baseline ecological study of Tinda Creek reported in Umwelt (2008). The inspection also indicated that the vegetation communities were in good condition, with no physical signs of degradation or die back observed. These observations accord with measured and modelled drawdown effects adjacent to the existing dredge pond, which show the horizontal extent of drawdown is limited, attributed to the high clay content (35–40%) and consequent low permeability of soils on site.

Based on the threatened species assessment undertaken under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and EPBC Act, the Project is considered unlikely to result in significant impacts on threatened flora and fauna species recorded or considered likely to occur in the proposed disturbance area.

Management, Mitigation and Offsetting

Hy-Tec has sought to avoid and minimise potential impacts on the ecological values of the Project area throughout the project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities and fauna habitats. Hy-Tec has also committed to the design and implementation of a comprehensive strategy to mitigate the adverse impacts of the Project which includes the rehabilitation of disturbed areas, weed

control, sediment and erosion control, implementation of a robust tree felling procedure, nest box establishment in retained vegetation, and pre-clearance surveys in Rosenbergs goanna and threatened arboreal mammal habitat.

In addition, a direct, on-site like-for-like biodiversity offset is proposed as part of the Project to compensate for the residual impacts of the Project. The proposed Biodiversity Offset Area is located adjacent to Yengo National Park, and provides in-perpetuity conservation for each of the impacted species and communities. In response to adequacy comments from OEH and an on-site meeting with representatives of the NSW NPWS, Hy-Tec has proposed an alternative biodiversity offset that aims to address requirements of OEH and NPWS in relation to the extent and location of the proposed offset. The proximity of the National Park and the high conservation values of either of the proposed Biodiversity Offset Areas provide a range of options for the long-term management of the offset site. Consultation with OEH, NPWS and Department of Environment (DoE) will be undertaken as part of the approval process to discuss these options further.

TABLE OF CONTENTS

1.0	Introduction	1.1
1.1	Background	1.1
1.1.1	Alternative Project and Biodiversity Offset Proposal	1.2
1.2	Site Description	1.3
1.3	Purpose of this Document	1.3
1.4	Relevant Legislation and Guidelines	1.4
1.4.1	Relevant Guidelines, Frameworks and Policies.....	1.5
1.5	Assessment Approach	1.6
2.0	Regional Setting	2.1
2.1	Physiography, Geology and Soils	2.1
2.2	Surrounding Land Uses	2.1
2.3	Catchment Characteristics	2.1
2.4	Conservation Areas	2.2
2.5	Connectivity	2.2
3.0	Methods	3.1
3.1	Literature Review	3.1
3.2	Ecological Database Searches	3.4
3.3	Flora Survey	3.5
3.3.1	Systematic Quadrat-based Survey.....	3.5
3.3.2	Rapid Assessments.....	3.6
3.3.3	Targeted Threatened Flora Surveys.....	3.6
3.3.4	Plant Identification and Taxonomic Review	3.7
3.3.5	Vegetation Mapping.....	3.7
3.3.6	Biases and Limitations.....	3.8
3.4	Fauna Survey	3.8
3.4.1	Trapping Surveys	3.9
3.4.2	Area Searches.....	3.11
3.4.3	Targeted Winter Bird Surveys	3.13
3.4.4	Targeted Rosenbergs Goanna Surveys	3.13
3.4.5	State Environmental Planning Policy No. 44 – Koala Habitat Protection	3.13
3.4.6	Fauna Survey Effort Summary	3.14
3.5	Habitat Assessment Methodology	3.14
4.0	Survey Results	4.1
4.1	Flora Survey Results	4.1

4.1.1	Database Searches	4.1
4.1.2	Flora Species Recorded in the Project Area	4.1
4.1.3	Vegetation Communities	4.1
4.1.4	Extent of Vegetation Communities in the Project Area and Proposed Extraction Area	4.6
4.1.5	Threatened Flora Species, Endangered Flora Populations and Threatened Ecological Communities	4.6
4.2	Fauna Survey Results	4.8
4.2.1	Database Searches	4.8
4.2.2	Fauna Habitat of the Project Area	4.8
4.2.3	Fauna Survey Results	4.10
4.2.4	SEPP 44 Assessment Results	4.14
4.3	Aquatic Species and Habitat	4.14
4.3.1	Aquatic Habitat	4.15
4.3.2	Macroinvertebrate Sampling Results	4.15
4.3.3	Threatened Aquatic Species	4.17
4.3.4	Summary of Aquatic Habitat Condition	4.17
4.4	Groundwater Dependent Ecosystems	4.18
5.0	Impact Assessment	5.1
5.1	Project Changes to Avoid and Minimise Impacts	5.1
5.2	Impact of the Project on Ecological Values	5.2
5.2.1	Summary of Ecological Values	5.2
5.3	Impact of the Project on Flora Species	5.2
5.4	Impact of the Project on Vegetation Communities	5.3
5.4.1	Impact on Forest and Woodland Communities	5.3
5.4.2	Impact on Swamp Forest and Sedgeland Vegetation	5.4
5.4.3	Impact on Derived Native Grasslands	5.4
5.5	Impact of the Project on Fauna Habitat and Fauna Species	5.4
5.5.1	Woodland and Forest Habitat	5.4
5.5.2	Swamp Forest and Sedgeland Habitat	5.5
5.5.3	Derived Native Grassland Habitat	5.5
5.5.4	Aquatic Habitat	5.6
5.6	Impact of the Project on Threatened Species, Populations and Ecological Communities	5.6
5.6.1	Threatened Species Assessed Under the <i>Environmental Planning and Assessment Act 1979</i>	5.10
5.6.2	Threatened Species Assessed Under the <i>Fisheries Management (FM) Act 1994</i>	5.10
5.6.3	SEPP 44 Assessment	5.11

5.6.4	Threatened Species Assessed under the <i>Environment Protection and Biodiversity Conservation (EPBC) Act 1999</i>	5.11
5.7	Impact on Groundwater Dependent Ecosystems	5.11
5.8	Impacts of the Project on Adjacent National Parks	5.12
5.9	Impacts on Corridors and Connectivity.....	5.12
5.10	Summary of Differences relating to Impacts of the Alternative Project	5.13
6.0	Impact Mitigation Measures	6.1
6.1	General Impact Mitigation Measures	6.1
6.1.1	Weed Control	6.1
6.1.2	Sediment and Erosion Control	6.1
6.2	Rehabilitation.....	6.2
6.3	Protection and Management of Arboreal Species and Habitat.....	6.2
6.3.1	Nest Box Establishment.....	6.3
6.4	Rosenbergs Goanna Impact Mitigation Measures	6.4
6.5	National Park Protection Measures	6.4
7.0	Biodiversity Offset Strategy	7.1
7.1	General Industry Approaches to Biodiversity Offsetting	7.2
7.1.1	'Traditional' Approaches	7.2
7.1.2	NSW Offsetting Principles and Policies.....	7.2
7.1.3	Commonwealth Environmental Offsets Policy	7.5
7.2	Tinda Creek Quarry Biodiversity Offset Strategy	7.6
7.2.1	Ecological Values of the Tinda Biodiversity Offset Area.....	7.6
7.2.2	Ecological Values of the Alternative Biodiversity Offset Area.....	7.8
7.3	Assessment of the Biodiversity Offset Strategy against Offsetting Guidelines	7.10
7.3.1	NSW Offset Principles for Major Projects (State Significant Development and Infrastructure) (OEH, 2013b).....	7.10
7.3.2	Assessment of the Biodiversity Offset Strategy against the Commonwealth Environmental Offsets Policy 2012	7.12
7.4	Summary of Commonwealth Offsets Calculator	7.14
7.4.1	EPBC Calculator Assessment for the Proposed Biodiversity Offset Area....	7.14
7.4.2	EPBC Calculator Assessment for the Alternative Biodiversity Offset Area ..	7.16
7.5	Summary of Biodiversity Offset Strategy.....	7.19
8.0	References	8.1

FIGURES

1.1	Locality Map	1.1
1.2	Project Area.....	1.1
2.1	Regional Context	2.1
3.1	Flora Survey Methods.....	3.5
3.2	Fauna Survey Methods.....	3.8
4.1	Vegetation Communities	4.1
4.2	Threatened Flora Species	4.7
4.3	Threatened Fauna Species.....	4.10
5.1	Application of the Precautionary Principle to the Impact Assessment and Development of Mitigation and Offset Strategies	5.7
7.1	Tinda Creek Biodiversity Offset Area.....	7.6
7.2	Proposed Alternative Tinda Creek Biodiversity Offset Area.....	7.8

APPENDICES

A	Threatened Species Assessment
B	Flora Species List
C	Fauna Species List
D	Seven Part Tests under the <i>Environmental Planning and Assessment Act 1979</i>
E	Assessment of Significance under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>
F	Tinda Creek Quarry Koala Plan of Management

1.0 Introduction

1.1 Background

Aus-10 Rhyolite Pty Ltd t/a Hy-Tec Concrete and Aggregates (Hy-Tec) operate Tinda Creek, a sand quarry located approximately 67 km north of Windsor along Putty Road, NSW (**Figure 1.1**). Hy-Tec is seeking approval to increase production levels from Tinda Creek Quarry from approximately 125,000 tonnes per annum (tpa) up to 300,000 tpa and is seeking to increase the area subject to sand extraction to include additional identified resource domains. The quarry is currently located within Lot 2 DP 628806.

The quarry expansion is proposed to be undertaken on the site as shown in **Figure 1.2**, within parcels of land described in cadastral terms as Lot 1, Lot 2 and Lot 3 in DP 628806, on Putty Road, approximately 23 km north of Colo Heights, NSW. Lot 1, Lot 2 and Lot 3 are 86 hectares (ha), 86.67 ha and 86 ha respectively, with a total site area of 258.67 ha. The Project area is bounded on the north, east and south by Yengo National Park and on the west by Putty Road, several agricultural land holdings and Wollemi National Park (**Figure 1.2**).

The proposed extension to extraction operations will be for additional areas of development on site. The following resource domains are the subject of this assessment:

- Domain 1 – approximately 14.17 ha area comprising an indicated product-sand resource of 1.89 million tonnes (Mt).
- Domain 2 – approximately 5.29 ha area comprising an indicated product-sand resource of 0.35 Mt.
- Domain 3 – approximately 13.40 ha area comprising an indicated product-sand resource of 1.95 Mt.
- Domain 4 – approximately 4.14 ha area comprising an indicated product-sand resource of 0.39 Mt.
- Domain 6 – approximately 13.17 ha area comprising an indicated product-sand resource of 2.26 Mt.
- Domain 7 – approximately 17.54 ha area comprising an indicated product-sand resource of 2.64 Mt.

It is noted that quarrying will either occur within Domain 3 or Domain 7 depending on whether it is decided to include the Domain 3 resource within the on-site Biodiversity Area or not.

The total product-sand resource is therefore estimated at approximately 7 Mt, based on a recent geological assessment on Lot 1, Lot 2 and Lot 3 (Stitt, 2010; 2012) and a constraints analysis undertaken as part of this environmental impact statement (EIS), a maximum extraction depth of 15.24 m below ground level and design internal batters of 3H:1V.

Each extraction stage will involve the removal and stockpiling of topsoil followed by the extraction of available resource via cutter suction dredge. A summary of the extraction sequence is described as follows:

- Following completion of dredging in Domain 4 (which is within the existing approved extraction area), extraction will continue in a westerly direction into Domain 6.



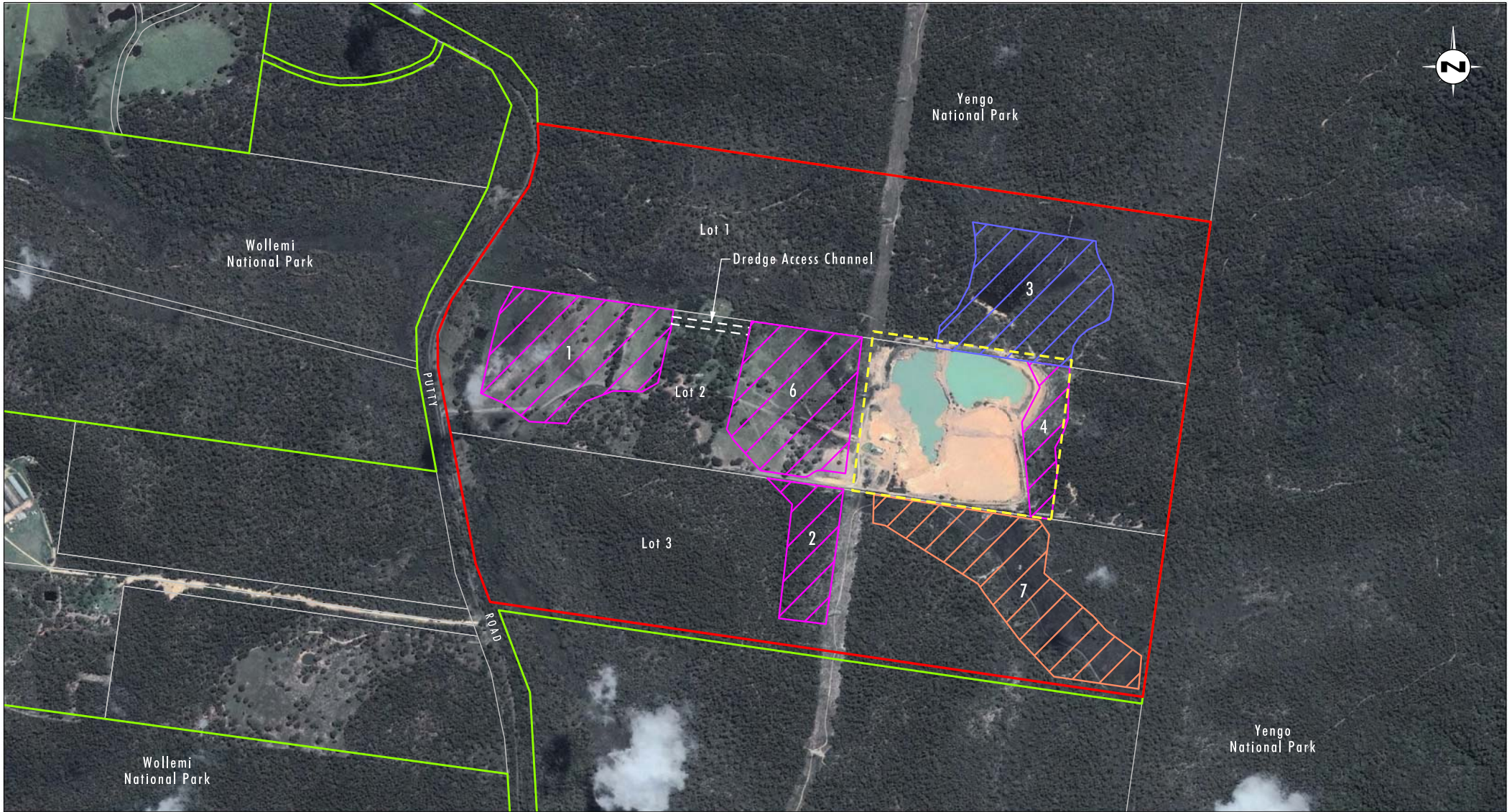
Source: Google (2002)

0 0,5 1,0 2km
1:35 000

Legend

 Project Area

FIGURE 1.1
Locality Map



Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Limit of Approved Extraction (DA 134/95)

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FIGURE 1.2
Project Area

- While the dredge is located within Domain 6, extraction operations will also be undertaken in Domain 2 as a dry extraction operation, from which sand will be 'pushed' into the Domain 6 dredge pond (e.g. via dozer, excavator and haulage truck) and then dredged to the processing plant.
- After extraction in Domain 6 is completed, operations would move into the Domain 1 area.
- After completion of Domain 1, the dredge will be dismantled and moved back upstream to the Domain 3 area.

If Domain 7 is quarried rather than Domain 3, quarrying will commence in Domain 7 and then progress to Domain 6 as outlined above and progressing to Domain 1. This ecological assessment has been prepared by Umwelt (Australia) Pty Limited (Umwelt) as part of the EIS for the Project.

1.1.1 Alternative Project and Biodiversity Offset Proposal

Following receipt of adequacy comments from the Office of Environment and Heritage (OEH) and the Commonwealth Department of the Environment (DoE) and on-site consultation with the NSW National Parks and Wildlife Service (NPWS), an alternative biodiversity offset area has been considered as part of the Project, with the final area to be determined in consultation with OEH and DoE. The currently proposed Biodiversity Offset Strategy involves the proposed donation of the offset land to the NPWS estate to satisfy the requirement for in-perpetuity conservation. At an on-site meeting in January 2014, NPWS discussed a range of potential alterations to the proposed Strategy in relation to the location, extent and composition of the Strategy for consideration by Hy-Tec. These options were identified as improving the offset outcomes for inclusion in the NPWS estate. The feedback included:

- Potential inclusion of the highest quality examples of Mellong Sandmass Sedgeland, identified in the north-eastern portion of the Project area, in the proposed alternative offset area.
- Potential inclusion of Domain 3 in the proposed alternative offset area and the avoidance of any impact relating to quarry activities in this area to provide a 'clean' boundary between the operation and NPWS estate; with quarrying to take place in Domain 7 rather than Domain 3.
- Identification of sufficient areas to meet the minimum 2:1 offset ratio required to meet State offsetting policy requirements.
- Potential inclusion of the extensive areas of *Grevillea parviflora* subsp. *parviflora* within the offset area.
- Provision of access for fire fighting between the quarry and the NPWS estate and the removal of car bodies and rubbish from Lot 1.
- Maintenance of areas of open water to facilitate fire fighting opportunities within the adjacent National Parks.

The proposed alternative that would result in quarrying in Domain 7 rather than in Domain 3 results in a small increase in the area of impact from 45.1 ha to 46.9 ha whilst providing access to a similar resource volume and provides a substantial increase in the area proposed for biodiversity offsetting from 71.5 ha to 106.2 ha.

As part of the design of the proposed project, Hy-Tec has, where possible, modified the Project to avoid and minimise ecological impacts. This included further reduction to the proposed quarry plan following the receipt of Supplementary Director-General's Requirements (DGRs) from the DoE in December 2013, to avoid impacting known occurrences of *Grevillea parviflora* subsp. *parviflora*. Umwelt has undertaken substantial ecological survey across the entire site including Domain 7 as part of the Project to facilitate an appropriate assessment of the ecological impacts and benefits of the alternative proposal discussed on-site with NPWS in January 2014. Changes to the proposed biodiversity offset area will not result in substantial changes to the proposed Project with components of the Project described in **Section 1.1** above remaining substantially the same. The only material change will be quarrying in Domain 7 rather than Domain 3.

Section 5.0 identifies the impacts of the Project and compares these with the biodiversity impacts associated with the alternative offset strategy proposal. **Section 7.0** provides an assessment of the relative merits of both proposed biodiversity offset scenarios, with the final biodiversity offset location to be determined in consultation with OEH and DoE.

1.2 Site Description

The quarry site consists of Lot 1, Lot 2 and Lot 3 of DP 628806, located in the Parish of Ivory, Hunter County, Hawkesbury City Council Local Government Area (LGA), approximately 23 km north of Colo Heights, or 67 km north of Windsor, along Putty Road in NSW. The three lots are referred to collectively as the 'Project area'. A gravel road connects the Project area to Putty Road. An existing high voltage electricity transmission line runs north – south through all three lots.

The proposed disturbance area represents the area that will be directly impacted as a result of the Project and will be between 45.1 ha and 46.9 ha depending on whether quarrying is undertaken in Domain 3 or Domain 7. Ecological surveys for this report focused on the proposed disturbance area (as shown in **Figure 1.2**) however, impact avoidance measures implemented by Hy-Tec have reduced the extent of the proposed disturbance area by in excess of 15 ha (refer to **Section 5.1**).

The Project area includes the confluence of two small ephemeral drainage lines in the upper reaches of Tinda Creek catchment. Tinda Creek is a tributary of Wollemi Creek which joins the Colo River approximately 16 km to the west of the Project area. The valley in which the quarry is located is approximately 500 m wide and is bounded to the east by the Mellong Range and to the north and south by a series of unnamed ridges.

Tinda Creek flows ephemerally to the north-west from the existing quarry, and has been diverted around the eastern and northern boundaries of the current operations via a small earthen drainage channel. Tinda Creek joins with other ephemeral second order streams on the northern boundary of the existing quarry. These drainage lines convey water during and immediately following rainfall, but do not hold water during periods of dry weather, due to the sandy nature and consequent relative high permeability of the substrate.

1.3 Purpose of this Document

This ecological assessment has been prepared by Umwelt to describe the potential impact of the Project on threatened and migratory flora and fauna species, endangered populations, threatened ecological communities and their habitats that occur in the proposed disturbance area and wider Project area. Terrestrial vegetation communities, flora and fauna species and

fauna habitat, and aquatic flora and fauna species and habitat, present in the Project area have been identified and considered as part of the impact assessment.

The objectives of the Ecological Assessment were to:

- identify the flora and fauna species recorded within the Project area from previous studies in the Project area, local studies and/or ecological databases;
- undertake targeted surveys to further identify any threatened flora or fauna species, migratory fauna species, Endangered Populations (EPs), Threatened Ecological Communities (TECs), or their habitats within the Project area, particularly those listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act), or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) in the Project area;
- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) on lands adjoining the Project area;
- develop appropriate impact mitigation and management options to minimise ecological impacts associated with the Project;
- inform rehabilitation of the sites;
- prepare a comprehensive biodiversity offset strategy to compensate for the residual impacts of the Project that cannot otherwise be satisfactorily avoided, minimised or mitigated; and
- prepare a detailed monitoring program to assess the success of the impact mitigation, rehabilitation and biodiversity offset strategies in reducing and compensating for the residual impacts of the Project.

1.4 Relevant Legislation and Guidelines

The ecological assessment completed as part of this Project was prepared in accordance with the relevant Department of Planning and Infrastructure – DP&I (now known as the Department of Planning and Environment – DP&E), Director-General’s Requirements (DGRs) for the Project, dated 12 December 2012 and supplementary DGRs issued December 2013 as detailed in **Table 1.1**.

Table 1.1 – Matters Specified in the Director-General’s Requirements and where they are addressed in this Report

DGR	Section Addressing the DGR
measures taken to avoid, reduce or mitigate impacts on biodiversity	Section 5.1
accurate estimates of proposed vegetation clearing	Section 5.4
a detailed assessment of potential impacts of the development on: <ul style="list-style-type: none"> terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems 	Section 5.6 Section 5.7
a detailed assessment of potential impacts of the development on: <ul style="list-style-type: none"> regionally significant remnant vegetation, or vegetation corridors 	Section 5.9
a detailed assessment of potential impacts of the development on: <ul style="list-style-type: none"> the Wollemi National Park and the Yengo National Park, including potential edge effects and impacts on the conservation and recreational values of these National Parks 	Section 5.8
a comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term	Section 7.0

Supplementary DGRs relating to the EPBC Act requirements were issued in December 2013. These are addressed in *Supplementary DGRs Report – Assessment of Matters of National Environmental Significance, Proposed Expansion of Tinda Creek Sand Quarry* (Umwelt, 2014).

The ecological survey and assessment completed as part of the Project was undertaken in accordance with Part 4 of the EP&A Act and the following legislation and licences, where relevant:

- TSC Act;
- FM Act;
- EPBC Act;
- NPWS Scientific Research Licence; and
- Animal Research Authority as provided by the NSW Department of Primary Industries.

1.4.1 Relevant Guidelines, Frameworks and Policies

The ecological survey and assessment completed as part of the Project took into account the following guidelines, frameworks and policies.

Table 1.2 – Relevant Guidelines, Frameworks and Policies Considered in the Ecological Assessment

Specified in the Project DGRs
<ul style="list-style-type: none"> • Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians (DECC, 2009). • Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC, 2004). • Threatened Species Assessment Guidelines: the Assessment of Significance (DECC, 2007a). • Guidelines for Threatened Species Assessment (DoP, 2005). • Department of Environment, Climate Change and Water (DECCW) (2009a). <i>BioBanking Assessment Methodology and Credit Calculator Operational Manual</i>. • NSW State Groundwater Dependent Ecosystem Policy (DLWC, 2002). • Policy & Guidelines – Aquatic Habitat Management and Fish Conservation (DPI, NSW Fisheries, 1999) – update and revision in June 2013 (DPI, 2013a). • Policy & Guidelines – Fish Friendly Waterway Crossings (NSW Fisheries DPI, 2004). • SEPP 44 Koala Habitat Protection.
Other Relevant Guidelines
<ul style="list-style-type: none"> • NSW Office of Environment and Heritage (OEH) Interim Policy on Assessing and offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) Projects, June 2011. • DECC (2008a). <i>Hygiene Protocol for the Control of Disease in Frogs</i>. • OEH (2012) <i>Assessors’ Guide to Using the BioBanking Credit Calculator V.2</i>. • Department of the Environment (2013) <i>Draft EPBC Act Referral Guidelines for the Vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)</i>.
<ul style="list-style-type: none"> • Department of Environment, Water, Heritage and the Arts (DEWHA) Commonwealth EPBC Act Policy Statement.1.1 – <i>Significant Impact Guidelines – Matters of National Environmental Significance</i>. December 2009. • Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) EPBC Act Environmental Offsets Policy (2012). • DPI (2008). <i>Threatened Species Assessment Guidelines – The Assessment of Significance</i>. February 2008. • NSW Offset Principles for Major Projects (State Significant Development and Infrastructure).

1.5 Assessment Approach

This Ecological Assessment has been prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, EPs, TECs and their habitats occurring in the proposed disturbance area and Project area and on adjoining lands. The process of undertaking an ecological assessment requires particular steps to identify the ecological features that require specific assessment, and to determine the level at which they are likely to be impacted. This is initially undertaken without consideration of any mitigation or offsetting measures, however the preliminary impact assessment informs project design and, in this case, has led to the development of project avoidance measures undertaken specifically to protect, or reduce impacts on ecological matters (see **Section 5.1**). Through the use of impact assessments under the EP&A Act and the EPBC Act, a decision is made as to whether or not species, populations or communities will be significantly affected by the Project. For those species and communities that were determined to be significantly impacted, or potentially significantly impacted, detailed mitigation and offsetting measures were developed.

During all steps the precautionary principle was applied to ensure that wherever there was uncertainty resulting from lack of data or knowledge, or uncertainty in the level or extent of impact, the maximum reasonable potential impact was assumed. The application of the precautionary principle in the project assessment is detailed in **Section 5.6**.

2.0 Regional Setting

2.1 Physiography, Geology and Soils

Tinda Creek Quarry is located in the Sydney Basin Bioregion, which generally consists of lower rock strata belonging to the Narrabeen Group (sandstone, mudstone, shale) overlain by Hawkesbury Sandstone (sandstone with some shale lenses). Formations of Tertiary basalt occur as mountains (Yengo and Wareng) and as plugs in the bottom of some valleys. The Project area is underlain by Hawkesbury Sandstone, which in turn is overlain by sand and clay layers.

A geological investigation of the site was undertaken by Coffey (1992) who reported that the geological sequence within this area consists of a colluvial layer of sands and silty sands to a depth of 0.5–2 m, underlain by residual clayey sands to a depth of 10–27 m. The sequence was subsequently confirmed by exploration drilling undertaken for this Project. The clayey sands are derived from alluvial and colluvial deposition from upslope areas and in-situ weathering of the underlying Hawkesbury Sandstone.

2.2 Surrounding Land Uses

Quarrying activities have been undertaken on Lot 2 for over 30 years, with the quarry currently producing up to 125,000 tonnes of product sand per year. The majority of Lot 2 has been cleared of vegetation and prior to commencement of sand quarrying operations on the site, was utilised for low intensity grazing. Lot 1 and Lot 3 are predominantly vegetated and contain several internal access tracks, in addition to a 50 m easement for a 132 kV sub-transmission line. Lot 2 also contains a residence that is currently occupied by quarry employees.

While there are some landholdings nearby zoned as Rural (Mixed Agriculture), the majority of the surrounding land is reserved as National Park under the *National Parks and Wildlife Act 1974*. Wollemi National Park is located to the west of the Project area and Yengo National Park to the north, east and south of the site which together form part of the Greater Blue Mountains World Heritage Area (refer to **Figure 2.1**). Activities in the area include:

- recreational uses of both Wollemi and Yengo National Parks for bushwalking, mountain biking and other associated activities;
- agricultural uses such as duck farming;
- rural residential properties; and
- appreciation of the historic and scenic values of the local area, with Putty Road a popular road for cyclists, motorcyclists and other tourists.

2.3 Catchment Characteristics

The Project area occurs within the Wollemi Creek sub-catchment of the Hawkesbury-Nepean Catchment. Tinda Creek flows into Wollemi Creek which flows into the Colo River west of the Project area. The Project area is located at the confluence of two small intermittent creeks in the upper reaches of Tinda Creek Catchment. The valley in which the quarry is located is up to approximately 700 m wide and is bounded to the east by the Mellong Range and to the north and south by a series of unnamed ridges. Tinda Creek intermittently flows to the



Source: OEH (2013), Google Earth (2006), Australian Government Department of the Environment - Water - Heritage and the Arts (2007)

0 5 10 15 km
1:300 000

Legend

- Project Area (DP 628806)
- National Park
- Greater Blue Mountains World Heritage Area

FIGURE 2.1
Regional Context

north-west and has been diverted around the eastern and northern boundaries of the existing quarry via a constructed drainage channel.

An intermittent second order tributary flows into Tinda Creek adjacent to the northern side of Putty Road. Drainage lines surrounding the quarry are ephemeral and only flow during and immediately following rainfall.

At the location of the existing quarry the valley floor is approximately 500 m wide. Underlying the quarry is an unconfined aquifer that is composed of approximately 30 m of sandy clay which is underlain by approximately 40 m of weathered sandstone.

2.4 Conservation Areas

The Project area occurs between two large regional National Parks and a World Heritage Area (see **Figure 2.1**). To the west the Project area adjoins Wollemi National Park and to the north, east and south Yengo National Park. The Project area is one of a number of small areas of freehold land located along the Putty Road between the two national parks. Wollemi National Park and Yengo National Park both form part of the Greater Blue Mountains World Heritage Area.

Wollemi National Park covers more than 500,000 ha, containing good condition native vegetation; approximately 2000 flora species and over 400 fauna species; and is known to contain in excess of 100 threatened species. Wollemi National Park spans from near Denman in the north, to Kurrajong in the south, and Broke to Bylong in the east and west respectively.

Yengo National Park comprises approximately 140,000 ha and contains high quality native vegetation, comprising of 1150 flora species and 310 fauna species of which 55 species are known to be threatened. The park spans from near Broke in the north to Wisemans Ferry in the south and Wollombi in the east. Yengo joins Wollemi at its westernmost boundary along the Putty Road.

The Greater Blue Mountains World Heritage Area consists of over 1 million hectares of forested landscape with high quality wilderness habitats containing over 400 fauna species. The area is valued for its high biological diversity of habitats, species and communities. The Greater Blue Mountains World Heritage Area surrounds the Project area and shares borders with Wollemi and Yengo National Parks.

2.5 Connectivity

The open, disturbed areas of the Project area represent one of the few open areas within a large regional expanse of forest and woodland (see **Figure 1.2**). Wollemi and Yengo National Parks, along with surrounding woodland and forest areas, form a minimum 40 km radius of woodland and forest habitat around the Project area.

3.0 Methods

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the Project area. The methods included a detailed literature review of relevant reports and vegetation mapping, as well as searches of relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design a field survey program to map and survey vegetation communities and fauna habitats, and to target threatened species, endangered populations, TECs, and their habitats. The field surveys were undertaken in consideration of the relevant OEH fauna survey guidelines (DEC, 2004) and Commonwealth threatened species survey guidelines (DEC 2004; DEWHA 2010a and 2010b; DSEWPC 2011a and 2011b).

3.1 Literature Review

The Native Vegetation of Yengo and Parr Reserve and Surrounds (DECC, 2008)

This report describes the distribution and composition of the native vegetation of Yengo National Park, Parr State Conservation Area, Comleroy State Forest and adjoining private lands. The project provides a revision of previous vegetation classification and mapping studies (Sanders et al. (1988) and Bell et al. (1993)) due to the increased demand placed on vegetation maps to delineate the distribution of Endangered Ecological Communities (EECs) and threatened species habitats, as well as to describe the condition of the vegetation within the reserve system to aid reserve management and regional conservation planning.

Forty-three vegetation communities were defined as part of the project with 36 classified using numerical analysis of systematically collected field data. An additional seven communities were described based on field traverse and aerial photo interpretation only. These communities were cross referenced to existing literature describing the vegetation of the study area. Five EECs, listed under the NSW TSC Act (1995) and 18 plant species listed as threatened under the NSW TSC Act 1995 and/or the Commonwealth EPBC Act 1999 were found to occur in the study area.

The vegetation map produced as a product of the report includes predictive mapping of the Project area. The Native Vegetation of Yengo and Parr Reserve and Surrounds vegetation map (DECC, 2008) shows the extent of the following vegetation units in the Project area:

- Sydney Hinterland Peppermint-Apple Forest;
- Sydney Hinterland Exposed Red Bloodwood-Stringybark Forest;
- Hunter Range Exposed Stringybark-Grey Gum Woodland;
- Mellong Sands Drooping Red Gum Sedge Woodland;
- Mellong Sands Scribbly Gum Woodland;
- Sydney Hinterland Rocky Yellow Bloodwood Woodland;
- Hunter Range Flats Freshwater Wetland; and
- Regenerating Trees and Shrubs.

Hunter Range Flats Freshwater Wetland is considered to conform to the NSW scientific committee description of *Freshwater Wetlands on Coastal Floodplains of the North Coast, Sydney Basin and South East Corner Bioregions EEC*.

Flora and Fauna Survey of Sand Extraction Site at Tinda Creek, Colo Heights (P & J Smith Ecological Consultants, 1992)

During May 1992, P & J Smith Ecological consultants conducted a two day flora and fauna survey for the current quarry operation. Three vegetation communities were identified:

- sedges, grasses and herbs;
- *Eucalyptus sclerophylla*, *E. parramattensis* and *Angophora bakeri* woodland; and
- *E. parramattensis* woodland.

No threatened flora species or TECs were identified. The fauna survey comprised a single night of trapping with 20 Elliott A traps and two cage traps, spotlighting, bird survey and frog and reptile searches. No threatened fauna species were identified however since the date of the report the scarlet robin has been listed as a threatened species under the TSC Act.

Wollemi National Park Vegetation Survey (Bell, 1998)

A preliminary classification and mapping project of the vegetation communities of Wollemi National Park was conducted by Bell and published in 1998. This work resulted in the first classification of native vegetation using numerical analysis of systematically collected field data and has provided a foundation for future surveying effort in the area. A total of 72 vegetation communities were mapped and described in the report which provides a general overview of regional trends in vegetation mapping across the full extent of Wollemi National Park.

Wollemi National Park occurs along the eastern boundary of the Project area. Bell (1998) proposed the following communities as likely to occur on the Mellong Plateau:

- Mellong Sandmass Dry Woodland;
- Mellong Sandmass Swamp Woodland;
- Mellong Sandmass Alluvial Woodland;
- Mellong Sandmass Sedgeland; and
- Mellong Sandmass Riparian Scrub.

Rare or Threatened Vascular Plant Species of Wollemi National Park, Central Eastern New South Wales (Bell, 2008)

This paper summarises the status of all rare or threatened taxa, describes habitat and associated species for many of these, as well as suggesting revisions to current conservation risk codes for some species. Surveys within Wollemi National Park over the last decade have recorded several new populations of significant vascular plant species, including some sizeable range extensions. At the time of publication, Wollemi National Park was known to provide habitat for 37 species currently listed as Endangered (15 species) or Vulnerable (22 species) under the TSC Act. The paper concludes with the importance of the National Park preserving these taxa, particularly those of restricted distribution.

Yengo National Park & Parr State Recreation Area Vegetation Survey (Bell et al., 1993)

Bell et al. (1993) mapped the vegetation communities of neighbouring Yengo National Park with a total of 15 vegetation communities mapped and 701 species of plant identified. It was found that 24 species of rare or endangered flora species occurred or were expected to occur within Yengo National Park. Vegetation was delineated into broad groupings based on a combination of floristic components and structure as well as the geomorphology of the areas in which they occurred. The following communities were determined to potentially occur in the Project area:

- Narrabeen Hawkesbury Ironbark Forest;
- Exposed Hawkesbury Woodland;
- Woodland on Perched Sands; and
- Swamp Woodland on Perched Sands.

Results of Ecological Condition Assessment and Photo Monitoring, Tinda Creek (Umwelt, 2008)

Umwelt undertook baseline ecological monitoring surveys of Tinda Creek on behalf of Birdon Contracting Pty Limited on 15 and 16 August 2007. The aim of the monitoring surveys was to provide baseline ecological information to contribute to an assessment of whether Tinda Creek Sand Quarry was having any impact on the ecosystems of Tinda Creek. The ecological condition assessment comprised photo monitoring, amphibian surveys, macro-invertebrate sampling, water quality testing and an assessment of the general condition of Tinda Creek. Studies indicated that aquatic habitat within the vicinity of the quarry was consistent with the surrounding area.

The information from the 2007 condition assessment and photo monitoring methodology (Umwelt, 2008), including the reference sites, was used as a baseline for reference during surveys undertaken for the Project in 2011, to assess if there were any detectable impacts from the operation of the existing quarry on the ecology of Tinda Creek.

At each of the eight permanently marked sites a condition assessment proforma was completed to record the range or category scores for the following habitat or condition features:

- level of dieback;
- age diversity of dominant species;
- native diversity of upper and mid strata;
- native diversity of lower strata;
- level of disturbance;
- density of tree hollows;
- density of fallen timber and rocks;
- density of fissures in bark;
- density of ground cover/leaf litter; and

- signs of feral animal presence.

The results of the monitoring program reported in Umwelt (2008) demonstrated that the quarry was not adversely impacting on the ecology of Tinda Creek and that provided the quarry continues to operate with the current closed water management system is unlikely to adversely impact on the aquatic ecology of Tinda Creek. Review of the sites undertaken during the 2011 surveys confirmed that there have been no adverse changes to the ecological condition of Tinda Creek.

Ecological Inspection of Proposed Groundwater Monitoring and Drill Boreholes at Tinda Creek Quarry, Mellong NSW (Umwelt, 2010)

Twenty-two proposed borehole locations within Tinda Creek Quarry were inspected by an ecologist on 18 June 2010. The proposed borehole locations were assessed for potential impacts to threatened species, EPs and TECs listed under the TSC Act and the EPBC Act.

Rapid vegetation assessments were completed at each borehole location with the dominant flora species recorded and the presence of any potentially occurring threatened species, EPs or TECs was assessed. The presence of key habitat features relevant to threatened fauna species was also assessed at each proposed borehole site including tree hollows, hollow logs, nests, significant rocky outcropping and the presence of key feed tree species for the koala (*Phascolarctos cinereus*) and glossy black-cockatoo (*Calyptorhynchus lathami*). Any threatened fauna species or significant habitat feature identified during the survey effort was recorded.

3.2 Ecological Database Searches

In order to identify threatened species, migratory species, EPs and TECs with the potential to occur in the Project area relevant ecological databases were searched.

The databases searched were:

- a 10 km radius search from the centre of Project area of the OEH Atlas of NSW Wildlife (OEH, 2014) (June 2014);
- a 10 km radius search from the centre of Project area of the Department of the Environment (formerly the Department of Sustainability, Environment, Water, Populations and Communities (DSEWPC)) Protected Matters Database (Department of the Environment, 2014) (June 2014);
- NSW Fisheries threatened and protected species – records viewer (DPI, 2014); and
- *PlantNET* (Royal Botanic Gardens Sydney) database search for Rare or Threatened Australian Plants (ROTAP) species within the Hawkesbury LGA (Botanic Gardens Trust, 2014) (June 2014).

Records from these database searches were combined with records derived through literature reviews and professional opinion to identify the range of potentially occurring threatened and migratory species. The identification of potentially occurring threatened and migratory species was then used to assist in the development of appropriate survey methods.

Current lists of threatened species and key threatening processes were also sourced from the OEH (2013b), Department of Primary Industries (NSW Fisheries) (DPI, 2013c) and Department of the Environment (2013b) websites.

3.3 Flora Survey

Five flora surveys were undertaken within the Project area during winter 2010, spring 2010, summer 2011, winter 2011 and spring 2012. Three methods of flora surveys were undertaken during the field survey, being: systematic quadrat-based sampling; rapid vegetation assessment; and targeted threatened flora searches. The locations of the flora survey sites are shown on **Figure 3.1**.

Table 3.1 – Flora Survey Periods

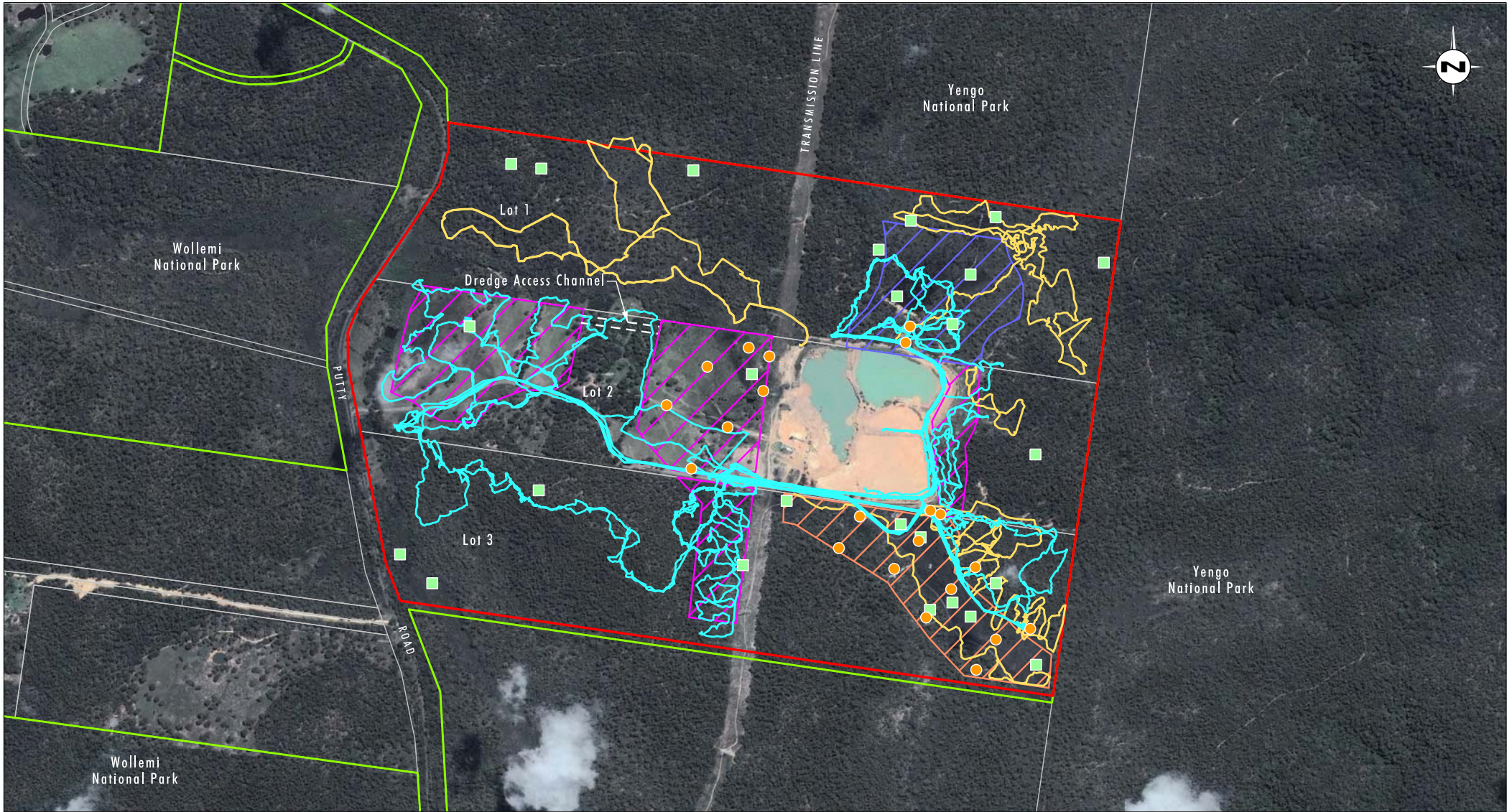
Timing	Duration
Winter 2010 (18 June 2010)	1 day
Spring 2010 (17 and 18 November 2010)	2 days
Summer 2011 (7 to 10 February 2011)	4 days
Winter 2011 (11 and 12 August 2011)	2 days
Spring 2012 (26 to 28 November 2012)	3 days

3.3.1 Systematic Quadrat-based Survey

A total of 25 systematic vegetation quadrats were sampled in the Project area during the field surveys. The quadrats were positioned at sites that were selected by considering a range of attributes that influence or determine the type of vegetation community present, particularly topographic position, slope, aspect and soil type. The selection of quadrat locations aimed to achieve effective coverage of the proposed disturbance area, particularly areas in which the vegetation was thought to have potential to support threatened species, TECs or any other potentially significant vegetation types.

Each vegetation quadrat comprised 20 m by 20 m (400 m²), a standard size used widely for systematic flora surveys throughout NSW and recognised by OEH and the Royal Botanic Gardens Sydney. Within each quadrat, approximately one hour was spent searching for species, either by traversing the area in parallel lines throughout the quadrat, or assessing the edges and then spiralling towards the centre of the quadrat.

A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore, 1955 and Austin et al., 2000) was used to estimate cover-abundances of all plant species within each quadrat. **Table 3.2** shows the cover-abundance categories used.



Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Threatened Flora Meandering Transect (Winter 2011)
- Threatened Flora Meandering Transect (Spring 2012)
- Flora Quadrat
- Rapid Assessment Point

FIGURE 3.1
Flora Survey Methods

Table 3.2 – Modified Braun-Blanquet Crown Cover-Abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	
4	20 – less than 50% cover	
5	50 – less than 75% cover	
6	75 – 100% cover	

Note:* Modified Braun-Blanquet scale (Poore, 1955; Austin et al., 2000)

Information on the structural characteristics of the vegetation in the quadrat was also recorded, including the height range and canopy cover of each stratum and the dominant species in each stratum. Any species observed outside the plot but within the vegetation community being sampled was recorded. These species were noted as being present but were not assigned any cover-abundance values and were not used in subsequent analyses. A proforma was used to record plant species cover-abundance data. The location of flora quadrats is shown on **Figure 3.1**.

3.3.2 Rapid Assessments

Rapid assessments were completed at 22 locations across the Project area during June 2010. These rapid assessments were undertaken as part of the due diligence surveys for proposed groundwater monitoring and drill boreholes (Umwelt, 2010). The data from the rapid assessment were primarily used to provide assistance in the delineation and refinement of vegetation mapping and also in surveys for targeted threatened flora species and endangered populations. Dominant plant taxa from each vegetation strata layer were recorded at each location. The location of each rapid assessment completed within the Project area is shown on **Figure 3.1**.

The rapid assessments utilised a qualitative sampling approach, as this method was designed to allow rapid collection of non-quantitative species dominance data across the Project area within limited timeframes.

The relative abundance of vascular plants recorded within each vegetation community was recorded using the modified Braun-Blanquet 6-point scale described in **Section 3.3.1**. At each assessment site records were made of all dominant plants, most common plants and a selection of occasional and localised plants to facilitate further description of the vegetation communities.

3.3.3 Targeted Threatened Flora Surveys

Extensive meandering transects were walked throughout the Project area targeting potentially occurring threatened flora species across the site (refer to **Figure 3.1**). Along these transects, searches were undertaken for potential threatened flora species, in particular the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) which was considered likely to occur, and all of the other threatened flora species for which the Project area provided potential habitat such as Bynoes wattle (*Acacia bynoeana*), *Dillwynia tenuifolia*

and *Olearia cordata*. The area searches were variable in length and location, and were tailored to suit the environment to gain maximum coverage of likely habitat for potentially occurring threatened flora species.

A meandering technique was selected over the plot-based method since the amount of replicate plots that could have been sampled within each vegetation unit is generally restricted. The meandering technique within each search area increased the amount of data that could be collected within the available survey time, thereby maximising the quality and coverage of targeted threatened species surveys.

3.3.4 Plant Identification and Taxonomic Review

All vascular plants were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002), and Wheeler et al. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust, 2014), the online plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources, such as local names where these references do not provide a common name. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney for identification.

3.3.5 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Project area.

Vegetation mapping involved the following key steps:

- preparation of draft vegetation community map based on landform elements and preliminary delineation of vegetation community floristics;
- ground-truthing of vegetation map based on survey effort; and
- revision of vegetation community floristic delineations following analysis of quadrat data.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were then compared to those vegetation communities identified in the Wollemi National Park Vegetation Survey (Bell, 1998) and the Yengo National Park and Parr State Recreation Area Vegetation Survey (Bell et al., 1993). The vegetation community profiles provided in the Bell (1998) and Bell et al. (1993) were interrogated to identify those communities that contained similar species and structural compositions to ensure that, where suitable, the communities identified in the Project area were aligned with similar communities known to occur elsewhere in the region.

3.3.5.1 Determination of Threatened Ecological Communities

Vegetation communities identified in the Project area were compared to TECs listed under the NSW TSC Act and the Commonwealth EPBC Act.

The assessment of similarity to TECs was made using the following approach:

- comparison with published species lists, including lists of ‘important species’, for the TSC Act and EPBC Act listed TECs; and
- comparison with habitat descriptions and distributions for the TSC Act and EPBC Act listed TECs, as published by the NSW Scientific Committee and the Threatened Species Scientific Committee respectively.

3.3.6 Biases and Limitations

The findings of the surveys were influenced by seasonal factors. While surveys were conducted in three out of four seasons, each survey covered did not cover exactly the same area of the site each time and thus may not have detected all cryptic species such as orchids.

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens were always forwarded to the National Herbarium of New South Wales if they were considered to be of potential significance or importance.

3.4 Fauna Survey

Four fauna surveys were undertaken within the Project area during spring 2010, summer 2011, winter 2011 and spring 2012. Survey sites were selected based on habitat types and included:

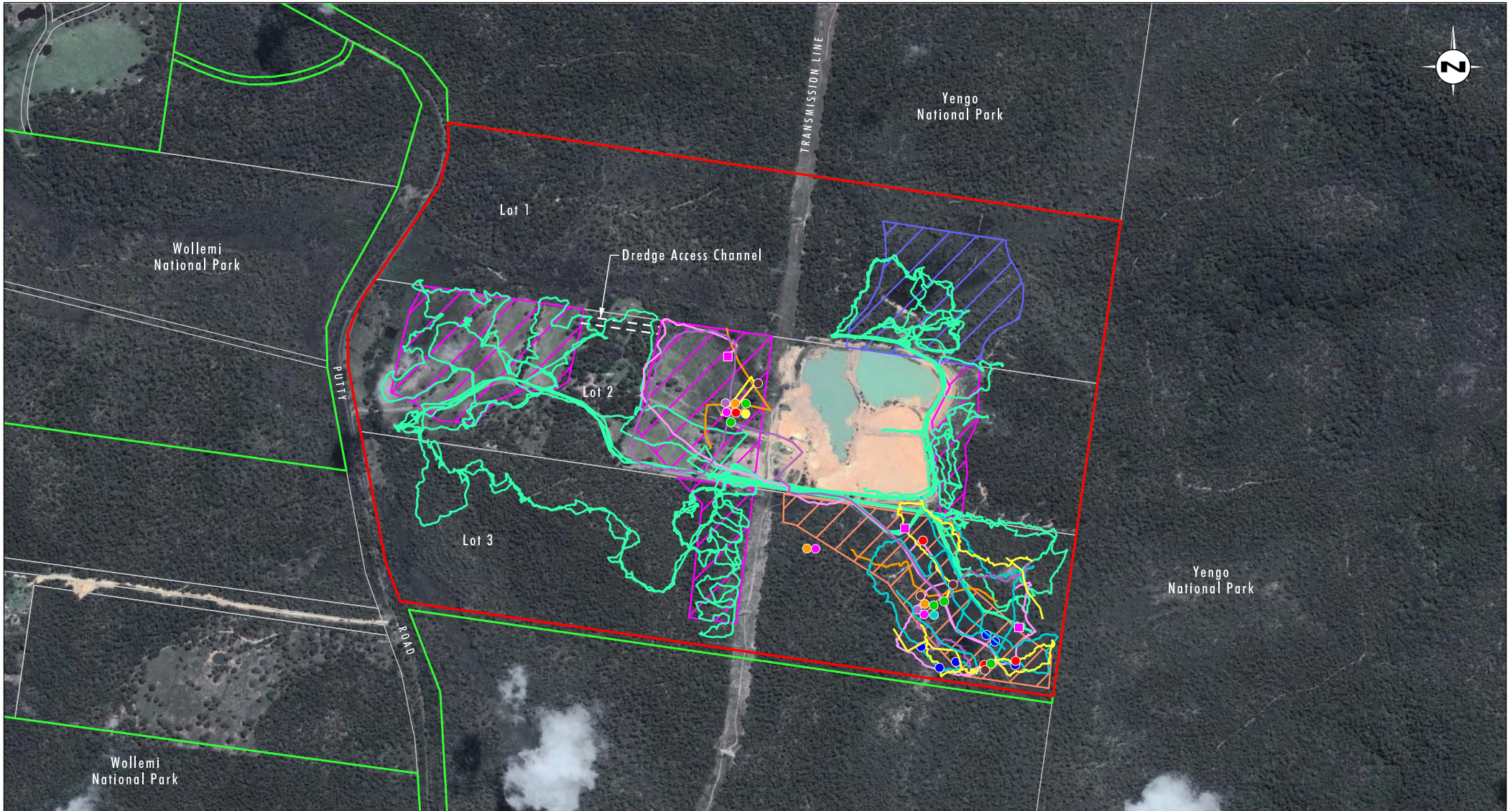
- woodland habitat;
- swamp forest habitat;
- derived native grassland habitat; and
- sedgeland habitat.

A summary of the fauna survey schedule is provided in **Table 3.3**. **Figure 3.2** shows the location of all fauna survey methods undertaken as part of the Project.

Table 3.3 –Fauna Survey Periods

Timing	Duration
Spring 2010 (15 to 19 November 2010)	5 days/4 nights
Summer 2011 (7 to 11 February 2011)	5 days/4 nights
Winter 2011 (11 and 12 August 2011)	2 days
Spring 2012 (26 to 28 November 2012)	3 days

During each of the fauna survey periods, a variety of survey techniques were employed. Each technique is described in detail in the following sections.



Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- | | | | |
|--------------------------------------|--|------------------------------|---|
| Project Area | Terrestrial Eliot A and B and Cage Trap Transect | Hair Funnel Trap Transect | Bird Survey Site |
| Proposed Extraction Area | Bird Survey | Anabat Echolocation Recorder | Diurnal Reptile and Amphibian Survey Site |
| Domain 3 Extraction Area | Diurnal Reptile and Amphibian Survey | Pitfall Trap Site | Spotlighting Survey Site |
| Domain 7 Extraction Area | Spotlighting Survey | Habitat Assessment Site | Nocturnal Reptile and Amphibian Survey Site |
| National Park Boundary | Nocturnal Reptile and Amphibian Survey | Owl Call Playback Site | Targeted Winter Bird Survey Site |
| Threatened Fauna Meandering Transect | Arboreal Elliott B Trap Transect | Harp Trap Site | |

File Name (A4): R17_V1/1731_378.dgn

FIGURE 3.2

Fauna Survey Methods

3.4.1 Trapping Surveys

A variety of different types of traps, targeting a wide range of mammal species, were used during the general fauna surveys, as detailed below.

Terrestrial Elliott Traps

Terrestrial Elliott A and Elliott B traps were set in pairs approximately 20 m apart on the ground and baited with a mixture of rolled oats and peanut butter. All traps were positioned where possible amongst habitat features such as logs, fallen bark, rocks and ground cover. All Elliott traps were covered with a plastic bag to prevent rain entering and were lined with woollen wadding to provide insulation for captured animals. All terrestrial Elliott traps were positioned to avoid overheating in early morning sunlight, and were tilted towards the front to prevent rain from entering the plastic bag covering the trap.

During spring 2010, 25 terrestrial Elliott A and 25 terrestrial Elliott B traps were set at each of the two terrestrial Elliott trapping transects located in the centre of the Project area and (refer to **Figure 3.2**). This was repeated in the same location during the summer 2011 surveys. A total of 800 terrestrial Elliott trap nights were completed, comprising 400 terrestrial Elliott A trap nights and 400 terrestrial Elliott B trap nights undertaken over two survey periods.

Arboreal Elliott B Traps

Arboreal Elliott B traps were set approximately 30 m apart on tree trunks, and were baited with a mixture of rolled oats, peanut butter and honey. Traps were positioned on platforms attached to the trunks of large trees approximately 3 to 4 m above the ground. Where possible, large trees with hollows were targeted for use as trap locations. The trunk of the tree and entrance to the trap were sprayed with a honey and water mixture (spring survey) or a brown sugar and water mixture (summer survey) to attract arboreal mammals. All Elliott traps were covered with a plastic bag to prevent rain entering and were lined with woollen wadding to provide insulation for captured animals. All traps were positioned to avoid exposure to morning sunlight, and were tilted to prevent rain from entering the plastic bag covering the trap. Arboreal Elliott B trapping was undertaken during both the spring and summer survey periods.

During spring 2010, a total of 10 arboreal Elliott B traps were set, while the summer 2011 survey included a total of 13 arboreal Elliott B traps at each of the two arboreal Elliott B trapping transects in the south east of the Project area (refer to **Figure 3.2**). A total of 132 arboreal Elliott B trap nights were sampled within the Project area.

Terrestrial Cage Traps

Single ended cage traps (600 mm (L) × 300 mm (H) × 300 mm (W)) were baited with raw chicken necks. Half of the length of each trap was covered with a plastic bag and shade cloth to provide rain, wind and shade protection for captured animals. All cage traps were positioned to avoid exposure to early morning sunlight. Traps were positioned at level ground or amongst vegetation where the trap was unable to roll away if a captured animal struggled within the trap. Cage trapping was undertaken during the spring 2010 survey period (refer to **Figure 3.2**).

During spring 2010, six cage traps were set along each of the two cage trapping transects for four nights. A total of 48 terrestrial cage trap nights were completed across the Project area.

Terrestrial Hair Funnels

Terrestrial hair funnels were baited with either meat (raw chicken necks) or a rolled oats and peanut butter mixture. All terrestrial hair funnels were positioned amongst habitat features such as logs, fallen bark, rocks and ground cover. All hair funnels were left in position for between 4 and 86 nights and all hair samples collected were identified by Barbara Triggs (a recognised expert in the field of hair and scat identification) of 'Dead Finish', Victoria.

During the spring 2010 and summer 2011 surveys, a total of 20 terrestrial hair funnels were set at each of the two hair funnel transects (refer to **Figure 3.2**). A total of 3600 terrestrial hair funnel trap nights were sampled within the Project area.

Arboreal Hair Funnels

Large Faunatech style hair funnels were baited with a rolled oats, peanut butter and honey mixture and were positioned 1.5 m to 2.0 m above the ground on tree trunks or branches. The hair funnel and the tree trunk were sprayed with a honey and water emulsion that acts as an attractant. All collected hair samples were identified by Barbara Triggs (a recognised expert in the field of hair and scat identification) of 'Dead Finish', Victoria.

During the spring 2010 survey, a total of 10 arboreal hair funnels were set at each of the two hair funnel transects (refer to **Figure 3.2**) with an additional 13 hair funnels distributed during the summer 2011 survey. A total of 1720 arboreal hair funnel sampling nights were completed across the Project area.

Harp Traps

Harp traps were positioned along potential micro-bat flyways such as existing tracks and corridors in the vegetation. Captured bats were kept during the day in small calico bags suspended inside an animal-holding box, which was kept in a cool, sheltered position at all times. All bats were released at dusk on the day of capture after they had aroused from daily torpor. Harp traps were also inspected during nocturnal surveys and any captured bats were released immediately following identification.

Four harp traps were set across the Project area during each of the spring 2010 and summer 2011 harp trapping sites for two nights (refer to **Figure 3.2**). A total of 16 harp trap nights were sampled within the Project area.

Pit Fall Traps

Six pitfall traps were positioned in the south east of the Project area among nearby sedges and swamp lands in the 2010 and 2011 surveys. They were opened late in the afternoon and checked for fauna at dawn the next day. Pitfall traps consisted of a 20 L plastic bucket buried in the ground and positioned centrally along a drift fence (0.2 m high and 10 m long). The drift fence was held taut by 10 mm diameter steel rods driven into the ground. Steel rods and tie wire supported the length of the drift fence. The drift fence was buried approximately 10 mm into the ground and all potential obstacles (sticks, rocks, dirt clumps, etc) were removed from 100 mm on either side. Pitfall traps were positioned to avoid areas of significant run-off and areas of high ant or wildlife activity. Moist soil and leaf litter was placed in the pitfall bucket to provide moisture and shelter for captured fauna. The moisture level of the soil was checked and maintained daily. Small sticks and timber debris were also placed within the bucket to provide shelter for captured fauna.

A total of 12 trap nights were completed at the spring 2010 and summer 2011 pit fall trapping sites (refer to **Figure 3.2**).

3.4.2 Area Searches

A variety of area searches of differing duration and purpose were undertaken as part of the general fauna surveys. The area searches employed across the Project area are detailed below, and **Figure 3.2** displays the locations of all area searches.

Spotlighting Searches

Spotlighting searches were undertaken both on foot and from a slow moving vehicle. Walking spotlighting searches were undertaken by two observers for a period of at least 30 minutes (total of one person hour) on each occasion. Vehicle spotlighting searches were undertaken by the passenger(s) from a slow moving vehicle along vehicle tracks between trapping sites. Walking and vehicle spotlighting searches were undertaken using 30 watt Lightforce spotlights.

A total of eight person hours and opportunistic driving spotlighting searches were completed across the Project area across the spring 2010 and summer 2011 surveys.

Reptile and Amphibian Searches

Diurnal searches targeting reptiles and amphibians were undertaken during the warmest parts of the day. All reptile and amphibian searches were undertaken by two ecologists for a period of at least 30 minutes. Nocturnal reptile and amphibian searches were undertaken using Petzl headlamps and/or 30 watt Lightforce spotlights.

Habitat features investigated during reptile and amphibian searches included water bodies, emergent vegetation, wet soak areas, logs, rocks, loose bark on tree trunks, exposed bedrock, leaf litter and open grassland areas. Amphibians not identifiable from their calls were captured for visual identification. All amphibians were handled according to the hygiene protocol for the control of disease in frogs (Wellington and Haering, 2001). Non-venomous snake species and small lizards were captured for identification where necessary.

A total of 14 person hours of herpetological searches were completed across the Project area during the spring 2010 and summer 2011 surveys, comprising four person hours of nocturnal survey and 10 person hours of diurnal survey.

Bird Searches

Bird surveys were undertaken across the Project area at various times of the day, primarily in early to mid morning and mid to late afternoon. Bird searches were undertaken for one person hour (by one or two observers) on two separate days during each survey period. Opportunistic observations were recorded during all other aspects of the field survey, particularly while checking traps and when travelling between survey sites. Bird species were identified from characteristic calls and by observation using a 15 – 45 x 50 spotting scope or 10 x 42 binoculars.

A total of 8 person hours of bird searches were completed across the Project area during the spring 2010 and summer 2011 surveys.

Signs of Presence Searches

Searches for indirect evidence of animal presence were conducted opportunistically during all survey activities, particularly during habitat searches and reptile and amphibian searches. Due to the opportunistic nature of signs of presence surveys the level of survey effort was not recorded. Evidence of presence included scats, feathers, nests, burrows, bones, tufts of hair and scratch marks on trees. All hair, scat and bone samples were identified by Barbara

Triggs (a recognised expert in the field of hair and scat identification) of 'Dead Finish', Victoria.

Micro-bat Echolocation Recordings

Echolocation calls were detected using an Anabat II Bat Detector. Echolocation calls were recorded using an Anabat CF storage ZCAIM. The combination of detector and recording device is hereafter collectively referred to as the 'Anabat'. Anabats were positioned horizontally on tree trunks or at an approximate 30° angle on the ground.

Anabats were also positioned in potential micro-bat flyways, where possible and the recorders were automated and programmed to start recording one hour before dusk and to stop recording one hour after sunrise the following morning. Recordings were collected over four nights at any single Anabat location, with a total of 16 nights of survey completed in the Project area.

All recorded calls were analysed by Glenn Hoye of Fly by Night Surveys Pty Limited (a recognised expert in the identification of micro-bat calls). The echolocation calls of species were identified to one of three levels of confidence:

- confident;
- probable; and
- possible.

For the purposes of this assessment, all three levels of confidence were treated as positive identifications. The location of Anabat surveys is shown on **Figure 3.2**.

Nocturnal Call Playback

Nocturnal call playback sessions were undertaken within the four hours following dusk in five locations across the Project area. Calls were broadcast using a 10 watt directional loud hailer. Call playback sessions commenced and ended with a quiet listening period of approximately two minutes. Each species' call was played for a minimum of four minutes followed by a listening period of two minutes before the beginning of the next species' call. Mammal calls were played before bird calls to prevent the calls of predators (such as owls) decreasing the likelihood of prey species (such as gliders) responding to call playback. Call playback sessions included the calls of:

- squirrel glider (*Petaurus norfolcensis*);
- koala (*Phascolarctos cinereus*);
- masked owl (*Tyto novaehollandiae*);
- barking owl (*Ninox connivens*); and
- powerful owl (*Ninox strenua*).

A total of eight sessions of nocturnal call playback was undertaken across the 2010 and 2011 surveys of the Project area. Locations of all nocturnal call playback sessions are shown on **Figure 3.2**.

3.4.3 Targeted Winter Bird Surveys

Additional bird surveys were undertaken to target threatened winter migratory bird species known to occur in the local area, primarily being the regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*). Diurnal call playback sessions were undertaken at three sites (refer to **Figure 3.2**), using a 15 watt directional loud hailer. The sessions began with a period of quiet listening for approximately five minutes. Each species' call was played for a minimum of four minutes followed by a listening period of five minutes before the beginning of the next species. If a potential call of a target species was heard the method was repeated. Bird species were identified by characteristic calls or observation using a 60x magnification spotting scope or 10 x 42 binoculars. Targeted winter bird surveys were undertaken from early morning until late afternoon by two surveyors for a minimum of 20 minutes. A total survey effort of three person hours was undertaken across the Project area during the targeted surveys.

3.4.4 Targeted Rosenbergs Goanna Surveys

Targeted surveys for the threatened Rosenbergs goanna (*Varanus rosenbergi*), including searches for likely burrows, were undertaken between 26 and 28 November 2012. Areas of likely habitat were searched on foot to identify potential burrows or nest sites. An inspection camera with LED lighting was used to inspect each potential burrow with the interior of the burrows viewed in real time. A total of 24 person hours was completed across the Project area.

3.4.5 State Environmental Planning Policy No. 44 – Koala Habitat Protection

Any development application in a SEPP 44 specified local government area, affecting an area of 1 ha or greater, must be assessed under SEPP 44. Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala (*Phascolarctos cinereus*) habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy constitute 15% or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land comprises core koala habitat.

The species listed in Schedule 2 of the policy are shown in **Table 3.4**.

Table 3.4 – Species of Eucalypt listed in Schedule 2 of SEPP 44

Scientific Name	Common Name
<i>Eucalyptus tereticornis</i>	forest red gum
<i>Eucalyptus microcorys</i>	tallowwood
<i>Eucalyptus punctata</i>	grey gum
<i>Eucalyptus viminalis</i>	ribbon or manna gum
<i>Eucalyptus camaldulensis</i>	river red gum
<i>Eucalyptus haemastoma</i>	broad-leaved scribbly gum
<i>Eucalyptus signata</i>	scribbly gum
<i>Eucalyptus albens</i>	white box
<i>Eucalyptus populnea</i>	bimble box or poplar box
<i>Eucalyptus robusta</i>	swamp mahogany

An assessment of the presence of koala feed tree species (as listed on **Table 3.4**) was made opportunistically across the Project area as well as formally at each flora quadrat. Where

koala feed species were present in the Project area, an assessment of the proportion of feed species (compared to non-feed species) within the canopy was undertaken. Assessment of the proportion of Schedule 2 feed tree species was undertaken during habitat assessments and flora quadrats. The location of the SEPP 44 Assessment corresponds to the flora quadrats shown on **Figure 3.1** and the Habitat Assessment locations shown on **Figure 3.2**.

3.4.6 Fauna Survey Effort Summary

Fauna surveys have been conducted over several months and seasons in order to optimise the likelihood of identifying the full range of species that could occur in the Project area and proposed disturbance area. Fauna surveys were conducted in summer and winter to account for the known seasonal requirements and detectability period for most of the targeted species. Surveys across the Project area also focused on providing high levels of survey effort for a number of key species which were considered to be difficult to detect and this was carried out within predicted seasonal times of highest detectability. This effort was also matched to habitat areas considered likely to be of importance for target species.

During each of the fauna survey periods, a variety of survey techniques were employed. Consideration was given to the relevant OEH fauna survey guidelines (DEC, 2004) when designing the field survey, with appropriate survey methods selected that maximised the opportunities of identifying the full suite of fauna species that occur within the Project area.

3.5 Habitat Assessment Methodology

An assessment of the habitat features of the three broad habitat types occurring in the Project area; being woodland/forest, sedgeland and derived native grassland habitat was undertaken (refer to **Figure 3.2**). Within each main habitat type a habitat assessment proforma was completed, recording the following habitat characteristics:

Physical Site Characteristics:

- aspect; and
- slope.

Disturbance Level:

- fire history;
- cut stump density;
- grazing pressure level;
- erosion severity and type;
- weed infestation level and dominant species;
- level of rubbish dumping; and
- signs of feral animals.

Foliage Health:

- dieback level;
- mistletoe infestation level; and
- level of foliage insect attack.

Ground Cover:

- number and types of ground logs;
- number and types of stumps;
- per cent rock cover;
- per cent boulder and solid rock cover;
- ground vegetation cover percentage, dominant growth form and dominant species; and
- understorey layer cover percentage, dominant growth form and dominant species.

Tree Cover:

- canopy cover percentage, dominant growth form, dominant species;
- amount of horizontal perch sites;
- number of trees with loose bark; and
- number of trees with bark/litter mound at base.

Many of the habitat parameters measured at each quadrat were scored into categories or ranges, while the remainder were derived from direct measurements or counts.

4.0 Survey Results

4.1 Flora Survey Results

The results of the flora surveys, including field survey and desktop components, are presented in the following sections.

4.1.1 Database Searches

The threatened flora species recorded on the OEH Atlas of NSW Wildlife and the Department of the Environment Protected Matters Database are included in **Appendix A**.

4.1.2 Flora Species Recorded in the Project Area

A total of 246 species were recorded within the Project area, of which 232 (94.3%) are native and 14 (5.7%) are introduced species. A full list of the flora species recorded during surveys of the Project area is presented in **Appendix B**.

Of the flora species recorded, one species was recorded from the Class Cycadopsida (cycads), six species from the Class Filicopsida (ferns), one from the class Lycopsidea (clubmoss), and 238 from Magnoliopsida (flowering plants) (of which 79 were from sub-class Liliidae (monocots) and 159 from sub-class Magnoliidae (dicots)). Flora species were recorded from a wide representation of plant families, 56 in total. The most speciose families in the Project area were Poaceae (grasses) with 28 species recorded, followed by Myrtaceae (Eucalypts, tea-trees and paperbarks) with 25 species recorded, Proteaceae (banksias and grevilleas) with 23 species recorded and Fabaceae (Faboideae) (pea flowers) with 18 species recorded.

A total of 14 introduced species were recorded in the Project area during the field surveys, all of which are common pasture species occurring on roadsides, drainage lines, transmission line easements and cleared pasture areas. Introduced species included narrow-leaved carpet grass (*Axonopus fissifolius*), paspalum (*Paspalum dilatatum*), whiskey grass (*Andropogon virginicus*), coblers pegs (*Bidens pilosa*), stinking Roger (*Tagetes minuta*) and purpletop (*Verbena bonariensis*).

4.1.3 Vegetation Communities

Descriptions of each of the vegetation communities recorded in the Project area are provided below. These descriptions draw upon data obtained during field surveys and also from information referenced from DECC (2008) and Bell (1998). **Figure 4.1** provides the location and distribution of each vegetation community within the Project area.

Each of the vegetation communities recorded in the Project area were compared to the vegetation communities delineated under the Native Vegetation of Yengo and Parr Reserve and Surrounds (DECC, 2008) and the corresponding community is provided under each vegetation community description below.

No EECs listed under the TSC Act, FM Act or the EPBC Act were identified within the Project area or the Proposed Disturbance Area.



Source: Google Earth (2012), LMPA (2009), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- | | | |
|--|--|--|
| Project Area | Stringybark - Ironbark Forest | Hawkesbury Hornsby Plateau Exposed Woodland |
| Proposed Extraction Area | Mellong Sandmass Swamp Woodland | Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland |
| Domain 3 Extraction Area | Mellong Sandmass Swamp Woodland (Modified - Overstorey Absent) | Disturbed Land |
| Domain 7 Extraction Area | Mellong Sandmass Dry Woodland | Water body |
| National Park Boundary | Mellong Sandmass Dry Woodland Derived Native Grassland | Wetlands (Hawkesbury LEP 2012 mapping) |
| Limit of Approved Extraction (DA 134/95) | Mellong Sandmass Sedgeland | |

File Name (A4): R17_V1/1731_182.dgn

FIGURE 4.1
Vegetation Communities

4.1.3.1 Mellong Sandmass Dry Woodland

The Mellong Sandmass Dry Woodland is the dominant vegetation community within the Project area. This community typically occurs on the mid to lower slopes on an undulating sandy substrate.

Mellong Sandmass Dry Woodland is characterised by an open canopy (20% canopy cover), to 15 m in height, dominated by hard-leaved scribbly gum (*Eucalyptus sclerophylla*) and rough-barked apple (*Angophora floribunda*). Scattered forest red gum (*Eucalyptus tereticornis*) and Parramatta red gum (*Eucalyptus parramattensis* subsp. *parramattensis*) occur throughout this community.

The sub-canopy is typically open (20% canopy cover), to 8 m in height, dominated by narrow-leaved apple (*Angophora bakeri*), old-man banksia (*Banksia serrata*) and slender tea-tree (*Leptospermum trinervium*). This stratum is often absent, particularly in disturbed areas.

The understorey ranges from moderately dense to open (20 to 40% canopy cover) across the community's extent in the Project area with a diverse mix of heath species, including hairpin banksias (*Banksia spinulosa*), broad-leaved hakea (*Hakea dactyloides*), prickly Moses (*Acacia ulicifolia*), *Dillwynia retorta* and variable boosiaea (*Bossiaea heterophylla*). This stratum occurs to 3 m in height.

The ground cover is moderately dense (to 40% cover) and is dominated by grasses, low shrubs, herbs and sedge species. Dominant species include kangaroo grass (*Themeda australis*), wiry panic (*Entolasia stricta*), thyme honey-myrtle (*Melaleuca thymifolia*), Daphne heath (*Brachyloma daphnoides*), blue flax-lilly (*Dianella caerulea* var. *caerulea*) and blady grass (*Imperata cylindrica*).

Mellong Sandmass Dry Woodland occurs on the mid to lower slopes throughout the Project area. This community is affiliated with Mellong Sandmass Swamp Woodland which occurs on the lower slopes in areas of impeded drainage. Understorey species are similar at the ecotone of these two communities.

A large proportion of this community is situated within Yengo and Wollemi National Parks. Clearing has impacted on the extent of the community in adjoining private lands and despite the high levels of protection by inclusion in the reserve system, this community is recognised as one of high conservation value as it forms a component of Sydney Sand Flats Dry Sclerophyll Forests of Keith (2004) a unique vegetation class in NSW (DECC, 2008).

Mellong Sandmass Dry Woodland conforms to the description of Mellong Sands Scribbly Gum Woodland of DECC (2008). The community does not conform to any described EEC listed under the TSC Act or EPBC Act

4.1.3.2 Mellong Sandmass Dry Woodland Derived Native Grassland

Mellong Sandmass Dry Woodland derived native grassland is a variable community with scattered overstorey species including hard-leaved scribbly gum (*Eucalyptus sclerophylla*) and rough-barked apple (*Angophora floribunda*).

The understorey is dense (to 90% cover) and is dominated by a range of grasses, sedges and shrubs. These include *Eragrostis* and *Aristida* species, blady grass (*Imperata cylindrica*), grass trigger plant (*Stylidium graminifolium*), thyme honey-myrtle (*Melaleuca thymifolia*), tea-tree (*Leptospermum trinervium*), bracken fern (*Pteridium esculentum*) and *Leptocarpus tenax*.

Mellong Sandmass Dry Woodland Derived Native Grassland occurs in previously cleared areas surrounding Mellong Sandmass Dry Woodland within the Project area and comprises a highly modified and disturbed variant of Mellong Sands Scribbly Gum Woodland of DECC (2008). This community is of low conservation value and does not conform to any described EEC listed under the TSC Act or EPBC Act.

4.1.3.3 Mellong Sandmass Swamp Woodland

Mellong Sandmass Swamp Woodland occurs on lower slopes in association with Tinda Creek and its tributaries. This community is characterised by an open canopy (20% canopy cover) to 15 m in height, dominated by Parramatta red gum (*Eucalyptus parramattensis* subsp. *parramattensis*) and forest red gum (*Eucalyptus tereticornis*).

The sub-canopy and understorey stratum is typically absent from this community however scattered understorey species occur on the ecotone with Mellong Sandmass Dry Woodland. Scattered understorey species include *Conospermum ericifolium*, crimson bottlebrush (*Callistemon citrinus*), thyme honey-myrtle (*Melaleuca thymifolia*) and hairpin banksia (*Banksia spinulosa*).

The ground cover is dense (70% cover) and is dominated by sedge, low shrub, herb and grass species including *Leptocarpus tenax*, *Juncus* spp., wiry panic (*Entolasia stricta*), thyme honey-myrtle (*Melaleuca thymifolia*), fringed heath-myrtle (*Micromyrtus ciliata*), *Dampiera stricta* and blady grass (*Imperata cylindrica*).

Mellong Sandmass Swamp Woodland is affiliated with Mellong Sandmass Dry Woodland, which occurs up-slope of this community, and Mellong Sandmass Sedgeland, which occurs in areas that are periodically inundated which restricts the growth of canopy species. Understorey species are similar between Mellong Sandmass Swamp Woodland and Mellong Sandmass Sedgeland.

Mellong Sandmass Swamp Woodland conforms to the regional mapping description of Mellong Sands Drooping Red Gum Woodland (DECC, 2008). This community is known to occur within the Mellong Swamps and is considered to be of high conservation value as it is a naturally rare and isolated community. The community does not conform to any described EEC listed under the TSC Act or EPBC Act.

4.1.3.4 Mellong Sandmass Swamp Woodland (modified – overstorey absent)

This community comprises a derived community following the removal of canopy and shrub layers. The ground cover is dense and is dominated by sedges, low shrubs, herb and grass species including *Leptocarpus tenax*, *Juncus* sp., wiry panic (*Entolasia stricta*), thyme honey-myrtle (*Melaleuca thymifolia*), fringed heath-myrtle (*Micromyrtus ciliata*), *Dampiera stricta* and blady grass (*Imperata cylindrica*). The shrub layer is dominated by tea-trees (*Leptospermum* species), and regenerating canopy species including Parramatta red gum (*Eucalyptus parramattensis* subsp. *parramattensis*) and forest red gum (*Eucalyptus tereticornis*).

This community comprises a highly modified and disturbed variant of Mellong Sands Scribbly Gum Woodland of DECC (2008) and is of low conservation value. The community does not conform to any described EEC listed under the TSC Act or EPBC Act.

4.1.3.5 Hawkesbury Hornsby Plateau Exposed Woodland

Hawkesbury Hornsby Plateau Exposed Woodland occurs on upper slopes in the north, east and west within the Project area. This community is characterised by an open canopy (to 30% canopy cover) to 16 m in height, dominated by smooth-barked apple (*Angophora*

costata), yellow bloodwood (*Corymbia eximia*) and narrow-leaved stringybark (*Eucalyptus sparsifolia*).

The understorey is open (30% canopy cover) to 3 m in height and is dominated by narrow-leaved geebung (*Persoonia linearis*), prickly shaggy pea (*Podolobium ilicifolium*), rough bush-pea (*Pultenaea scabra*), large wedge pea (*Gompholobium grandiflorum*) and mountain devil (*Lambertia formosa*).

The ground cover is moderately dense (40% cover) and is dominated by kangaroo grass (*Themeda australis*), wiry panic (*Entolasia stricta*), wallaby grass (*Austrodanthonia fulva*), blue flax-lily (*Dianella caerulea* var. *caerulea*), wattled matt-rush (*Lomandra filiformis*) and rough guinea flower (*Hibbertia aspera*).

Hawkesbury Hornsby Plateau Exposed Woodland occurs in the east and west of the Project area on mid to upper slopes and is associated sandstone outcropping. This community conforms to the description of Sydney Hinterland Rocky Yellow Bloodwood Woodland. This community is the most common mapped community in the Yengo and Parr reserves (DECC, 2008). The community does not conform to any described EEC listed under the TSC Act or EPBC Act

4.1.3.6 Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland

Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland is a variable community which is maintained at or below one metre in height by slashing.

The understorey is dense (to 90% cover) and is dominated by a range of grasses, sedges and shrubs. These include *Eragrostis* and *Aristida* species, *Leptocarpus tenax*, blady grass (*Imperata cylindrica*), grass trigger plant (*Stylidium graminifolium*), thyme honey-myrtle (*Melaleuca thymifolia*), tea-tree (*Leptospermum trinervium*) and bracken fern (*Pteridium esculentum*).

Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland occurs within the electricity easement adjacent to areas of Hawkesbury Hornsby Plateau Exposed Woodland within the Project area.

4.1.3.7 Stringybark – Ironbark Forest

Stringybark – Ironbark Forest typically occurs on mid to lower slopes within the Project area. This community is characterised by an open canopy (to 35% canopy cover) to 20 m in height and is dominated by narrow-leaved stringybark (*Eucalyptus sparsifolia*), red ironbark (*Eucalyptus fibrosa*) and rough-barked apple (*Angophora floribunda*).

The sub-canopy is open (20% canopy cover), to 10 m in height, dominated by silver stemmed wattle (*Acacia parvipinnula*), *Allocasuarina gymnanthera* and regenerating canopy species.

The understorey is open (35% canopy cover) to approximately 3 m in height and is dominated by silver stemmed wattle (*Acacia parvipinnula*), native blackthorn (*Bursaria spinosa* subsp. *spinosa*) and narrow-leaved geebung (*Persoonia linearis*).

The ground cover is dense (to 70% cover), dominated by weeping grass (*Microlaena stipoides* var. *stipoides*), basket grass (*Oplismenus imbecillis*), blady grass (*Imperata cylindrica*) and Browns lovegrass (*Eragrostis brownii*).

Stringybark – Ironbark Forest occurs on mid slopes to the north and centre of the of the Project area in the west of the Project area. This community is affiliated with Hawkesbury

Hornsby Plateau Exposed Woodland, which occurs on upper slopes and Mellong Sandmass Dry Woodland and Mellong Sandmass Swamp Woodland, which occurs on the lower slopes. Several understorey species are shared between these communities however Stringybark - Ironbark Forest is a sheltered forest and therefore typically has a lower abundance of heath species.

Stringybark – Ironbark Forest conforms to Hunter Range Ironbark Forest of DECC (2008) and does not conform to any described EEC listed under the TSC Act or EPBC Act. While past evidence of disturbance was recorded within Yengo NP during surveys undertaken as part of the regional vegetation mapping project, continued threats have abated and extensive areas are now protected within the reserve system (DECC, 2008).

4.1.3.8 Mellong Sandmass Sedgeland

Mellong Sandmass Sedgeland occurs in association with Tinda Creek and its tributaries, in areas of impeded drainage. A canopy stratum is typically absent from this community however scattered Parramatta red gum (*Eucalyptus parramattensis* subsp. *parramattensis*) were identified regenerating within this community, at less than 5% cover.

The sub-canopy and understorey stratum is typically absent from this community however scattered understory species occur in the ecotone with Scribbly Gum Woodland with typical species including *Conospermum ericifolium*, laurel geebung (*Persoonia laurina*) and hairpin banksia (*Banksia spinulosa*).

The ground cover is dense (70% cover), dominated by sedge, low shrub, herb and grass species that included *Leptocarpus tenax*, *Juncus* species, *Lepyrodia scariosa*, zig-zag bog-rush (*Schoenus brevifolius*), wiry panic (*Entolasia stricta*), creeping raspwort (*Gonocarpus micranthus* subsp. *ramosissimus*), thyme honey-myrtle (*Melaleuca thymifolia*), fringed heath-myrtle (*Micromyrtus ciliata*) and *Dampiera stricta*.

Mellong Sandmass Sedgeland occurs on periodically waterlogged soils in the headwaters of Tinda Creek. This community is affiliated with Mellong Sandmass Swamp Woodland and share several understorey species. Mellong Sandmass Sedgeland occurs in areas that are periodically inundated with water which restricts the growth of canopy species.

Mellong Sandmass Sedgeland occurring in the Project area conforms to the description of Sydney Hinterland Sandstone Upland Swamp. This regional community is situated on seepage zones where periodically waterlogged peat and sandy loam soil gathers above Hawkesbury Sandstone bedrock (DECC, 2008). Regionally, the community comprises a dense cover of *Lepyrodia scariosa*, *Schoenus brevifolius*, *Leptocarpus tenax* and *Ptilothrix deusta* with shrubs sparsely distributed, often near the fringes of the community (DECC, 2008).

The DECC (2008) vegetation mapping of the Project area described the sedgelands occurring as Hunter Range Flats Freshwater Wetland. Hunter Range Flats Freshwater Wetland describes small areas of permanent water occurring on poorly drained alluvial flats of the Howes and Garland Valleys. The tall sedge *Carex appressa* forms very dense clumps in and around the permanent water. Scattered tall *Melaleuca linariifolia* and lower growing shrubs including *Leptospermum juniperinum* and *Acacia filicifolia* fringe drier margins of the wetlands and a range of other moisture loving sedges, ferns and herbs are known to occur (DECC, 2008). The sedgeland present in the Project area does not comprise an area of permanent water and the tall sedge, *Carex appressa* was not recorded during surveys, with dominant sedges including *Leptocarpus tenax*. Hunter Range Flats Freshwater Wetland was not recorded in the Project area.

The community does not conform to any described EEC listed under the TSC Act or EPBC Act.

4.1.4 Extent of Vegetation Communities in the Project Area and Proposed Extraction Area

Table 4.1 shows the area of each vegetation community within the Project area and proposed disturbance area. Should this option be pursued, the impacts associated with the alternative biodiversity offset strategy described in **Section 1.1.1** are provided in **Section 5.0**.

Table 4.1 – Vegetation Communities Identified Within the Project Area

Formation	Vegetation Community	Area of Community in the Project Area (ha)	Area of Community in the Proposed Disturbance Area (ha)
Forest and Woodland	Stringybark – Ironbark Forest	19.6	2.1
	Hawkesbury Hornsby Plateau Exposed Woodland	58.1	1.5
	Mellong Sandmass Dry Woodland	92.5	15.1
Swamp Forest and Sedgeland	Mellong Sandmass Swamp Woodland	29.6	4.8
	Mellong Sandmass Sedgeland	4.6	0.6
Derived Native Grassland	Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland	2.2	0.1
	Mellong Sandmass Dry Woodland Derived Native Grassland	24.4	17.5
	Mellong Sandmass Swamp Woodland (modified – overstorey absent)	6.6	3.1
Disturbed Land	Disturbed Land	21.8	0.1
Water body		0.2	0.2
Total		259.6	45.1

4.1.5 Threatened Flora Species, Endangered Flora Populations and Threatened Ecological Communities

A detailed table of all potentially occurring threatened flora species, endangered populations and TECs is provided in **Appendix A**. The small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was recorded in large numbers in clusters in the eastern portion of the Project area, including three plants within the proposed disturbance area. No endangered populations, TECs or other threatened flora species is known to occur in the Project area.

Those threatened flora species, endangered populations and TECs that are known or have the potential to occur in the Project area (refer to **Appendix A**) are listed in **Table 4.2**.

Table 4.2 – Threatened Flora Species with Known or Potential Habitat in the Project Area

Common Name <i>Scientific Name</i>	Legal Status		Recorded in Project Area	Recorded in Locality (within 10km)
	TSC Act	EPBC Act		
Small-flower grevillea <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	E	E	✓	✓
Bynoes wattle <i>Acacia bynoeana</i>	E	V	x	✓
<i>Eucalyptus</i> sp. Howes Swamp Creek	E	E	x	✓
White-flowered wax plant <i>Cynanchum elegans</i>	E	E	x	✓
<i>Olearia cordata</i>	V	V	x	✓
<i>Zieria involucreta</i>	E	V	x	✓
<i>Dillwynia tenuifolia</i>	V	-	x	✓

The location of small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) within the Project area is shown on **Figure 4.2**. A total of 849 individuals of this species were recorded in the Project area, of which three occur within the proposed disturbance area. The small-flower grevillea is listed as Vulnerable under the TSC and EPBC Acts.

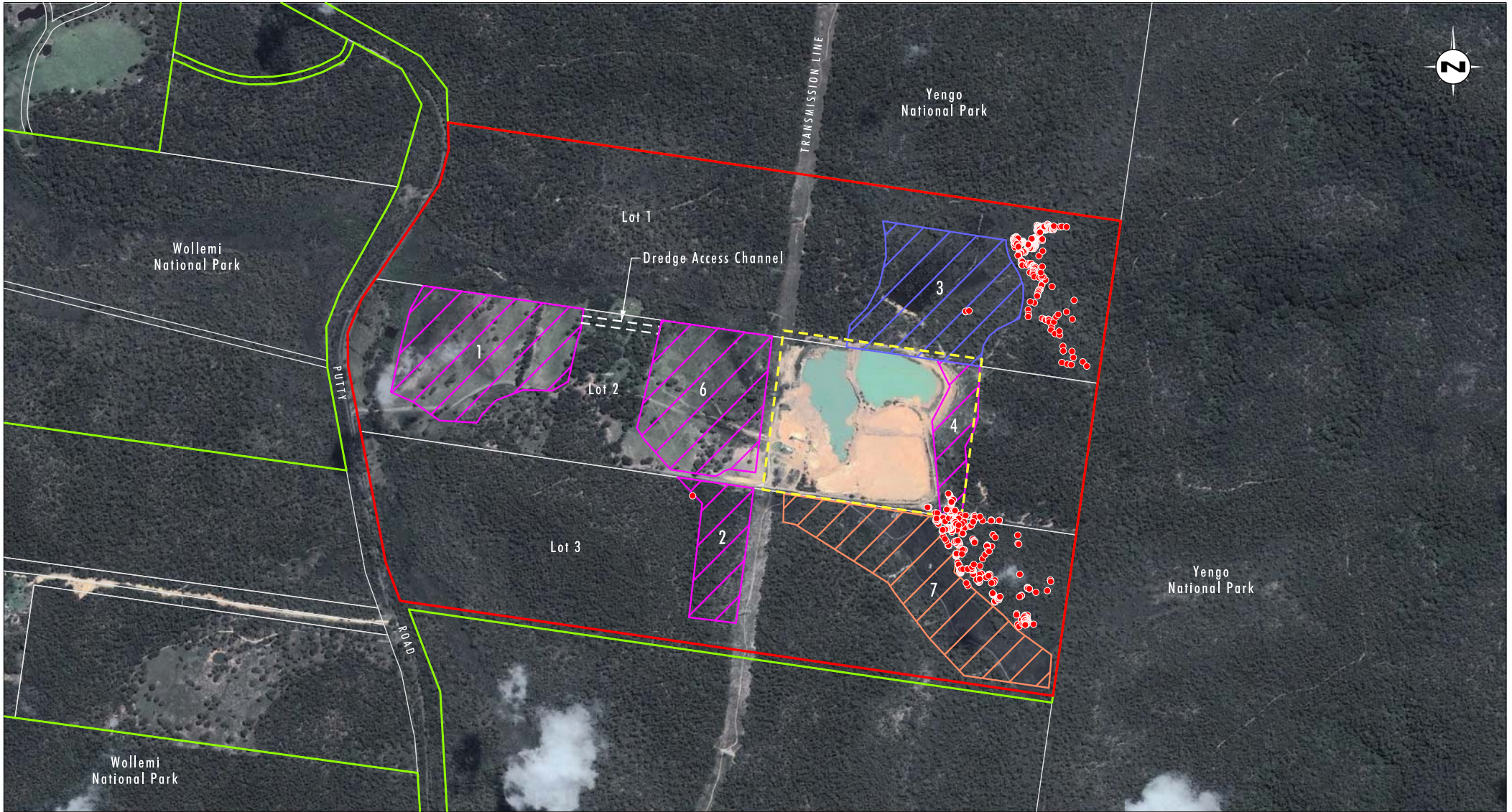
An assessment of the likely level of impact on small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) and each of the species assessed as having potential to occur in the proposed disturbance area has been undertaken in **Section 5.0** of this report.

4.1.5.1 Threatened Ecological Communities

Vegetation communities identified in the Project area were compared to TECs listed under the NSW TSC Act and the Commonwealth EPBC Act and an assessment of similarity with scientific determinations and listing advice of relevant TECs. Regional mapping identified the presence of *Freshwater Wetlands on Coastal Floodplains of the North Coast, Sydney Basin and South East Corner Bioregions EEC* and *River-flat Eucalypt Forest on Coastal Floodplains of the North Coast, Sydney Basin and South East Corner Bioregions EEC*, however an assessment of the floristic and structural components of the vegetation communities mapped in the Project area concluded that none of the identified vegetation communities identified through regional mapping conformed to any listed TECs. The following approach was used to verify the community vegetation community mapping in relation to TECs:

- comparison with published species lists, including lists of ‘important species’ as identified on the listing advice provided by OEH scientific committees;
- comparison with habitat descriptions and distributions for listed TECs;
- assessment using guidelines published by the NSW OEH; and
- comparison with other assessments of *Freshwater Wetlands EEC and River-flat Eucalypt Forest on Coastal Floodplains EEC* in the region.

Regional mapping undertaken by DECC (2008) included mapping of the Project area. Floristic data was not collected within the boundary of the Project area as part of the regional



Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15,000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Limit of Approved Extraction (DA 134/95)
- *Grevillea parviflora* subsp. *parviflora*

FIGURE 4.2
Threatened Flora Species

study and the Project area and vegetation communities were predicted based on aerial photography analysis.

The collection of targeted floristic data from 25 quadrats and 21 rapid assessments allowed for a thorough comparison between the mapped vegetation communities and the regional mapping data and EEC Scientific Committee determinations and the Project area is not considered to provide habitat for any State or Commonwealth listed EECs.

4.2 Fauna Survey Results

4.2.1 Database Searches

The threatened fauna species recorded on the OEH Atlas of NSW Wildlife Database and the Department of the Environment Protected Matters Database within 10 km of the Project area, are included in **Appendix A**.

4.2.2 Fauna Habitat of the Project Area

Four general fauna habitat types occurred within the Project area. Each of these broad habitat types has a range of characteristics which influence the habitat value, and the range of fauna species which are likely to be identified within each type. The broad habitat types recorded within the Project area comprised of sedgeland, woodland/forest, derived native grassland and farm dams.

4.2.2.1 Woodland/Forest Habitat

Approximately 170.2 ha of woodland/forest habitat occurs within the Project area (refer to **Figure 4.1**). The canopy was variable and dominated by stands of regenerating, middle aged and mature trees reaching between 10 and 20 m in height. The canopies of individual trees were typically affected by slight levels of dieback and mistletoe infestation during the time of the field surveys.

Tree hollows were recorded in middle-aged, mature and old growth trees. The dense shrub layer ranged between 0.2 m and 4.0 m in height and contained a high level of species and structural diversity. Ground cover was dominated by litter and herb/forb cover.

Species specific habitat was also recorded; including areas of litter at the base of trees, terrestrial and arboreal termite nests. No areas of rock on rock, rock overhangs, caves, or loose tree bark were recorded. Smooth barked tree trunks generally contained some large, medium and small scratch marks. None of the ten koala feed tree species listed on Schedule Two of SEPP 44 were recorded in excess of 15% of the canopy cover, however some areas of grey gum (*Eucalyptus punctata*) were recorded and comprised up to 10% of the canopy species.

4.2.2.2 Swamp and Sedgeland Habitat

Sedgeland areas were comprised of a dense stand of sedges up to one metre in height (refer to **Figure 4.1**) covering an area of 40.8 ha. Sedgelands were identified in areas of impeded drainage at the headwaters of Tinda Creek, at three discrete locations within the Project area. While most areas of the sedgeland were treeless, some areas contained a highly scattered canopy of regenerating (100 to 200 mm DBH) trees.

A highly scattered shrub layer ranged between 1.0 m and 4.0 m in height and contained a low level of species and structural diversity. Ground cover was dominated by sedge cover comprising 100% cover.

No species specific habitat areas of rock on rock, rock overhangs, caves, litter at the base of trees, loose tree bark, terrestrial or arboreal termite nests or log cover were recorded. None of the ten koala food tree species listed on Schedule Two of SEPP 44 were recorded at an individual or combined total of 15% of the canopy cover.

No evidence of a past fire history, grazing pressure, erosion, rubbish dumping or weed infestation were recorded. Parts of the sedgeland were disturbed by vehicle tracks, with areas of sedge flattened along the length of the vehicle tracks. The sedgeland was characterised by gentle (0° to 5°) sloping terrain and a north-easterly aspect.

During the November 2010 survey the sedgeland was wet and boggy under feet. During February 2011 the sedgeland was dry and did not contain any areas of free standing water or damp soil and it is expected that water levels in the sedgeland habitat will fluctuate according to rainfall.

4.2.2.3 Derived Native Grassland

Derived Native Grassland covered approximately 33.1 ha within the Project area (refer to **Figure 4.1**). Derived Native Grassland communities comprised intact native grassland with scattered trees. The canopies of individual trees were typically affected by slight levels of dieback and insect attack and appeared to be free of mistletoe infestation during the time of the field survey. The dominant canopy species were Parramatta red gum (*Eucalyptus parramattensis*) and rough-barked apple (*Angophora floribunda*).

Tree hollows were recorded in tree canopies with large (101 to 300 mm) tree hollows common and very small (<25 mm), small (26 to 50 mm), medium (51 to 100 mm) and very large (>301 mm) tree hollows rare.

A scattered shrub layer ranging between 0.2 m and 3.0 m in height was identified and contained a low level of species and structural diversity. Ground cover was dominated by grass and sedge cover. Areas of soil, litter and herb/forbs also occurred. No areas of lichen, or rocky ground cover were recorded. Derived Native Grassland areas typically comprised a mixed native and introduced species composition reaching an average height of 0.5 m. Log cover (fallen trees and branches) was absent.

No areas of rock on rock, rock overhangs, caves, litter at the base of trees, loose tree bark, terrestrial termite mounds or arboreal termite mounds were recorded. None of the ten koala food tree species listed on Schedule Two of SEPP 44 were recorded at an individual or combined total of 15% of the canopy cover.

Derived Native Grassland areas suffered slight grazing pressure from kangaroos and wallabies and slight sheet erosion. No evidence of a past fire history, rubbish dumping or weed infestation was recorded. Areas of grassland with scattered trees were typically characterised by gentle (0° to 5°) sloping terrain and a north-easterly aspect.

4.2.2.4 Farm Dam

A single small farm dam occurred within the Project area (along the north-eastern boundary of the eastern domain). The farm dam was approximately 5 m wide and 10 m long and during both survey periods contained approximately 0.5 m of water. No emergent water plant species were recorded and several large branches from a fallen tree were present within the farm dam. During the spring 2012 survey event this dam was dry. Further, a large shallow

sediment dam associated with existing quarry activities provided some foraging habitat areas for water birds and waders. Various drainage channels within the quarry area also potentially provide habitat for frog and water bird species. At the spring 2012 survey the large sediment dam had been drained of much of the water, with only scattered shallow standing ponds. The area was showing signs of recolonisation by sedgeland flora species.

4.2.3 Fauna Survey Results

A total of 121 fauna species were recorded during surveys of the Project area. The 121 species comprised 69 bird, 9 reptile, 11 frog and 32 mammal species. A list of all fauna species recorded within the Project area is presented in **Appendix C** of this report.

Records of fauna species should be interpreted with caution, since a record of a species within a particular area does not suggest it only occurs within that specific part of the Project area, and not within other parts. The high levels of mobility of many fauna species (particularly many birds and mammals) mean that those species could readily occur in areas other than where they were recorded.

Birds

A total of 69 bird species were recorded in the Project area, representing 30 families, with the largest number of species recorded in the families of Meliphagidae (honeyeaters – recording 13 species) and Pardalotidae (pardalotes – recording 10 species).

Some of the more frequently observed bird species recorded in woodland habitats included the noisy friarbird (*Philemon corniculatus*), white-checked honeyeater (*Phylidonyris niger*), brown thornbill (*Acanthiza pusilla*), yellow-faced honeyeater (*Lichenostomus chrysops*), laughing kookaburra (*Dacelo novaeguineae*) and superb fairy wren (*Malurus cyaneus*).

Bird species commonly recorded in the derived native grassland habitats included the noisy friarbird (*Philemon corniculatus*), yellow-faced honeyeater (*Lichenostomus chrysops*), laughing kookaburra (*Dacelo novaeguineae*) and willie wagtail (*Rhipidura leucophrys*).

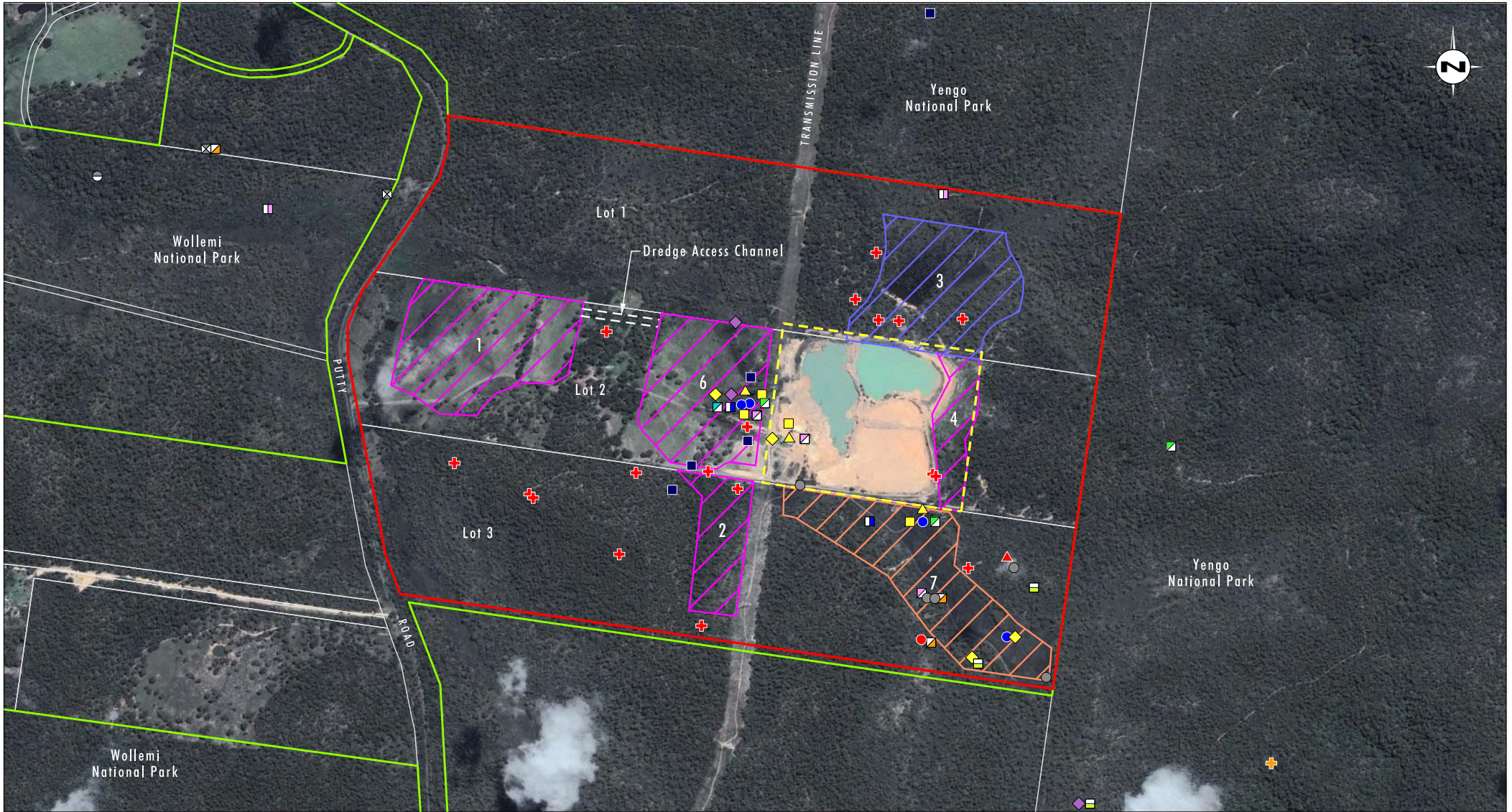
No introduced bird species were recorded within the Project area. Four threatened bird species were recorded, including the powerful owl (*Ninox strenua*); masked owl (*Tyto novaehollandiae*); varied sittella (*Daphoenositta chrysoptera*); and scarlet robin (*Petroica boodang*) (refer to **Figure 4.3**). One migratory species listed under the EPBC Act, the white-bellied sea-eagle (*Haliaeetus leucogaster*), was recorded soaring above the Project area during November 2010.

Reptiles

Nine reptile species were recorded within the Project area. The southern rainbow skink (*Carlia tetradactyla*) was the only reptile species recorded during the first two fauna survey periods and all reptiles were recorded in low abundance. One threatened reptile species, Rosenbergs goanna (*Varanus rosenbergi*) was recorded during the November 2010 and November 2012 surveys across the site (refer to **Figure 4.3**).

Amphibians

Eleven frog species were recorded in the Project area comprising five ground frog species in the family Myobatrachidae (southern frogs) and six tree frogs from the family Hylidae. Frog abundance was generally low across the Project area however, during the November 2010 survey frog abundance was very high at the small dam in the north-eastern corner of the Project area.



Source: Google Earth (2012), LPI NSW (2007), OEH (2013)

0 250 500 750m
1:15 000

Legend

- | | | | | |
|--|---------------------------|------------------------------------|-----------------------|------------------------|
| Project Area | East Coast Freetail-Bat | Large-eared Pied Bat | Rosenbergs Goanna | Grey-headed Flying-fox |
| Proposed Extraction Area | Eastern Cave Bat | Masked Owl | Scarlet Robin | Eastern Bentwing-bat |
| Domain 3 Extraction Area | Eastern False Pipistrelle | New Holland Mouse | Squirrel Glider | |
| Domain 7 Extraction Area | Greater Broad-nosed Bat | Eastern Pygmy Possum | Turquoise Parrot | |
| National Park Boundary | Glossy Black-Cockatoo | Potential Rosenbergs Goanna burrow | Yellow-bellied Glider | |
| Limit of Approved Extraction (DA 134/95) | Koala | Powerful Owl | Varied Sittella | |

FIGURE 4.3

Threatened Fauna Species

The most commonly recorded frog species were the banjo frog (*Limnodynastes dumerilii*), bleating tree frog (*Litoria dentata*), dwarf green tree frog (*Litoria fallax*) and broad-palmed frog (*Litoria latopalmata*). No threatened frog species were recorded.

Mammals

Thirty-two mammal species were recorded within the Project area, with the most common family Vespertilionidae (micro-bats) recording 13 species.

Four arboreal mammal species were recorded and comprised three threatened species, the koala (*Phascolarctos cinereus*), squirrel glider (*Petaurus norfolcensis*) and eastern pygmy possum (*Cercartetus nanus*) and the non-threatened common brushtail possum (*Trichosurus vulpecula*). Nine terrestrial mammal species were recorded and included one threatened species, the New Holland mouse (*Pseudomys novaehollandiae*), and three introduced species, the house mouse (*Mus musculus*), rabbit (*Oryctolagus cuniculus*) and fallow deer (*Dama dama*).

The koala (*Phascolarctos cinereus*), squirrel glider (*Petaurus norfolcensis*), common brushtail possum (*Trichosurus vulpecula*), east coast freetail-bat, white-striped freetail-bat (*Nyctinomus australis*), eastern bentwing-bat (*Miniopterus schreibersii*), Gould's wattled bat (*Chalinolobus gouldii*), chocolate wattled bat (*Chalinolobus morio*), greater broad-nosed bat (*Scoteanax rueppellii*), eastern broad-nosed bat (*Scotorepens orion*), little forest bat (*Vespadulus vulturinus*) and fallow deer (*Dama dama*) were all recorded during multiple survey periods.

A total of 17 bat species were recorded in the Project area and comprised one mega-bat species, the threatened grey-headed flying-fox (*Pteropus poliocephalus*), and 16 micro-bat species. Five of the micro-bat species were captured in harp traps and the remaining species were recorded using Anabat echolocation detectors.

There were 10 threatened mammals species recorded in the Project area (refer to **Figure 4.3** and **Section 4.2.3.1**).

4.2.3.1 Threatened Fauna Species

A total of 15 threatened fauna species were recorded within the Project area comprising 4 birds, 1 reptile and 10 mammals (including 6 bat species). Fourteen of these species are listed as Vulnerable under the TSC Act, with two of these species, and one additional species, also listed as Vulnerable under the EPBC Act. In addition, the grey-headed flying fox (*Pteropus poliocephalus*) was recorded during surveys via its characteristic call in habitats adjacent to the Project area. Following is a description of each of the threatened species records.

Those threatened fauna species that are known or have the potential to occur in the Project area (see **Appendix A**) are listed in **Table 4.3**.

Table 4.3 – Threatened Fauna Species Recorded or that may occur in the Project Area and Proposed Disturbance Area

Common Name <i>Scientific Name</i>	Legal Status		Recorded in Project Area	Recorded in Locality (within 10km)
	TSC Act	EPBC Act		
Giant burrowing frog <i>Heleioporus australiacus</i>	V	V	x	✓
Red-crowned toadlet <i>Pseudophryne australis</i>	V	-	x	✓
Rosenbergs goanna <i>Varanus rosenbergi</i>	V	-	✓	✓
Broad-headed snake <i>Hoplocephalus bungaroides</i>	E	V	x	✓
Glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V	-	x	✓
Gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V	-	x	✓
Swift parrot <i>Lathamus discolor</i>	E	E	x	x
Turquoise parrot <i>Neophema pulchella</i>	V	-	x	✓
Little lorikeet <i>Glossopsitta pusilla</i>	V	-	x	✓
Powerful owl <i>Ninox strenua</i>	V	-	✓	✓
Masked owl <i>Tyto novaehollandiae</i>	V	-	✓	✓
Brown treecreeper <i>Climacteris picumnus victoriae</i>	V	-	x	✓
Black-chinned honeyeater <i>Melithreptus gularis gularis</i>	V	-	x	✓
Scarlet robin <i>Petroica boodang</i>	V	-	✓	✓
Grey-crowned babbler <i>Pomatostomus temporalis temporalis</i>	V	-	x	✓
Varied sittella <i>Daphoenositta chrysoptera</i>	V	-	✓	✓
Regent honeyeater <i>Anthochaera phrygia</i>	CE	E	x	x
Spotted-tailed quoll <i>Dasyurus maculatus</i>	V	E	x	✓

Table 4.3 – Threatened Fauna Species Recorded or that may occur in the Project Area and Proposed Disturbance Area (cont)

Common Name Scientific Name	Legal Status		Recorded in Project Area	Recorded in Locality (within 10km)
	TSC Act	EPBC Act		
Brush-tailed rock-wallaby <i>Petrogale penicillata</i>	E	V	x	✓
New Holland mouse <i>Pseudomys novaehollandiae</i>	-	V	✓	x
Koala <i>Phascolarctos cinereus</i>	V	V	✓	✓
Long-nosed potoroo <i>Potorous tridactylus</i>	V	V	x	x
Eastern pygmy possum <i>Cercartetus nanus</i>	V	-	✓	x
Squirrel glider <i>Petaurus norfolcensis</i>	V	-	✓	✓
Yellow-bellied glider <i>Petaurus australis</i>	V	-	x	✓
Grey-headed flying-fox <i>Pteropus poliocephalus</i>	V	V	x	✓
Eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V	-	✓	✓
Little bentwing bat <i>Miniopterus australis</i>	V	-	x	x
Eastern cave bat <i>Vespadelus troughtoni</i>	V	-	✓	x
Large-eared pied bat <i>Chalinolobus dwyeri</i>	V	V	✓	✓
Eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	✓	x
East coast freetail-bat <i>Mormopterus norfolkensis</i>	V	-	✓	✓
Southern myotis <i>Myotis macropus</i>	V	-	x	x
Yellow-bellied sheath-tail bat <i>Saccolaimus flaviventris</i>	V	-	x	x
Greater broad-nosed bat <i>Scoteanax rueppellii</i>	V	-	✓	✓

Note:

TSC = Threatened Species Conservation Act 1995

EPBC Act = Environment Protection and Biodiversity Conservation Act 1999

V = Vulnerable

E = Endangered

CE = Critically Endangered

An assessment of the impact of the Project on threatened fauna species is provided in **Section 5.0** and in **Appendices D** and **E** of this report.

4.2.4 SEPP 44 Assessment Results

Two SEPP 44 tree species, grey gum (*Eucalyptus punctata*) and forest red gum (*Eucalyptus tereticornis*), were recorded within the Project area but neither comprised 15% or more of the total number of trees in the upper or lower strata of the tree component. However the Project area was identified as koala habitat by the identification of two koalas during spotlighting surveys. A single koala was identified via its characteristic call in the south-east of the Project area during spotlighting on 17 November 2011 (refer to **Figure 4.3**), however the individual was not positively identified during spotlighting surveys. An additional koala was identified in a hard-leaved scribbly gum (*Eucalyptus sclerophylla*) during spotlighting on 8 February 2011. This individual was identified as a young male, estimated to be between 4 and 6 kg in weight.

The identification of koalas within the Project area triggered the requirement to determine whether or not the Project area provides 'core koala habitat' in accordance with SEPP 44. Core koala habitat is determined by assessing the presence of a breeding population, particularly the presence of breeding females with back-young.

Only the November 2010 survey period occurred during the typical period (July to December) in which koala mothers are carrying their young on their backs. The single koala heard and that could not be located was likely a male, as females rarely bellow. The second koala identified during the February 2011 survey was an approximate 4 to 6 kg young male koala. Following a period of being on their mothers' backs, young koalas are forced to begin a stage of independence around the months of December and January. During this period young koalas typically remain within their mother's home range and often in trees close to their mother. During the first half of the subsequent calendar year young koalas will typically disperse out of their mother's home range area in search of a home range area of their own. It is most likely that the young male koala identified during February was still within his mother's home range, although he may have already started the dispersal process.

The presence of a young male koala during February and the resulting likely presence of his mother's home range area within the Project area or nearby indicate that the woodland areas in proximity to the Project area. To be conservative the Project area has been considered as most likely forming 'core koala habitat' as defined under SEPP 44.

The identification of potential core koala habitat under SEPP 44 triggers the requirement to prepare a koala management plan (KPoM) for the Proposal and a Koala Plan of Management for the Project is included as **Appendix F**.

4.3 Aquatic Species and Habitat

Aquatic habitats in the Project area include Tinda Creek, a tributary of Wollemi Creek which joins the Colo River approximately 16 km to the west of the Project area, artificial diversion channels and dam sites. Tinda Creek flows ephemerally to the north-west from the existing quarry, and has been diverted around the eastern and northern boundaries of the current operations via a small earthen drainage channel. Tinda Creek joins with other ephemeral second order streams on the northern boundary of the existing quarry. These drainage lines convey water during and immediately following rainfall, but do not hold water during periods of dry weather, due to the sandy nature and consequent relative high permeability of the substrate.

Surveys of the aquatic habitat within the Project area were undertaken by Umwelt in 2007 (Umwelt, 2008) and this information (including the reference sites) was used as a baseline for reference during surveys undertaken for the Project in 2011. As outlined in **Section 3.1**,

surveys reported in Umwelt (2008) involved condition assessments across eight monitoring sites, sampling of macroinvertebrates and water quality and photo monitoring points. Only sites 1 to 5 occur within the Project area. This monitoring was undertaken in August 2007 shortly after a period of relatively high precipitation and runoff that occurred during and following the June 2007 long weekend storm event.

4.3.1 Aquatic Habitat

The aquatic habitat within the Project area mainly consists of ephemeral tributaries of Tinda Creek with some associated dams and artificial diversion channels. Some areas do not have defined drainage channels, but are characterised by open floodplains and sedgeland.

Tributaries of Tinda Creek within the Project area are characterised by a dense cover of low trees and tall shrubs, including overhanging vegetation which provides shade to the creek. The results of the condition assessment undertaken at in a tributary on the west of the Project area near Putty Road showed the habitat in a healthy condition, although moderate levels of dieback were observed in the canopy trees. At the time of survey, water depth reached at least 0.7 m in some pooled areas. Very few introduced plant species were recorded and there was no evidence of significant disturbance from introduced fauna species. There was no evidence of significant erosion or sediment deposition.

Diversion channels and artificial dams within the Project area are characterised by narrow drainage lines and small isolated pools. Associated vegetation along the channels and dams ranges from moderate cover to sparse cover depending on disturbance and revegetation levels around the habitats. Diversion channels are generally between 1–2 m wide and low water depth (up to 0.3 m during surveys in 2007). Water in these areas is generally turbid with evidence of erosion and bank instability.

Open sedge aquatic habitats within the Project area are characterised by sandy floodplain, supporting a mono-specific sedgeland of round-headed bristle-sedge (*Chorizandra spaerocephala*). There are some scattered juvenile trees and shrubs in this location, in particular downstream closer to the quarry. Surface water is generally shallow or non-existent due to the sandy substrate and resultant high infiltration rate of the ridges adjacent to Tinda Creek that form the upper reaches of the catchment. The slope of the land and lack of a defined channel in the sedgeland area also contribute to the low surface water holding capacity at this location. No significant areas of erosion or sediment deposition occur in this area, and the vegetation is in a healthy condition.

4.3.2 Macroinvertebrate Sampling Results

The macroinvertebrate taxa recorded at each of the four sites sampled are listed in **Table 4.4** below. Sites 4 and 5 were located within the Project area and Sites 6 and 8 were located in downstream environments. This table also includes the SIGNAL 2 (Stream Invertebrate Grade Number Average Level) sensitivity grades (Chessman, 2003) for each taxon, where available.

Table 4.4 – Recorded Macroinvertebrates (August 2007)

Taxon	No. of Individuals Counted				SIGNAL 2
	Site 4	Site 5	Site 6	Site 8	
Acarina		3			-
Aeshnidae				1	4
Araneae	3		1	1	-
Atyidae		3			3
Baetidae	10	6	4	1	5
Brentidae	1				3
Ceinidae			1	12	2
Ceratopogonidae	6	6		4	4
Chironomidae	4	6	5	2	3
Cladocera			1		-
Coenagrionidae	6	2		1	2
Collembola	1	1			-
Corixidae	2	1			2
Culicidae	6	2	15	9	1
Cyclopoida	5	7	6		-
Dixidae				1	7
Dytiscidae	4	2	3	4	2
Hydraenidae	8			4	3
Hydrophilidae	21		1	17	2
Leptophlebiidae		1		1	8
Libellulidae		1		5	4
Lumbriculidae			2	1	-
Notonectidae		8			1
Ostracoda	3	7	130	3	-
Physidae				9	1
Planorbidae				1	2
Pyralidae	1				3
Scirtidae			2	1	6
Synthemistidae				1	2
Tricladida		1	1		-
Veliidae	7	1	2	13	3
Diptera pupae			7	4	-
Diptera adult			1		-
Total No. Individuals	88	58	182	96	
Total No. Taxa	16	17	16	22	
Taxa with SIGNAL grade > or = 5	1	3	2	4	

The results show relatively consistent taxa diversity across each of the four sites sampled. A slightly higher number of taxa were recorded at Site 8 compared to the other three sites. Site 8 is in a different catchment to the other three sites and is immediately downstream of a substantial swamp area and would therefore not be expected to support the same taxa composition and diversity as recorded at Sites 4, 5 and 6. Site 5 is on a tributary of Tinda

Creek and is upstream of the confluence of the tributary and Tinda Creek. As a result, Site 5 is not affected by runoff or discharges from the quarry.

A low SIGNAL2 score indicates taxa with low pollution sensitivity, while a higher score indicates taxa with high pollution sensitivity. The majority of the taxa recorded have a low SIGNAL 2 score, indicating taxa with high tolerance to disturbances. There are very few taxa with a SIGNAL 2 score of greater than 5 at all sites, with Site 8 (which is outside of the quarry catchment and therefore not potentially affected by quarry operations) having the greatest number.

In total, three taxa with a SIGNAL 2 value of 6 or greater were recorded. Those were:

- Dixidae (Site 8);
- Lethtophlebiidae (Sites 5 and 6); and
- Scirtidae (Sites 6 and 8).

Sites 5, 6 and 8 are located in areas where flowing water has been observed regularly even during dry periods whereas Site 4 which is downstream of the quarry is located on an intermittent drainage line that only flows during periods of rainfall generated surface runoff.

Macroinvertebrate taxa common to all four sites were Baetidae, Chironomidae, Culicidae, Dytiscidae, Ostracoda and Veliidae. Those taxa only recorded at Site 8, which is control site outside of the quarry catchment, were Aeshnidae, Dixidae, Physidae, Planorbidae and Synthemistidae, all of which have a low SIGNAL 2 grade (indicating tolerance) except Dixidae which has a SIGNAL 2 value of 7.

Each site supported relatively simple habitats for macroinvertebrate assemblages, and some sites supported a low volume of water and limited flow. No threatened macroinvertebrate or fish species were recorded.

4.3.3 Threatened Aquatic Species

No threatened aquatic species have been recorded in the aquatic habitats of the Project area. The Macquarie perch, listed as Endangered under the *Fisheries Management Act 1994* (FM Act) and the EPBC Act, has been previously recorded in Wollemi Creek and Colo River approximately 10 km west and downstream of the Project area (DPI, 2013b). The species has not been recorded in the Project area and due to the highly ephemeral nature of the aquatic habitats on site, it is considered unlikely that the species would occur.

Those threatened aquatic species that are known or have the potential to occur in the Project area are listed in **Appendix A**.

4.3.4 Summary of Aquatic Habitat Condition

The general health of the vegetation and waterways at each of the eight monitoring sites was found to be in good condition. All sites experienced disturbance from the summer 2006/2007 fire which appears to have caused the loss of much of the understorey vegetation and the dieback of a significant proportion of the canopy foliage also. At the time vegetation was found to be responding to the disturbance of the fire, with much new growth evident at the sites.

There was no obvious difference in the condition of the vegetation or riparian environment at any of the test sites compared with the control sites. There was also no indication that there had been a reduction in flow volumes in the reaches of Tinda Creek which occur downstream

of the quarry. All test sites were found to have a reasonable volume of water in the channel at the time of the monitoring survey (taking into consideration the natural capacity of the channel based on channel geomorphology), and there was no evidence of decline in riparian or floodplain vegetation that would be related to reduced flow volumes.

Based on the results of the baseline monitoring surveys conducted at eight sites along Tinda Creek and its tributaries, there are no indications that suggested that the quarry operations had resulted in any impacts on the ecology of Tinda Creek and by inference would be benign with respect to areas of the creek further downstream in the National Park and World Heritage Area.

4.4 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are described in the NSW GDE Policy (DLWC, 2002) and can include terrestrial vegetation, base flow in streams, aquifer and cave ecosystems and wetlands.

A review of the Groundwater Assessment (refer to Section 4.9 and Appendix 4 of the EIS) was undertaken to determine the extent and potential location of groundwater resources in the Project area to inform the identification of GDEs. None of the vegetation communities recorded in the Project area is expected to be exclusively groundwater dependent, however the following communities are expected to be reliant on groundwater interaction during periods of low surface water flow:

- Mellong Sandmass Swamp Woodland; and
- Mellong Sandmass Sedgeland.

The impact of the project on Groundwater Dependent Ecosystems is presented in **Section 5.7**.

5.0 Impact Assessment

The Project will result in the clearing of approximately 45.1 ha of land which includes areas of native vegetation, disturbed and open water areas. Approximately 238 ha of native vegetation occurs in the Project area providing known habitat for 15 threatened fauna species and one threatened flora species (refer to **Sections 4.2** and **4.3**).

The clearing associated with the Project and assessed as part of this Ecological Assessment includes approximately 44.9 ha of native woodland/forest, sedgeland; swamp forest and derived native grassland.

In addition to actions undertaken by Hy-Tec to avoid and minimise impacts on ecological values (refer to **Section 5.1**), substantial impact mitigation measures and a Biodiversity Offset Strategy are committed to ameliorate the impact of the Project on ecological values.

The majority of **Section 5.0** addresses the impacts of the Project as currently proposed as this provides a worse case impact scenario. As discussed in **Section 1.1.1**, an alternative biodiversity offset strategy has been proposed following feedback from OEH, DoE and the NSW NPWS. This proposed alternative offset site results in a slightly different and overall lesser impact to that of the Project and these differences are described in **Section 5.10**.

5.1 Project Changes to Avoid and Minimise Impacts

Hy-Tec undertook a detailed ecological constraints analysis to guide the development and detailed design of the Project. Through this process, alternative quarrying options were considered and Hy-Tec has sought to minimise the environmental impacts associated with the Project whilst maximising the economic resource recovery.

Key factors in Project design have been to ameliorate the impacts of the proposed Project on significant ecological features, such as threatened species and their habitats and native vegetation. The primary approach has been initially to avoid ecological impact, if possible, including maximising use of existing disturbed areas as much as possible for the Project.

As part of the preliminary environmental investigations for this project, the location and extent of the final extraction footprint has been refined by taking into consideration potential environmental constraints, in particular those related to ecology and the need to provide for an on-site biodiversity offset. As part of the ecological constraints analysis, a decision was made to not include the swamp woodland and sedgeland located in the in the south-east (referred to as Domain 7) of the Project area within the area to be quarried, despite the presence of high quality sand resources in that area. The disturbance footprint was relocated into majority grassland and previously disturbed habitats in an attempt to avoid high quality swamp and woodland vegetation. As a result, Hy-Tec reduced the extent of the proposed disturbance area by in excess of 15 ha. In addition, the large cluster of the threatened small-flower grevillea in the north-east of the site has been avoided through changes to the Proposed Disturbance Area boundary to directly avoid impacts to this population. This area of high conservation has now been included in the on-site offset area which represents a compromise between optimising the economic viability of extraction quantities and preserving habitat on site for use in developing the on-site offsetting strategy for the Project (refer to **Section 7.0**).

5.2 Impact of the Project on Ecological Values

5.2.1 Summary of Ecological Values

The ecological values identified in the Project area that have been considered in determining the impact of the Project and the development of impact mitigation and biodiversity offsetting requirements include:

- the loss of native vegetation communities and fauna habitats;
- known threatened species habitat, including:
 - identified habitat for one threatened terrestrial mammal species, the New Holland mouse, listed as Vulnerable on the EPBC Act;
 - core habitat for the koala (*Phascolarctos cinereus*), as described by SEPP 44 Koala Habitat Protection;
 - identified habitat of one threatened reptile species, Rosenbergs goanna, listed as Vulnerable on the TSC Act;
 - identified habitat for two forest owl species, the powerful owl and masked owl, both listed as Vulnerable on the TSC Act;
 - a large population of the TSC Act and EPBC Act listed *Grevillea parviflora* subsp. *parviflora*, with approximately 849 plants recorded during surveys;
 - an area of woodland habitat for threatened woodland birds and micro-bats including (but not limited to) the varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*), east coast freetail-bat (*Mormopterus norfolkensis*) and large-eared pied bat (*Chalinolobus dwyeri*); and
 - potential winter flowering woodland foraging habitat for the endangered swift parrot (*Lathamus discolor*) and for the critically endangered regent honeyeater (*Anthochaera phrygia*);
- the presence of groundwater dependent ecosystems Mellong Sandmass Swamp Woodland and Mellong Sandmass Sedgeland; and
- the presence of hollow dependent fauna habitat, including known habitat of the squirrel glider (*Petaurus norfolcensis*) and the eastern pygmy possum (*Cercartetus nanus*) both listed under the TSC Act.

5.3 Impact of the Project on Flora Species

A total of 246 flora species were recorded during flora surveys, of which approximately six per cent were not native to the area. The diversity of species recorded in the proposed disturbance area and Project area is considered likely to be similar to surrounding areas due to the intact nature of vegetation communities in the Project area generally and the contiguousness of the vegetation communities in the Project area with adjacent national parks.

The Project is not likely to result in a substantial impact on species diversity in the Project area as the high quality, in-tact communities in the Project area and Wollemi and Yengo National Parks will not be directly impacted as a result of the Project. In order to ameliorate the loss of species diversity from within the Project area, rehabilitation on site will target the re-establishment of native vegetation communities and will involve the use of native flora

species of local provenance to promote increased biodiversity in rehabilitation (refer to **Section 6.2**).

One threatened flora species listed under the TSC Act and EPBC Act small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) is known to occur in the Project area and within the proposed disturbance area. Impacts of the Project on this species are discussed further in **Section 5.8**.

5.4 Impact of the Project on Vegetation Communities

The dominant vegetation communities in the proposed disturbance area are Derived Native Grassland and Mellong Sandmass Dry Woodland. **Table 5.1** summarises the area of each vegetation community to be removed as a result of the Project. A range of impact mitigation measures have been formulated to minimise the impact of vegetation loss, as discussed in **Section 6.0**.

Table 5.1 – Area of Each Vegetation Community to be removed as a Result of the Project

Formation	Vegetation Community	Area of Community in the Project Area (ha)	Area of Community in the Proposed Disturbance Area (ha)
Forest and Woodland	Stringybark – Ironbark Forest	19.6	2.1
	Hawkesbury Hornsby Plateau Exposed Woodland	58.1	1.5
	Mellong Sandmass Dry Woodland	92.5	15.1
Swamp Forest and Sedgeland	Mellong Sandmass Swamp Woodland	29.6	4.8
	Mellong Sandmass Sedgeland	4.6	0.6
Derived Native Grassland	Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland	2.2	0.1
	Mellong Sandmass Dry Woodland Derived Native Grassland	24.4	17.5
	Mellong Sandmass Swamp Woodland (modified – overstorey absent)	6.6	3.1
Disturbed Land	Disturbed Land	21.8	0.1
Water body		0.2	0.2
Total		259.6	45.1

5.4.1 Impact on Forest and Woodland Communities

The Project will result in the removal of approximately 18.7 ha of woodland and forest communities (refer to **Table 5.1**). The Project area contains approximately 170.2 ha of woodland and forest communities, of which the Project will remove approximately 10.9% of the extent of woodland and forest communities in the Project area. The removal of 18.7 ha of woodland and forest vegetation as part of the Project is considered unlikely to be significant from a local or regional perspective.

None of the woodland and forest vegetation communities recorded in the proposed disturbance area conform to any EECs listed on the TSC or EPBC Acts.

5.4.2 Impact on Swamp Forest and Sedgeland Vegetation

The Project will result in the removal of approximately 5.4 ha of swamp forest and sedgeland vegetation. The Project area contains approximately 34.2 ha of swamp forest and sedgeland vegetation, which represents a loss of 8%. The removal of 5.4 ha of high quality swamp forest and sedgeland vegetation as part of the Project is considered unlikely to be significant from a local or regional perspective.

None of the swamp forest and sedgeland vegetation communities recorded in the proposed disturbance area conform to any EECs listed on the TSC Act or EPBC Act.

5.4.3 Impact on Derived Native Grasslands

The derived native grasslands identified within the disturbance footprint represent communities that have been substantially affected by past clearing, grazing practices and quarry activities. Despite this, the derived native grassland communities in the Project area and proposed disturbance area have a predominately native species composition.

The Project will result in the removal of 20.7 ha of Derived Native Grassland. The wider Project area contains approximately 33.2 ha of Derived Native Grassland, of which the Project will remove approximately 62.3%. The removal of 20.7 ha of Derived Native Grassland as part of the Project is considered unlikely to be significant from a local or regional perspective, due to the highly disturbed nature of the community and the retention of the woodland and forest communities within the Project area from which this community was derived.

The derived native grassland communities within the Project area and proposed disturbance area do not conform to any EECs listed on the TSC and EPBC Acts.

5.5 Impact of the Project on Fauna Habitat and Fauna Species

The Project will result in the loss of up to approximately 45.1 ha of native fauna species habitat within the proposed disturbance area. This comprises approximately 18.7 ha of woodland and forest habitat, 5.4 ha of swamp forest and sedgeland habitat and 20.7 ha of native grassland habitat. Native vegetation communities occurring in the Project area, including the proposed disturbance area provide a substantial and important area of habitat for native fauna species.

5.5.1 Woodland and Forest Habitat

The removal of approximately 18.7 ha of woodland and forest habitat within the proposed disturbance area represents a moderate loss of fauna habitat and represents a decrease of the area of remnant vegetation in the Project area. The majority of this habitat constitutes foraging habitat in the form of canopy vegetation, tree trunks and large branches and bark sub-surfaces. Associated with the extensive tree canopies of this habitat are moderate levels of leaf litter coverage, as well as fallen timber and rocky outcrops. Such features form important foraging and shelter resources for fauna species, including threatened species recorded in the proposed disturbance area and Project area. Other habitat features such as an open to moderately dense mid-understorey and shrub layer provide additional resources for foraging and nesting for the threatened woodland bird species known to occur.

The abundance of hollow-bearing trees in the woodland and forest habitat within the proposed disturbance area provides value as roosting and nesting habitat for hollow-dependent species. The woodland habitat is likely to be most valuable to both hollow-dependent and non-hollow-dependent threatened species such as the squirrel glider (*Petaurus norfolkensis*) and the proposed disturbance area is likely to provide important habitat for threatened micro-bat species such as the east coast freetail-bat (*Mormopterus norfolkensis*) and greater broad-nosed bat (*Scoteanax rueppellii*).

The loss of approximately 18.7 ha of woodland and forest habitat is not likely to result in a significant impact on native fauna species assemblages and in particular the range of woodland and forest-dependent threatened fauna species recorded in the proposed disturbance area or Project area.

5.5.2 Swamp Forest and Sedgeland Habitat

The loss of approximately 5.4 ha of swamp forest and sedgeland habitat is related to the removal of 4.8 ha of Mellong Sandmass Swamp Woodland and 0.6 ha of Mellong Sandmass Sedgeland.

These small areas of swamp forest and sedgeland habitat are important in the landscape as this habitat would be most valuable as flyways for threatened micro-bat species such as the threatened east coast freetail-bat (*Mormopterus norfolkensis*) and species dependent on dense closed habitats such as the powerful owl (*Ninox strenua*). The loss of approximately 5.4 ha of this habitat is not expected to be significant considering the availability of similar habitats in the wider locality.

The Project will result in the loss of one farm dam. Ephemeral and permanent aquatic habitat will remain unaffected in the wider Project area due to the ongoing utilisation of a dredge pond as part of the Project. Swamp Forest and sedgeland habitats, including aquatic species and habitats and the native fauna species dependent on those habitats will not be significantly impacted as a result of the Project.

5.5.3 Derived Native Grassland Habitat

The removal of approximately 20.7 ha of derived native grassland habitat within the proposed disturbance area represents a relatively minor loss of fauna habitat. Grassland habitat is most likely to provide open foraging habitat for fauna species occurring in adjoining vegetated refuge areas. It is likely that these open areas provide foraging habitat for a number of threatened fauna species, however this would be as sub-optimal, modified habitat only. Such habitat is most likely to benefit species that favour woodland margins and open areas such as the varied sittella (*Daphoenositta chrysoptera*), as well as species that would benefit from ecotones for foraging, such as the masked owl (*Tyto novaehollandiae*). It is unlikely that this vegetation community would form the primary foraging resource for any threatened fauna species identified within the proposed disturbance area or Project area.

The identification of threatened fauna species within derived native grassland habitats is also linked to the ease of sighting species during targeted surveys, especially species such as the masked owl (*Tyto novaehollandiae*) due to the reduced canopy cover. Similarly, the lack of canopy provides a quality flyway which allows for the easy identification of micro-bat species using the Anabat technology.

None of the threatened species recorded in the Project area are considered to be dependent on derived native grassland habitat and the derived native grassland occurring in the Project area is not expected to provide a core area of habitat for any threatened fauna species that could occur in the Project area.

The loss of 20.7 ha of derived native grassland as a result of the Project is not expected to be significant from a fauna habitat perspective.

5.5.4 Aquatic Habitat

During field surveys for the Project, aquatic ecology reference sites assessed in 2007 (Umwelt, 2008) were inspected to determine whether there had been any observable changes to habitat condition. The results of the assessment reported in Umwelt (2008) supported the conclusion that there were no indications that suggested that the quarry had resulted in any adverse impacts on the ecology of Tinda Creek.

Inspection of these areas during the field work for the Project indicated no observable changes to habitat condition. This is consistent with the findings of the baseline ecological study of Tinda Creek reported in Umwelt (2008) and demonstrates that the quarry operations are not having an adverse impact on the ecology of Tinda Creek and by inference would be benign with respect to areas of the creek further downstream in the National Park and World Heritage Area.

5.6 Impact of the Project on Threatened Species, Populations and Ecological Communities

The basic principles of reducing impacts on threatened species are to:

1. avoid direct impacts and retain habitat;
2. minimise impacts where ever possible;
3. mitigate or ameliorate impacts; and as a final step; and
4. compensate or offset for any unavoidable impacts.

Section 5.1 describes the impact avoidance measures implemented during project planning. The following sections provide a detailed assessment of the significance of impacts related to the Project on threatened species using the relevant tests of significance under State (EP&A Act) and Commonwealth (EPBC Act) legislation. The following assessments do not take into account the mitigation measures documented in **Section 6.0** or the Biodiversity Offset Strategy described in **Section 7.0**.

The precautionary principle has been consistently applied when assessing the potential impacts of the Project on threatened and migratory species and communities. The EP&A Regulation defines the precautionary principle as:

Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
- (ii) an assessment of the risk-weighted consequences of various options.

Further, the EPBC Act Significant Impact Guidelines 1.1 states the following:

When deciding whether or not a proposed action is likely to have a significant impact on a matter of national environmental significance, the precautionary principle is relevant. Accordingly, where there is a risk of serious or irreversible damage, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on a matter of national environmental significance.

In light of the above, where there was a lack of scientific certainty, the maximum reasonable potential impact was assumed. The development of mitigation and offset strategies were based on the outcomes of the impact assessment. The precautionary principle was also applied in the development of the mitigation and offset strategies to ensure that uncertainties were compensated for with more robust mitigation or more substantial offset outcomes.

The application of the precautionary principle described above is illustrated in **Figure 5.1** below.

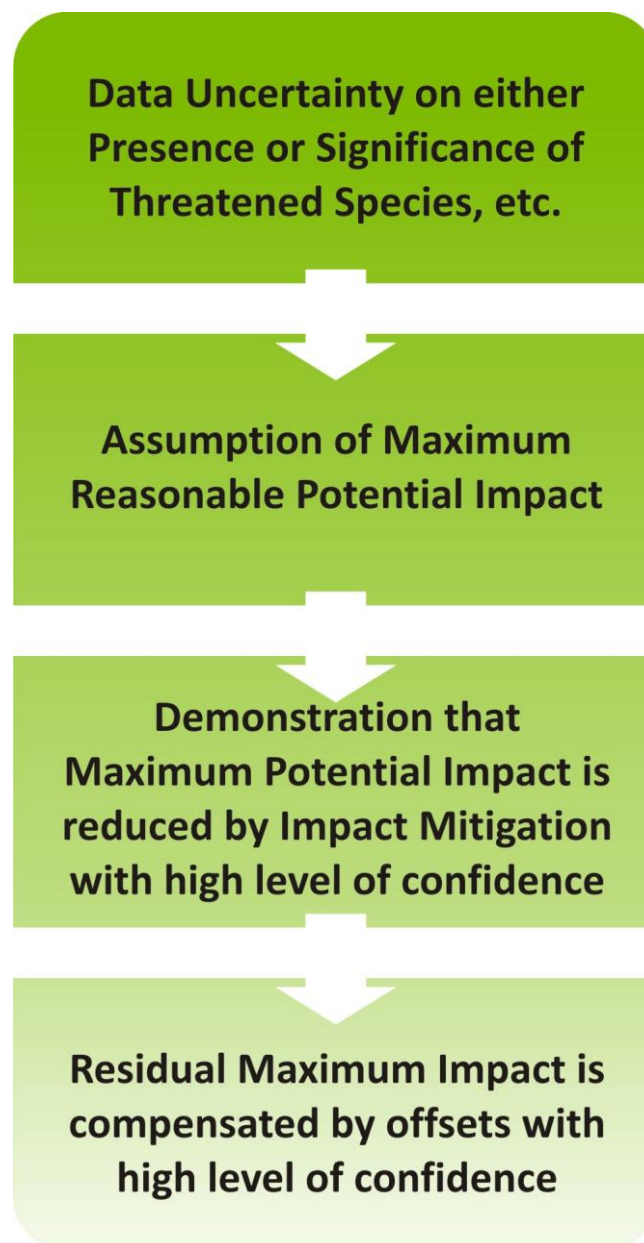


Figure 5.1 – Application of the Precautionary Principle to the Impact Assessment and Development of Mitigation and Offset Strategies

The potential level of impact on threatened species was assessed using the 'seven part test' as detailed in Section 5A of the EP&A Act (including terrestrial species listed under the TSC Act and aquatic species listed under the FM Act) and an 'Assessment of Significance' under the EPBC Act. The assessments of significance were undertaken following an initial screening process to identify species that may be potentially affected by the Project (refer to **Appendix A**), with a consequential full assessment of the likely significance of impacts being completed for these species (refer to **Appendices D** and **E**). The assessments of significance do not take into account the full range of impact mitigation strategies and biodiversity offsets proposed for the Project, rather they consider the impacts of the Project without any mitigation or offsetting, consistent with the requirements of both state and Commonwealth significant impact assessment guidelines (DECC, 2007a; DEHWA, 2009a). The Assessment of Significance was completed for the threatened species and TECs listed in **Table 5.2**, either due to their recorded presence or the presence of potential habitat in the proposed disturbance area, and the potential for the species to be affected.

Table 5.2 – Threatened Species for which an Assessment of Significance was undertaken under the EP&A Act or EPBC Act

Species/Community Name	Species Listed under the TSC Act		Species Listed under the EPBC Act	
	Assessed Under the EP&A Act (7 Part Test)	Significant Impact?	Assessed Under the EPBC Act	Significant Impact?
Threatened Flora				
Small-flower grevillea <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	✓	x	✓	x
Bynoes wattle <i>Acacia bynoeana</i>	✓	x	✓	x
<i>Olearia cordata</i>	✓	x	✓	x
<i>Dillwynia tenuifolia</i>	✓	x	x	x
Threatened Fauna				
Giant burrowing frog <i>Heleioporus australiacus</i>	✓	x	✓	x
Red-crowned toadlet <i>Pseudophryne australis</i>	✓	x	x	x
Rosenbergs goanna <i>Varanus rosenbergi</i>	✓	x	x	x
Glossy black-cockatoo <i>Calyptorhynchus lathami</i>	✓	x	x	x
Gang-gang cockatoo <i>Callocephalon fimbriatum</i>	✓	x	x	x
Swift parrot <i>Lathamus discolor</i>	✓	x	✓	x
Turquoise parrot <i>Neophema pulchella</i>	✓	x	x	x
Little lorikeet <i>Glossopsitta pusilla</i>	✓	x	x	x

Table 5.2 – Threatened Species for which an Assessment of Significance was undertaken under the EP&A Act or EPBC Act (cont)

Species/Community Name	Species Listed under the TSC Act		Species Listed under the EPBC Act	
	Assessed Under the EP&A Act (7 Part Test)	Significant Impact?	Assessed Under the EPBC Act	Significant Impact?
Powerful owl <i>Ninox strenua</i>	✓	x	x	x
Masked owl <i>Tyto novaehollandiae</i>	✓	x	x	x
Brown treecreeper <i>Climacteris picumnus victoriae</i>	✓	x	x	x
Black-chinned honeyeater <i>Melithreptus gularis</i>	✓	x	x	x
Scarlet robin <i>Petroica boodang</i>	✓	x	x	x
Grey-crowned babbler <i>Pomatostomus temporalis temporalis</i>	✓	x	x	x
Varied sittella <i>Daphoenositta chrysoptera</i>	✓	x	x	x
Regent honeyeater <i>Anthochaera phrygia</i>	✓	x	✓	x
Spotted-tailed quoll <i>Dasyurus maculatus</i>	✓	x	✓	x
Brush-tailed rock-wallaby <i>Petrogale penicillata</i>	✓	x	✓	x
New Holland mouse <i>Pseudomys novaehollandiae</i>	x	x	✓	x
Koala <i>Phascolarctos cinereus</i>	✓	x	✓	x
Long-nosed potoroo <i>Potorous tridactylus</i>	✓	x	✓	x
Eastern pygmy possum <i>Cercartetus nanus</i>	✓	x	x	x
Squirrel glider <i>Petaurus norfolcensis</i>	✓	x	x	x
Yellow-bellied glider <i>Petaurus australis</i>	✓	x	x	x
Grey-headed flying-fox <i>Pteropus poliocephalus</i>	✓	x	✓	x
Eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	✓	x	x	x
Eastern cave bat <i>Vespadelus trougtoni</i>	✓	x	x	x

Table 5.2 – Threatened Species for which an Assessment of Significance was undertaken under the EP&A Act or EPBC Act (cont)

Species/Community Name	Species Listed under the TSC Act		Species Listed under the EPBC Act	
	Assessed Under the EP&A Act (7 Part Test)	Significant Impact?	Assessed Under the EPBC Act	Significant Impact?
Eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	✓	x	x	x
East coast freetail-bat <i>Mormopterus norfolkensis</i>	✓	x	x	x
Greater broad-nosed bat <i>Scoteanax rueppellii</i>	✓	x	x	x
Large-eared pied bat <i>Chalinolobus dwyeri</i>	✓	x	✓	x
Southern myotis <i>Myotis macropus</i>	✓	x	x	x
Little bentwing-bat <i>Miniopterus australis</i>	✓	x	x	x
Yellow-bellied sheath-tail bat <i>Saccolaimus flaviventris</i>	✓	x	x	x

5.6.1 Threatened Species Assessed Under the *Environmental Planning and Assessment Act 1979*

The Project will result in the loss of a small area of habitat for a range of woodland-dependent threatened fauna species recorded in the proposed disturbance area and wider Project area. The loss of 18.7 ha of woodland/forest, 5.4 ha of swamp forest and sedgeland habitat and 20.7 ha of derived native grassland is not considered likely to result in the reduction in the local population of any of the threatened species recorded in the proposed disturbance area and wider Project area. Based on the threatened species assessment detailed in **Appendix D**, the Project is not considered likely to result in significant impacts on threatened fauna species recorded or considered likely to occur in the proposed disturbance area.

5.6.2 Threatened Species Assessed Under the *Fisheries Management (FM) Act 1994*

No FM Act listed threatened aquatic flora or fauna species were recorded within the proposed disturbance area and none are expected to occur.

This assessment concludes that no threatened aquatic species, populations or EECs have potential to occur within the proposed disturbance area. Tinda Creek does not provide known habitat for any threatened species listed under the FM Act.

5.6.3 SEPP 44 Assessment

As discussed in **Section 4.2.1**, the identification of core koala habitat under SEPP 44 triggers the requirement to prepare a koala management plan (KPoM) for the Project. A Koala Plan of Management is included as **Appendix F**.

5.6.4 Threatened Species Assessed under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment, Water, Heritage and the Arts is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- the Great Barrier Reef Marine Park;
- World Heritage properties;
- National Heritage places;
- nuclear actions; and
- a water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act lists criteria which are used to determine whether an action is likely to have a significant impact on MNES. These criteria are addressed in the Assessment of Significance provided in **Appendix E** and included the EPBC Act listed species identified in **Table 5.2**.

No EPBC Act-listed EECs were recorded in the proposed disturbance area or Project area. The outcome of the EPBC Act Assessment of Significance (refer to **Appendix E**), in relation to the threatened species listed recorded or potentially occurring in the proposed disturbance area in **Table 5.2**, indicates that the Project is not likely to result in a significant impact on any threatened species recorded, or potentially occurring in the proposed disturbance area.

One migratory species listed under international migratory species conventions was recorded during surveys within the Project area (refer to **Section 4.2.3**). The habitats of the disturbance footprint were not considered to be suitable for an important population of any migratory species, as defined by the EPBC Act impact assessment guidelines, and a significant impact on migratory species is not expected to occur as a result of the Project (refer to **Appendix E**).

5.7 Impact on Groundwater Dependent Ecosystems

As identified in **Section 4.4**, two vegetation communities, Mellong Sandmass Swamp Woodland and Mellong Sandmass Sedgeland, are considered to be Groundwater Dependent

Ecosystems, in accordance with the NSW GDE Policy (DLWC, 2002). The detailed analysis undertaken as part of the EIS indicates that changes to the groundwater regime as a result of the quarrying scenarios modelled may result in negligible reductions in average annual flows in Tinda Creek. Modelling indicates that the proposed quarry development is unlikely to significantly impact on the groundwater contribution to flows in Tinda Creek downstream of the quarry and subsequently is not likely to substantially impact the ecological values of Mellong Sandmass Swamp Woodland and Mellong Sandmass Sedgeland.

As part of the field surveys, an inspection of the areas potentially affected by drawdown of groundwater (adjacent to the existing extraction area) was undertaken, in the context of extraction operations being on site for approximately 30 years. This assessment related to GDEs present in Domain 7 (located in the south-east corner of the study area), Domain 3 (located in the north-east corner of the study area) and is also relevant to the area identified by Council LEP 2012 mapping as 'Wetland' (located in the western portion of the site, near the boundary of Lot 1 and Lot 2 and along the boundary with Putty Road) (refer **Figure 4.1**). It is worth noting that not all of the area designated by Council's LEP mapping is occupied by GDE's (**Figure 4.1**) and consequently, Council's mapping overstates the area of the site that supports 'wetland' habitat. This is presumably due to the scale at which Council mapping was undertaken and the lack of field verification.

The inspection concluded that the condition and floristic and structural components of the vegetation community adjacent to the extraction area was similar to vegetation occurring further away, with no apparent impacts from potential drawdown at the time of the field survey. The inspection also indicated that the vegetation communities adjacent to the current dredge area were in good condition, with no physical signs of degradation or die back observed. These observations accord with modelled drawdown effects of the existing dredge pond (based on measured groundwater levels in boreholes), which shows a limit of horizontal extent of drawdown, attributed to the high clay content (35-40%) and consequent low permeability of soils on site (refer **Section 4.9**). The Project is not expected to adversely impact Groundwater Dependent Ecosystems.

5.8 Impacts of the Project on Adjacent National Parks

The Project will not result in direct impacts to Wollemi or Yengo National Parks and the Project will be managed appropriately in order to limit the potential for in-direct impacts.

Indirect impacts identified by OEHL may include potential edge-effects and impacts on the conservation and recreational values of these National Parks.

Hy-Tec has incorporated a minimum 40 m buffer zone between the Project components and the National Park boundaries in order to minimise the potential for in-direct impacts to the conservation and recreational value of Wollemi and Yengo National Parks. Hy-Tec will manage sediment and erosion within the site's closed water management system and will incorporate a weed and feral animal monitoring schedule to minimise the potential for weed ingress from the site into the National Parks.

5.9 Impacts on Corridors and Connectivity

The Project area is surrounded by extensive areas of forested habitat within the Wollemi and Yengo National Parks that provide connectivity and movement corridors for a wide range of flora and fauna species from the Blue Mountains National Park in the south to the lower, central and upper Hunter Valley habitats in the north. The surrounding landscape is also

included in the Greater Blue Mountains World Heritage Area that is known for its extremely diverse ecosystems with over 400 species of fauna.

The protection of landscape connections are important to ensure the exchange of genetic material and ensure adequate feeding area, breeding grounds and allow for migration for species.

The open disturbed areas of the Project area are one of the few open areas within this large expanse of forest and woodland that is in excess of 600,000 ha. The Project will result in the loss of approximately 45 ha of native woodland and derived grassland habitat between Wollemi and Yengo National Parks. The disturbed and open areas of the Project area comprise isolated cleared areas within a large connected area of woodland and forest habitat. It is considered unlikely that the Project will restrict ecological vectors from moving from one habitat to another throughout the wider area or have substantial adverse impacts on the movement corridors and connectivity for species.

5.10 Summary of Differences relating to Impacts of the Alternative Project

As discussed in **Section 1.1.1** an alternative project and biodiversity offset strategy has been proposed following consultation with the NSW NPWS and also following feedback from OEH and DoE. The impact assessment provided above and throughout this report relates to the currently proposed Project. The alternative project and biodiversity offset strategy result in a similar level of direct impact and the impact assessment relating to threatened species indicates that the alternative project and biodiversity offset strategy does not result in changes to the Assessment of Significance at either the State or Commonwealth level (refer to **Section 5.6** and **Appendices D** and **E**). **Table 5.3** documents the key differences between the two proposals.

Table 5.3 – Comparison of Key Impacts and Attributes relating to the Project and the Alternative Project and Biodiversity Offset Strategy

Proposed Project	Alternative Project and Biodiversity Offset Strategy
Direct Impact of Vegetation and Fauna Habitat of 45.1 ha Area of Native Vegetation/Fauna Habitat 24.1 ha	Direct Impact of Vegetation and Fauna Habitat of 46.9 ha Area of Native Vegetation/Fauna Habitat 26.1 ha
Direct Impact to regionally significant vegetation communities 0.6 ha Mellong Sandmass Sedgeland 4.8 ha Mellong Sandmass Swamp Woodland	Direct Impact to regionally significant vegetation communities 2.5 ha Mellong Sandmass Sedgeland 6.7 ha Mellong Sandmass Swamp Woodland
3 <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	91 <i>Grevillea parviflora</i> subsp. <i>parviflora</i>
No significant impact on State listed threatened species, as identified through application of the Seven Part Test	No significant impact on State listed threatened species, as identified through application of the Seven Part Test
No significant impact on Commonwealth listed threatened species, as identified through application of the Assessment of Significance	No significant impact on Commonwealth listed threatened species, as identified through application of the Assessment of Significance
The Project will not result in direct impacts to Wollemi or Yengo National Parks and the Project will be managed appropriately in order to limit the potential for in-direct impacts	The alternative project and biodiversity offset strategy will not result in direct impacts to Wollemi or Yengo National Parks and the Project will be managed appropriately in order to limit the potential for in-direct impacts

Table 5.3 – Comparison of Key Impacts and Attributes relating to the Project and the Alternative Project and Biodiversity Offset Strategy (cont)

Proposed Project	Alternative Project and Biodiversity Offset Strategy
A minimum 237 m buffer between quarry activities and Yengo National Park	A 40 m buffer between quarry activities and Yengo National Park
The Project is not expected to adversely impact Groundwater Dependent Ecosystems	The Project is not expected to adversely impact Groundwater Dependent Ecosystems
Proposed biodiversity offset area of 71.5 ha	Proposed biodiversity offset area of 106.2 ha
Irregular shape boundary between National Park Estate and adjoining freehold land following incorporation of Biodiversity Offset Area into National Park Estate	Straight boundary between National Park Estate and adjoining freehold land following incorporation of Biodiversity offset Area into National Park Estate

6.0 Impact Mitigation Measures

Hy-Tec has sought to avoid and minimise potential impacts on the ecological values of the Project area throughout the project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities and fauna habitats. These avoidance measures are described in detail in **Section 5.1**.

Hy-Tec has committed to the design and implementation of a comprehensive strategy to mitigate the adverse impacts of the Project. Further to this, a comprehensive biodiversity offset strategy has been developed, which includes the protection and enhancement of native vegetation and threatened species habitat, to develop a positive long-term outcome for the threatened species and key ecological features affected by the Project. The proposed biodiversity offset strategy is documented in **Section 7.0**.

This section details the mitigation strategies that are designed to minimise impacts on significant ecological features known to occur in the areas to be disturbed as part of the Project.

Impact Mitigation Strategies will apply to both the proposed and the alternative biodiversity offset strategies whichever is adopted.

6.1 General Impact Mitigation Measures

6.1.1 Weed Control

Weed species could be inadvertently brought into the Project area with imported materials, or could invade naturally through removal of native vegetation. The presence of weed species within the Project area has the potential to significantly decrease the value of extant vegetation to native species, particularly threatened species and could adversely impact adjacent National Parks.

Hy-Tec will update their existing site Environmental Management Plan to incorporate details of the design and implementation of a robust weed management program. Noxious and other undesirable weed species within the Project area will be controlled to an acceptable level, and where possible eliminated, through an integrated approach involving a combination of chemical and physical control methods, and careful land management.

6.1.2 Sediment and Erosion Control

Prior to the quarry being established, Tinda Creek was an intermittent stream, draining from the south of the quarry in a north-westerly direction through the centre of the current extraction area. This flow path has subsequently been diverted around the eastern and northern boundaries of the current extraction area.

Surface water management procedures similar to those currently used are proposed for the quarry expansion. This will involve ensuring the clear flow of surface water around the quarry site and the containment of existing water within a closed quarry water management system. Proposed sediment and erosion control measures are detailed in Section 5.10 of the EIS.

6.2 Rehabilitation

The aim of the rehabilitation of the proposed disturbance area will be to re-establish those vegetation communities and fauna habitats currently recorded and connect, as far as practicable, the habitat areas to the north and south of the proposed disturbance area with a vegetated corridor. A range of criteria relating to biodiversity issues has been developed to direct the rehabilitation activities. Rehabilitation biodiversity objectives will be used in rehabilitation planning, and will:

- comprise a sustainable final landform and land use that can co-exist with surrounding land uses;
- re-establish vegetation consistent with extant vegetation communities of the proposed disturbance area within the post-mining landform; and
- re-establish fauna habitats consistent with extant fauna habitats of the proposed disturbance area within the post-mining landform.

Rehabilitation will consist of stabilising and returning the quarried ecological landscape to a condition similar to, or better than, its current state. To do so, two interrelated measures are proposed; the rehabilitation of the quarried landform, and a biodiversity offset package. The final quarried landform has been modelled and designed to create a free-draining landform, which was achieved using a commercially available software package called Natural Regrade™ which is based on Geofluv principles. The software was developed to allow the design of landforms based on natural landform principles, to ensure the stability of slopes created by the extraction operations. The principles of the proposed rehabilitation of the site have informed the objectives of the landform design process and parameterisation of the model set up.

Rehabilitation will be conducted progressively over the life of the quarry, as an integral component of quarry operations. All rehabilitation works will be scheduled to commence as soon as practicable after disturbance and reformation of the landscape. This approach will minimise the disturbed area at any point in time and hence reduce the ecological impact of the Project.

The post-mining areas will be progressively rehabilitated to derived native grassland and self-sustaining native vegetation communities, in accordance with a rehabilitation strategy. Rehabilitation works will use local provenance endemic species (for native communities), where practicable, including consideration of seed availability.

Further detail in regard to rehabilitation is provided in Section 4.15 of the EIS.

6.3 Protection and Management of Arboreal Species and Habitat

A robust tree felling procedure will be implemented at Tinda Creek Quarry to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees. The tree felling procedure is designed to minimise impacts to hollow-dependent fauna, particularly the threatened squirrel glider, tree-roosting hollow-dependent micro-bats, eastern pygmy possum, koala and threatened owls. The procedure includes the following:

- Comprehensive pre-clearing surveys by a suitably experienced and licensed ecologist, no more than two weeks prior to felling. This will include marking of hollow-bearing trees, as well as any other notable features such as fallen timber, hollow logs or boulders suitable for salvage; active nests, dreys or dens requiring consideration; and seed-bearing trees

for salvage. Surveys will include detailed searches for threatened flora and fauna species, including micro-bats.

- Removal of non hollow-bearing trees/vegetation as close to the hollow-bearing tree felling date as possible (in order to discourage fauna usage of the area).
- Visual canopy inspection of all trees to be removed by suitably experienced and licensed ecologist to ensure that the koala is not injured during tree felling operations.
- Detailed hollow-bearing tree felling procedures, including (but not limited to):
 - supervision of all hollow-bearing tree felling works by a suitably experienced and licensed ecologist. If an ecological issue is encountered, this person is to advise on the most appropriate measures to ensure minimal impact on fauna species, particularly threatened species;
 - visual canopy inspection on the day of the felling of hollow-bearing trees for fauna species and active nests;
 - shaking of hollow-bearing tree (with heavy machinery) for at least 30 seconds to encourage resident fauna to abandon tree, prior to felling;
 - lowering of hollow-bearing trees as gently as possible with heavy machinery;
 - inspection of all hollows in felled trees;
 - capture of any displaced/injured fauna;
 - release of unharmed fauna into nearby secure habitats;
 - injured fauna to be assessed and taken to wildlife carer, if necessary;
 - felled trees to be rolled so that the number of hollows blocked against the ground are minimised;
 - all felled trees to remain in place overnight to allow any unidentified fauna to escape; and
 - salvage of suitable hollows for treatment and installation within rehabilitation and revegetation areas as compensatory habitat, where practicable.

All personnel who will capture/handle/house and/or transport native fauna species (injured or uninjured) will be appropriately licensed under the requirements of the NSW Animal Ethics Committee.

Where trees are to be removed as part of quarrying activities an assessment of the density of tree hollows in surrounding woodland should be undertaken by a suitably qualified ecologist. The ecologist will determine the need for supplementation of tree hollows (using salvaged tree hollows or nest boxes) based on the number of hollows lost during felling and the extent of natural hollows in adjacent vegetation communities.

6.3.1 Nest Box Establishment

Nest boxes will be established in retained vegetation in proximity to area impacted as a result of the Project to mitigate the loss of hollow-bearing trees. An assessment of the number of tree hollows lost during clearing will be made as part of the tree felling activities and nest boxes will be established to compensate for this loss, where appropriate. Suitably designed nest boxes will be established for the range of hollow-dependent species that are known to occur in the Project area.

6.4 Rosenbergs Goanna Impact Mitigation Measures

A pre-clearance survey of the proposed disturbance areas will be undertaken prior to ground disturbance (within seven days of the planned disturbance) to ensure that no Rosenbergs Goanna burrows are present. The assessment should be undertaken by a suitably qualified and licensed ecologist. If burrows are present, the ecologist will provide advice on how to ensure that no goannas remain within the burrows during the clearing process.

A pre-clearance survey of all areas to be cleared will be undertaken (within seven days of the planned clearing time) to ensure that no termite mounds used by Rosenberg's Goannas are present. The assessment should be undertaken by a suitably qualified and licensed ecologist. If termite mounds are present, the ecologist will provide advice on how to ensure that no goanna eggs or juveniles remain within the mounds during the clearing process.

6.5 National Park Protection Measures

The '*Guidelines for developments on adjoining land and water managed by the Department of Climate Change and Water*' (DECCW, 2010) (now known as Office of Environment and Heritage) has been prepared to help avoid and minimise any direct or indirect adverse impacts on the National Parks estate.

The following issues need to be considered for developments adjoining OEHL land and, in particular, their impacts:

- erosion and sediment control;
- stormwater runoff;
- wastewater;
- management implications relating to pests, weeds and edge effects;
- fire and the location of asset protection zones;
- boundary encroachments and access through OEHL lands;
- visual, odour, noise, vibration, air quality and amenity impacts;
- threats to ecological connectivity and groundwater dependent ecosystems; and
- cultural heritage.

In order to address the issues that are relevant to the Project, a range of measures have been proposed including the:

- Use of a minimum 40 m buffer zone between Yengo National Park/Greater Blue Mountains World Heritage Area and the Project area to minimise the potential for adverse impact to NPWS estate;
- Implementation of weed control protocols within the buffer zone to prevent weed species spreading into Yengo National Park; and
- Implementation of appropriate sediment and erosion control measures to ensure that there are no off-site impacts associated with the Project.

7.0 Biodiversity Offset Strategy

A comprehensive biodiversity offset strategy has been prepared in accordance with the DGRs for the Project to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term. The Strategy has been prepared in accordance with Scenario 2 Mitigated Net Loss (Tier 3) as described in OEH's submission to inform the DGRs on 10 December 2012.

Hy-Tec has, where possible, modified the Project to avoid and minimise ecological impacts (refer to **Section 5.1**), and a range of impact mitigation strategies have been included in the Project to mitigate the impact on ecological values (refer to **Section 6.0**). Impact avoidance, minimisation and mitigation strategies have resulted in the reduction of impacts on threatened species known or considered likely to occur in the proposed disturbance area.

This section documents the approach that has been taken to develop a comprehensive biodiversity offset strategy, and provides information on how the biodiversity offset strategy will compensate for impacts on threatened species, vegetation communities and fauna habitats, together with a framework on how the biodiversity offset strategy will be implemented and monitored.

As stated in **Section 5.0**, the precautionary principle has been considered in the development of the mitigation and offsetting strategies, due to uncertainty and data deficiencies for some threatened species. The precautionary principle assumes the maximum reasonable potential impact is applied to these species in the impact assessment and therefore helps ensure robust requirements for mitigation and offsetting.

The objectives of the biodiversity offset strategy are to:

- identify offsets that contain as many as possible of the threatened vegetation communities, threatened flora species and threatened fauna species impacted by the Project;
- identify offsets that are strategically located;
- identify offsets through which an environmental gain can be made via appropriate management strategies;
- secure offsets in perpetuity;
- develop a management strategy for the positive environmental management of the proposed offset site; and
- as a minimum provide offsets that have the same ecological value as the residual impacts of the Project on vegetation communities, threatened flora species and threatened fauna species.

As discussed in **Section 1.1.1**, an alternative project and biodiversity offset strategy has been proposed in order to address adequacy comments provided by OEH and DoE and is based on discussions held at an on-site meeting with NSW NPWS. The objectives of the Strategy are common to both proposals and the alternative biodiversity offset strategy is generally in accordance with the description provided below for the originally proposed strategy. The key differences between the two strategies are provided as a summary in **Section 7.4**.

7.1 General Industry Approaches to Biodiversity Offsetting

7.1.1 'Traditional' Approaches

Over the course of the last 10-15 years, biodiversity offsets have been used in NSW as an effective measure to compensate for developmental impacts on biodiversity. Biodiversity offsets are often used where there will be a residual impact on biodiversity once impact avoidance, minimisation and mitigation have all been implemented to reduce impacts. While there have been no consistent, universally applied guidelines, it has generally been accepted that, in principle, biodiversity offsets should be:

- located as close as possible to the areas subject to impact, depending on the availability and suitability of such areas;
- appropriately monitored and managed for biodiversity outcomes;
- appropriately protected;
- at least as large as the area impacted; and
- designed to lead to a net gain in biodiversity values in the medium to long term.

Although these principles are not universally employed, it is recognised that they form an appropriate approach around which individual development offsets are assessed, even if it is not always possible to achieve all elements. In the past, biodiversity offsetting has taken the form of:

- developers managing land that is set aside for biodiversity conservation;
- developers donating appropriate land to OEH or other similar bodies for biodiversity conservation; and
- financial contributions to the government to fund land purchases for biodiversity conservation, or to fund biodiversity land enhancement projects, or funding to other organisations to implement threatened species recovery actions, and to undertake research and monitoring.

7.1.2 NSW Offsetting Principles and Policies

The NSW Government is currently developing a new approach to guide how biodiversity offsets are used for major projects (state significant development and state significant infrastructure). The NSW Government has recently developed (August 2013) the following seven principles to be used in assessing impacts to biodiversity and determining acceptable offsets for state significant development and state significant infrastructure projects.

- 1. Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.**

Offsets sit within a hierarchy of 'avoid, minimise, offset'. The first priority in a development proposal is always to avoid any unnecessary impact to biodiversity. Where impacts cannot be avoided, a reasonable attempt should be made to minimise the impact as much as possible. After all feasible measures have been taken to avoid or minimise impacts to biodiversity, offsets should be used to compensate for any remaining impacts.

2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.

Offsetting decisions should be based on a reliable and transparent assessment of the loss in biodiversity due to the development proposal and the likely gain in biodiversity through the offset.

3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

Offsets should reflect the biodiversity values, including threatened species and their habitat, that are being lost. This should be on a like-for-like basis for NSW-listed species and ecological communities that are also nationally listed.

Like-for-like is preferable for ecological communities, threatened species and their habitat that are only listed in NSW. However, where offset sites that are exactly like-for-like are not reasonably available, offsets may include vegetation communities of a similar type or a type of a higher conservation priority, or threatened species of a higher conservation priority.

4. Offsets must be additional to other legal requirements.

The biodiversity protection and management requirements of an offset must be in addition to any legal requirements already in place for biodiversity on that land. This includes, for example, any existing legal restrictions on clearing under the *Native Vegetation Act 2003*. Improvements in the condition of native vegetation not currently required by other legislation would count as an offset.

5. Offsets must be enduring, enforceable and auditable.

Offset sites must be subject to good governance arrangements to ensure they are not inadvertently developed in the future. This includes having an appropriate plan of management, resourcing for management, legal security and accountability mechanisms.

For terrestrial offsets, a BioBanking agreement or addition to the NSW national parks system are the preferred mechanisms for securing an offset site.

Suitable offsets must be determined prior to approval. However the offset does not need to be finalised (e.g. be purchased or have relevant protection over it) prior to approval, providing it is subject to a suitable mechanism that will remain enforceable after the project has been completed.

6. Supplementary measures can be used in lieu of offsets.

For terrestrial offsets, supplementary measures can be used in lieu of offsets in situations where land-based offsetting is not feasible or practical. The supplementary measure must be relevant to the biodiversity value being impacted. The monetary value of a supplementary measure is to be determined by an appropriate method that is repeatable and transparent.

7. Offsets can be discounted where significant social and economic benefits accrue to NSW as a consequence of the proposal.

While an outcome in which biodiversity values are improved or maintained is preferred, it is acknowledged that in some circumstances flexibility may be required, especially in the context of a project providing significant social or economic benefits to NSW.

Section 7.3 details how the above OEH (OEH, 2013b) biodiversity offsetting principles for state significant development and state significant infrastructure have been taken into account and addressed in the development of the Biodiversity Offset Strategy. The Biodiversity Offset Strategy is generally consistent with the NSW Offset Principles for Major Projects (OEH, 2013b).

7.1.2.1 OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts

On 25 June 2011 OEH released the NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) (OEH, 2011). The interim policy acknowledges that proposals assessed as State significant projects under the EP&A Act do not have to meet the 'improve or maintain' standard, which is required under the BioBanking scheme, nevertheless, adopts the use of the BioBanking Assessment Methodology (BBAM) for the purpose of:

- quantifying and categorising the biodiversity values and impacts of State significant projects;
- establishing, for benchmarking purposes, the offsets that would be required if the State significant project had been expected to meet the improve or maintain standard; and
- providing a structured approach to determining how proposals may, in lieu of meeting the improve or maintain standard, meet one of two alternative standards established under this policy.

The Policy provides for a range of mechanisms to be used to implement offsets (i.e. not only BioBanking credits) in view of the currently limited supply of biodiversity credits on the market. The Policy describes three possible outcomes that proposals should strive to meet depending on the circumstances. These outcomes are:

- Tier 1 – Improve or maintain with offsets calculated via the BioBanking calculator;
- Tier 2 – No net loss with offsets calculated via the BioBanking calculator; or
- Tier 3 – Mitigated net loss with offsets calculated by the BioBanking calculator but then amended by offset variation criteria to a minimum land offset to clearing ratio of 2:1.

The Biodiversity Offset Strategy has been prepared in accordance with Tier 3 of the Policy. In considering whether the mitigated net loss standard is appropriate, consideration is given to:

- whether the credits required by the calculator are available on the market;
- whether alternative offset sites (other than credits) are available on the market; and
- the overall cost of the offsets and whether these costs are reasonable given the circumstances.

Should any of these circumstances apply, then it is reasonable to apply the variation criteria to the point that:

- suitable offset sites can be found within a reasonable timeframe;
- the costs of offsetting is brought within a reasonable range; and
- an offset to clearing ratio of at least 2:1 vegetated to cleared hectares is achieved.

7.1.3 Commonwealth Environmental Offsets Policy

In October 2012 the Australian Government released the EPBC Act Environmental Offsets Policy (DSEWPC, 2012a). The policy relates to all protected matters under the EPBC Act including adversely impacted heritage values, and applies to offsetting requirements in terrestrial and aquatic (including marine) environments.

The Policy has five key aims:

- to ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
- to provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
- to deliver improved environmental outcomes by consistently applying the policy;
- to outline the appropriate nature and scale of offsets and how they are determined; and
- to provide guidance on acceptable delivery mechanisms for offsets.

According to the policy, direct offsets must constitute a minimum of 90% of the total offset requirement. The remaining offset requirement (up to a maximum of 10%) may be made up by 'other compensatory measures' to complete the 100% offset requirement. Deviation from the 90% direct offset requirement will only be considered in limited circumstances.

While this reinforces the move to direct offsets, the concept of 'advanced offsets' has been introduced. These are a supply of offsets for potential future use, transfer or sale, established before any impact is undertaken. While an advanced offset can reduce an overall future offset requirement, it does not influence whether or not an action referred under the EPBC Act will be determined as acceptable.

The policy requires that the 'conservation gain' for the impacted protected matter, which is delivered by the offset, is to be new or additional to what is already required by a duty of care or to any environmental planning laws at any level of government.

Importantly, the policy makes use of an impact and offsets calculator which is designed to determine the ecological costs of a development, termed 'impact points', together with the likely ecological benefit of offset sites, termed 'offset points' in order to assess the relative value of proposed offset packages. The policy also includes the provision that at least 90% of offset points must be earned from direct (i.e. land-based) offsets, while the remainder can be earned through indirect measures (e.g. funding or relevant recovery actions). The EPBC Act Offset Calculator Assessment has been applied to the impacts and proposed offsets for the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) which will be directly impacted as a result of the Project (refer to **Section 7.4**). The results from the EPBC Offset Assessment Guide indicate that the proposed Tinda Biodiversity Offset Site for the Project provides in excess of 100% of the offsetting requirements for the predicted impacts of the Project on the small-flower grevillea. This exceeds the minimum 90% direct offset requirement for these species as specified by the EPBC Offsets Assessment Guide.

An assessment of the Biodiversity Offset Strategy in relation to the principles governing the Policy is provided in **Section 7.1** and an assessment of the 'impact points' and 'offset points' generated has been undertaken and is provided in **Section 7.3**.

7.2 Tinda Creek Quarry Biodiversity Offset Strategy

As discussed in **Section 5.2.1**, the ecological values identified in the Project area that have been considered in determining the impact of the Project and the development of impact mitigation and biodiversity offsetting requirements include:

- the loss of native vegetation communities and fauna habitats;
- known threatened species habitat, including:
 - identified habitat for one threatened terrestrial mammal species, the New Holland mouse, listed as vulnerable on the EPBC Act;
 - core habitat for the koala (*Phascolarctos cinereus*), as described by SEPP 44 Koala Habitat Protection;
 - identified habitat of one threatened reptile species, Rosenbergs goanna (*Varanus rosenbergi*), listed as Vulnerable on the TSC Act;
 - identified habitat for two forest owl species, the powerful owl (*Ninox strenua*) and masked owl (*Tyto novaehollandiae*), both listed as Vulnerable on the TSC Act;
 - a large population of the TSC Act and EPBC Act listed *Grevillea parviflora* subsp. *parviflora*, with approximately 849 plants recorded during surveys;
 - an area of woodland habitat for threatened woodland birds and micro-bats including (but not limited to) the varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*), east coast freetail-bat (*Mormopterus norfolkensis*) and large-eared pied bat (*Chalinolobus dwyeri*); and
 - potential winter flowering woodland foraging habitat for the endangered swift parrot (*Lathamus discolor*) and for the critically endangered regent honeyeater (*Anthochaera phrygia*);
- presence of groundwater dependent ecosystems Mellong Sandmass Swamp Woodland, Mellong Sandmass Sedgeland and Red Gum Riparian Forest; and
- presence of hollow-dependent fauna habitat, including known habitat of the squirrel glider (*Petaurus norfolcensis*) and the eastern pygmy possum (*Cercartetus nanus*) both listed under the TSC Act.

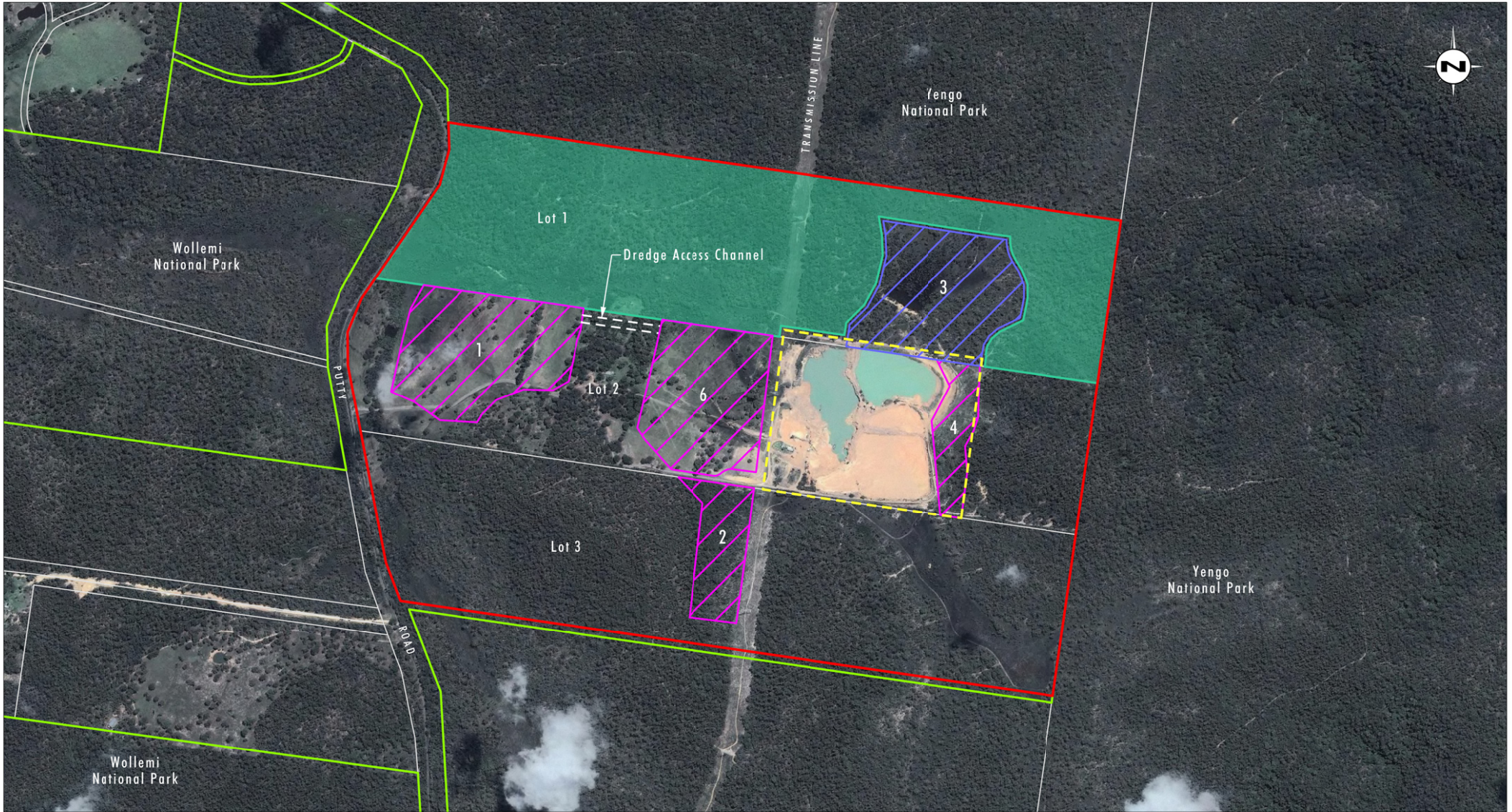
A direct, like-for-like biodiversity offset is proposed as part of the Project to compensate for the residual impacts of the Project. The Tinda Biodiversity Offset Site is located in Lot 1 of the Project area (refer to **Figure 7.1**) and includes 71.5 ha of vegetation and habitats that are like-for-like to the area to be impacted in the Proposed Disturbance Area.

7.2.1 Ecological Values of the Tinda Biodiversity Offset Area

Vegetation Communities and Fauna Habitats

Vegetation communities occurring within the proposed Biodiversity Offset Area were described and mapped as part of the Ecological Assessment. The following vegetation communities occur within the Biodiversity Offset Area:

- Mellong Sandmass Dry Woodland:
 - Variant: Mellong Sandmass Dry Woodland Derived Native Grassland.
- Mellong Sandmass Swamp Woodland.



Source: Google Earth (2012), LPI NSW (2007), OEH (2013)

0 250 500 750m
1:15,000

Legend

- ▭ Project Area
- ▭ Proposed Extraction Area
- ▭ Domain 3 Extraction Area
- ▭ National Park Boundary
- Limit of Approved Extraction (DA 134/95)
- ▭ Proposed Biodiversity Offset Area

FIGURE 7.1
Tinda Creek Biodiversity Offset Area

- Mellong Sandmass Sedgeland.
- Hawkesbury Hornsby Plateau Exposed Woodland:
 - Variant: Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland.
- Stringybark – Ironbark Forest.

Section 4.2 of this report provides a detailed discussion of the floristic and structural characteristics of these vegetation communities and the extent of the communities is shown on **Figure 4.1**. **Table 7.1** details the area of each vegetation community and broad fauna habitat classification occurring within the Biodiversity Offset Area.

Table 7.1 – Area of Vegetation Community and Fauna Habitat in the Tinda Creek Biodiversity Offset Area

Fauna Habitat Formation	Vegetation Community	Area of Impact (ha)	Area Present in Offset Area (ha)	Offset Ratio
Forest and Woodland	Stringybark - Ironbark Forest	2.1	8.2	3.1:1
	Hawkesbury Hornsby Plateau Exposed Woodland	1.5	14.1	
	Mellong Sandmass Dry Woodland	15.1	35.5	
Swamp Forest and Sedgeland	Mellong Sandmass Swamp Woodland	4.8	10.7	2:1
	Mellong Sandmass Sedgeland	0.6	0.0	
Total Native Woodland, Forest and Sedgeland		24.1	68.5	2.8:1
Derived Native Grassland and other highly modified communities	Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland	0.1	1.0	No offset proposed for DNG
	Mellong Sandmass Dry Woodland Derived Native Grassland	17.5	2.0	
	Mellong Sandmass Swamp Woodland (modified – overstorey absent)	3.1	0.0	
Total Derived Native Grassland		20.7	3.0	
Disturbed Land	Disturbed Land	0.1	0.0	No offset proposed for disturbed land
Water body		0.2	0.0	No offset proposed for waterbodies
TOTAL		45.1	71.5	

Direct Offset for Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)

The Project will impact known habitat for and remove three small-flower grevillea individuals within the Proposed Disturbance Area. The field surveys of the Project area identified 390 small-flower grevillea within the proposed Tinda Biodiversity Offset Site in a large cluster in the north-east of the Project area. The Tinda Biodiversity Offset Site provides a 130:1 offset for individuals of small-flower grevillea and a 3.1:1 offset in relation to known and likely habitat for the species,

Proximity to Yengo and Wollemi National Parks and the Greater Blue Mountains National Heritage Place and World Heritage Property

The Tinda Biodiversity Offset Site is located directly adjacent to Yengo National Park, on the northern boundary of the Project area (refer to **Figure 7.1**). The offset site is also adjacent to the Greater Blue Mountains National Heritage Place and World Heritage Property that includes Yengo and Wollemi National Parks. The Tinda Biodiversity Offset Site is part of a vast, continuous area of vegetation that is over 600,000 ha in size and is valued for its high biodiversity of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals including features of high conservation significance. The inclusion of the Tinda Biodiversity Offset Site as an area of in-perpetuity conservation will extend this area by 71.5 ha.

The Biodiversity Offset Strategy was developed for the Project in a manner consistent with Commonwealth and State offsetting policies. The objectives of the Biodiversity Offset Strategy are described in **Section 7.0**. The proposed offset provides a direct, 'like for like' offset for both vegetation communities and fauna habitat and subsequently, those threatened flora and fauna species that will be directly impacted as a result of the project.

Proposed Long-term Conservation Mechanism

The Biodiversity Offset Area is located adjacent to Yengo National Park, on its northern boundary. The proximity of the National Park and the high conservation values of the Biodiversity Offset Site suggest one option may be donation of the offset to the NPWS estate to ensure the long-term protection of the offset site. Further consultation with NPWS will be undertaken as part of the approval process to determine an appropriate long term management strategy.

7.2.2 Ecological Values of the Alternative Biodiversity Offset Area

The alternative Biodiversity Offset Area operations are shown on **Figure 7.2**. If this offset area is adopted, extraction would not be undertaken in Domain 3 to the north of the existing dredge point, but would instead be undertaken in Domain 7 which is to the south-east of the existing dredge pond.

Vegetation Communities and Fauna Habitats

Vegetation communities occurring within the alternative biodiversity offset strategy were described and mapped following the receipt of adequacy comments and the on-site discussions held with the NSW NPWS. The following vegetation communities occur within the alternative biodiversity offset strategy (refer to **Figure 7.2**):

- Mellong Sandmass Dry Woodland;
 - Variant: Mellong Sandmass Dry Woodland Derived Native Grassland.
- Mellong Sandmass Swamp Woodland;
 - Mellong Sandmass Swamp Woodland (modified – overstorey absent).
- Mellong Sandmass Sedgeland;
- Hawkesbury Hornsby Plateau Exposed Woodland;
 - Variant: Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland; and



Source: Google Earth (2012), LPI NSW (2007), OEH (2013)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Limit of Approved Extraction (DA 134/95)
- Proposed Alternate Biodiversity Offset Area

File Name (A4): R17_V1/1731_429.dgn

FIGURE 7.2

Proposed Alternative Tinda Creek
Biodiversity Offset Area

- Stringybark – Ironbark Forest.

Table 7.2 details the area of each vegetation community and broad fauna habitat classification occurring within the alternative Biodiversity Offset Area and the area that would be impacted as a result of quarrying in Domain 7 rather than Domain 3.

Table 7.2 – Area of Vegetation Community and Fauna Habitat in the Alternative Project and Biodiversity Offset Area

Fauna Habitat Formation	Vegetation Community	Area of Impact (ha)	Area Present in Offset Area (ha)	Offset Ratio
Forest and Woodland	Stringybark - Ironbark Forest	0.8	9.5	5:1
	Hawkesbury Hornsby Plateau Exposed Woodland	1.5	23.9	
	Mellong Sandmass Dry Woodland	14.6	54.4	
Swamp Forest and Sedgeland	Mellong Sandmass Swamp Woodland	6.7	14.4	1.6:1
	Mellong Sandmass Sedgeland	2.5	0.7	
Total Native Woodland, Forest and Sedgeland		26.1	102.9	3.9:1
Derived Native Grassland	Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland	0.1	1.4	No offset proposed for DNG
	Mellong Sandmass Dry Woodland Derived Native Grassland	17.5	1.5	
	Mellong Sandmass Swamp Woodland (modified – overstorey absent)	3.1	0.3	
Total Derived Native Grassland		20.7	3.2	
Disturbed Land	Disturbed Land	0.1	0.0	No offset required for disturbed land
Water body		0.0	0.2	No offset required for waterbodies
Total		46.9	106.2	

Direct Offset for Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)

The alternative project and quarry in Domain 7 rather than Domain 3 will impact known habitat for and remove 91 small-flower grevillea individuals within the impact area. Six hundred and twenty-nine small-flower grevilleas have been recorded within the proposed alternative biodiversity offset area in a large cluster in the north-east of the Project area (refer to **Figure 7.2**). The alternative biodiversity offset area provides a 6.9:1 offset for individual stands of small-flower grevillea and a 5:1 offset in relation to known and likely habitat for the species.

In addition, a 10 metre linear buffer between the proposed alternative biodiversity offset area and the proposed disturbance footprint, adjacent to Domain 7, has been incorporated that will result in the avoidance of 68 small-flower grevillea individuals.

Proximity to Yengo and Wollemi National Parks and the Greater Blue Mountains National Heritage Place and World Heritage Property

The alternative biodiversity offset area is located directly adjacent to Yengo National Park, on the northern and eastern boundary (refer to **Figure 7.2**). The alternative biodiversity offset area is also adjacent to the Greater Blue Mountains National Heritage Place and World Heritage Property that includes Yengo and Wollemi National Parks. The alternative biodiversity offset area is part of a vast, continuous area of vegetation that is over 600,000 ha in size and is valued for its high biodiversity of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals including features of high conservation significance. The inclusion of the alternative biodiversity offset area as an area of in-perpetuity conservation will extend this area by 108 ha.

The alternative biodiversity offset area considered Commonwealth and State offsetting policies and is consistent with the objectives described in **Section 7.1**. The proposed alternative biodiversity offset area provides a direct, 'like for like' offset for both vegetation communities and fauna habitat and subsequently, those threatened flora and fauna species that will be directly impacted as a result of the project.

Proposed Long-term Conservation Mechanism

The alternative biodiversity offset area is located adjacent to Yengo National Park, on its northern boundary. The proximity of the National Park and the high conservation values of the alternative biodiversity offset area suggest one option may be donation of the offset to the NPWS estate to ensure the long-term protection of the offset site. Consultation with NPWS will be undertaken as part of the approval process to determine an appropriate long term management strategy.

7.3 Assessment of the Biodiversity Offset Strategy against Offsetting Guidelines

The following section documents the Biodiversity Offset Strategy against the state and Commonwealth guidelines for biodiversity offsetting. The assessment against the guidelines considered both the proposed and alternative offset strategies, as the key outcomes of both strategies are strategically consistent.

7.3.1 NSW Offset Principles for Major Projects (State Significant Development and Infrastructure) (OEH, 2013b)

Section 7.1.1 documents the OEH (2013b) NSW Offset Principles for Major Projects (state significant development and infrastructure). The following provides an assessment of the Project and alternative Biodiversity Offset Strategies against these principles.

- 1. Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.**

Section 5.1 of the Ecological Assessment details the substantial impact avoidance measures that have been implemented as part of project planning. This has resulted in approximately 16 ha, that was originally earmarked for sand extraction being avoided. Substantial impact mitigation measures have also been proposed as part of the Project, as detailed in **Section 6.0**. Impact mitigation measures include general measures to minimise the impact of the Quarry on adjacent vegetation communities and fauna habitats, such as

appropriate sediment and erosion control measures, and substantial commitments designed to minimise the impact of habitat removal on fauna species, in particular threatened fauna species. A Koala Plan of Management was also prepared as part of the Project to manage the impact of the Project on this species.

The Biodiversity Offset Strategy was developed subsequent to the finalisation of the final quarry plan and following the development of the Impact Mitigation Strategy and applies to the residual impacts of the project that could not be avoided or minimised through mitigation measures.

2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.

The Biodiversity Offset Strategy has been developed through detailed consideration of known impacts on known records of threatened species (including their habitats), which have been identified and discussed in detail in **Sections 4.0** and **5.0** of this Ecological Assessment. The selection of the Biodiversity Offset Area took into account such identified impacts, and identified preferences based on the ability of such areas to appropriately address such impacts.

The area of impact has been derived from detailed GIS mapping of project boundaries and impact areas. The ecological survey, mapping and impact assessments have been completed by qualified ecologists with considerable experience in the region. The Ecological Assessment indicates that extensive surveying has been undertaken at appropriate seasonal times to adequately determine the likely subject species.

All relevant ecological features of the offset sites are quantifiable and, where the information is available, are presented in such a manner in this report. The quantification is documented in **Tables 7.1** of this report. The offset requirements are therefore based on a reliable and transparent assessment of the losses and gains in biodiversity as a result of the Project.

3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

The development of the Biodiversity Offset Strategy has been based on addressing the identified ecological impacts of the Project (refer to **Section 5.0**). These impacts have been identified via a thorough survey and assessment process, which has been described in detail within this document. Following this identification of impact, the Biodiversity Offset Strategy has been designed to provide mitigation actions targeted at each of the major impacts. **Table 7.1** clearly documents the key ecological species, communities and features that would be impacted by the Project and are hence targeted for offsetting.

The Biodiversity Offset Strategy results in a direct, like-for-like offset.

4. Offsets must be additional to other legal requirements.

The Biodiversity Offset Area proposed as part of the Project does not overlap with any other government funded protection or habitat restoration program on the site. The offset site is located on currently non-reserved land and will add a significant area into the reserve system.

5. Offsets must be enduring, enforceable and auditable.

As the Biodiversity Offset Strategy is being proposed as an integral component of the Project, it is expected that the commitments in this strategy will be included within the project approval conditions, and any other relevant legally binding consents. As noted previously,

one approach may be to transfer the Biodiversity Offset Area to an appropriate land manager, such as NPWS, for long term protection and management, an action facilitated by the proximity of the offset site to the existing reserve network.

The proposed Biodiversity Offset Strategy commitments for the Project will occur over the long-term, until such time that the commitments have been achieved, completion criteria have been met and sign-off has occurred.

The Biodiversity Offset Area will be secured for long-term conservation. The mechanism for securing this conservation will be determined in consultation with NSW DP&E, OEH and DoE.

6. Supplementary measures can be used in lieu of offsets.

Supplementary measures are not proposed as part of the Project in lieu of offsets.

7. Offsets can be discounted where significant social and economic benefits accrue to NSW as a consequence of the proposal.

It is not proposed to discount the proposed offset.

7.3.2 Assessment of the Biodiversity Offset Strategy against the Commonwealth Environmental Offsets Policy 2012

As documented in **Section 7.1.4**, the Commonwealth's position on offsetting was formalised in October 2012, as outlined in the Environmental Offset Policy (DSEWPC, 2012). This section provides an assessment of the Biodiversity Offset Strategy proposed as part of the Project against the Environmental Offset Policy.

1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter.

The Biodiversity Offset Strategy for the Project has been developed with the aim to maintain the biodiversity values of the surrounding region in the long term. With the various impact mitigation and offset strategies to be employed as part of the Project, it is likely that the conservation value of the local area will be maintained, particularly given that the Biodiversity Offset Area is well situated adjacent to existing conservation reserves, and offset site could be transferred to NPWS management. These sites will contribute towards a net improvement in biodiversity over time through the long-term protection of a land-based sites that contain high conservation value vegetation communities and fauna habitats, in particular threatened fauna species habitat.

The Biodiversity Offset Sites will be secured for long-term conservation. The mechanism for securing this conservation will be determined in consultation with NSW P&I, OEH, and DoE. Currently Hy-Tec envisages that the offset site would be transferred to an appropriate land manager such as NPWS.

2. Suitable offsets must be built around direct offsets but may include other compensatory measures.

The Biodiversity Offset Strategy is based on the use of direct land-based offsets that are situated next to the area of impact.

3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.

The level of statutory protection that applies to the potentially impacted Matters of National Environmental Significance was considered during project planning to ensure that adequate offsets were obtained, commensurate with the status of the threatened species. The result is a suitable biodiversity offset for impacted species, as detailed in **Tables 7.1** and **7.2**.

4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.

Section 7.0 and **Table 7.1** concisely document the area of impact on Matters of National Environmental Significance, together with the relevant ecological features within the offset site that is proposed for each Matter of National Environmental Significance. These show that the Biodiversity Offset Strategy achieves a minimum 2:1 land-based offset that is 'like for like.' Additionally, the results of the EPBC Offsets Calculator show that the proposed Biodiversity Offset Strategy exceeds the minimum 90% direct offset requirement for significantly impacted species listed under the EPBC Act. As stated before, it is envisaged that the Biodiversity Offset Strategy will maintain biodiversity in the medium and long term.

5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding.

The Biodiversity Offset Strategy is based on the use of direct land-based offsets that occur at the location of impact.

A positive feedback loop between monitoring and adaptive management of the land-based offset sites will be established. Thresholds for key monitoring parameters will be proposed, together with trigger points or threshold exceedance levels to ensure that there are clear points at which a review of the monitoring and management approach is enacted. The management of the ecological components of the Project will be responsive to any new ecological data that may arise through the ecological monitoring of the Biodiversity Offset Sites, or any other studies completed as part of the Project.

6. Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs.

As discussed above, the land-based offsets proposed as part of the Project do not overlap with any other government funded protection or habitat restoration program on the site. The offset site is located on currently non-reserved land and will add a significant area into the reserve system.

7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.

The Biodiversity Offset Strategy allows for the up-front protection and pro-active conservation management of the Biodiversity Offset Site, to provide immediate compensation for loss of habitat from the Project area. It is anticipated that an offset management plan will be prepared following project approval, restoration (where appropriate) would be undertaken, and an appropriate long term conservation strategy would be determined (e.g. transfer to an appropriate land manager such as NPWS).

The area of impact has been derived from detailed GIS mapping of project boundaries and impact areas, and the ecological survey, mapping, impact assessments and design of the Biodiversity Offset Strategy have been completed by qualified ecologists with considerable experience in the region ensuring that the Strategy is scientifically robust, transparent and reasonable.

8. Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

As the Biodiversity Offset Strategy is being proposed as an integral component of the Project, it is expected that the commitments in this strategy will be included within the project approval conditions, and any other legally binding consents. **Section 6.0** documents the elements that will be included in detailed Monitoring Plans for the Project, and it is anticipated that regular auditing of the offset strategy commitments will be undertaken.

7.4 Summary of Commonwealth Offsets Calculator

7.4.1 EPBC Calculator Assessment for the Proposed Biodiversity Offset Area

The Offset Assessment Guide indicated that the proposed Tinda Biodiversity Offset Site would provide a 234% offset for the impacts on small-flower grevillea as a result of the Project. The Offset Assessment Guide input values used in the assessment are listed in **Table 7.3**.

Table 7.3 – Small-flower Grevillea Offset Assessment Guide Values for the Proposed Tinda Biodiversity Offset Site

	Woodland/Forest Areas to Offset Impacts on Woodland/Forest Habitat
Impact Area	18.7 ha
Impact Quality	6
Offset Area	57.8 ha
Offset Site Start Quality	8
Without Offset Quality	8
With Offset Quality	8
Risk of Loss Without Offset	75%
Risk of Loss With Offset	1%
Time Over Which Loss is Adverted	20 years
Time Until Ecological Benefit	1 year
Confidence in Loss	80%
Confidence in Quality Change	80%
% of Impact Offset	234%

7.4.1.1 Habitat Quality for Small-flower Grevillea

Impact Area

Habitat quality for the small-flower grevillea was assessed as 6 out of 10 for the proposed disturbance area with moderate scores across the range of habitat quality parameters (site condition, site context, species stocking rate). The habitat quality scores were based on the known and potential habitats that occurred which included all woodland and forest habitat across the impact site.

The species has been recorded at three locations within the proposed disturbance area for the Project during surveys undertaken for this assessment and 849 individuals were recorded within the broader Project area. The habitat for the species within the proposed

disturbance area is limited, with most vegetation communities conforming to Derived Native Grassland variants that do not provide known or likely habitat for this species. Where habitat does occur (in woodland and forest communities), the habitat condition is considered good with variable structure and moderate diversity of species known to occur in association with small-flower grevillea. The proposed disturbance area is currently well connected to surrounding vast habitats within the Greater Blue Mountains World Heritage Area and located in proximity to a known population of the species in the Putty area. However, the species has been recorded in low numbers in the proposed disturbance area, despite the large population occurring in the wider Project area. Known threats to the species in the proposed disturbance area are high and include habitat fragmentation, clearing and disturbance from quarry activities and the impacts of high frequency fires.

Proposed Tinda Biodiversity Offset Site

Habitat quality for the small-flower grevillea was assessed as 8 out of 10 for the Tinda Biodiversity Offset Site with high scores across the range of habitat quality parameters (site condition, site context, species stocking rate). The habitat quality scores were based on the known and potential habitats that occurred which included all woodland and forest habitat across the offset site.

The species has been recorded within the Tinda Biodiversity Offset Site for the Project during surveys undertaken for this assessment, with 390 individuals recorded. The habitat for the species within the Tinda Biodiversity Offset Site is vast, with most vegetation communities comprising woodland or forest communities that provide known or likely habitat for this species. The habitat condition is considered good with variable structure and moderate diversity of species known to occur in association with small-flower grevillea. The proposed Tinda Biodiversity Offset Site is well connected to surrounding vast habitats within the Greater Blue Mountains World Heritage Area and located in proximity to a known population of the species in the Putty area. The species has been recorded in high numbers in the Tinda Biodiversity Offset Site. Known threats to the species in the Tinda Biodiversity Offset Site are currently high and include habitat fragmentation, clearing and disturbance from quarry activities and the impacts of high frequency fires. It is considered that the inclusion of this area as a Biodiversity Offset Site would reduce the threats to the species and provide in-perpetuity conservation for a large population of the species in the local area.

7.4.1.2 Time over which Loss is Averted

The 'time over which loss is averted' was entered as 20 years for the small-flower grevillea at the proposed Tinda Biodiversity Offset Site. As it is intended for the proposed Tinda Biodiversity Offset Site to be transferred into in-perpetuity protection to NPWS, the highest value that can be entered into the calculator is 20 years. This is consistent with the approach in the 'How to Use the Offset Assessment Guide' (DSEWPC, 2012b).

7.4.1.3 Time until Ecological Benefit

The 'time until ecological benefit' was entered as 1 year for the small-flower grevillea at the proposed Tinda Biodiversity Offset Site as the establishment of the site would immediately reduce the threats to the population posed by the potential expansion of quarrying activities.

7.4.1.4 Risk of Loss With and Without the Offset

The 'risk of loss without the offset' percentage score was entered as 75% due to the potential loss of known and potential habitat due to the expansion of quarrying activities within the Project area. A large known and inferred sand resource is located within the area that is proposed as the Tinda Biodiversity Offset Site. The Site is proximate to an existing approved

quarry and for there is substantial demand for the quarried material. These factors combine to result in a 'high risk of loss without the offset'.

The 'risk of loss with the offset' percentage score was entered as 1% due to the reduced of risk of quarry activities disturbing the population once the offset site is established.

7.4.1.5 Confidence in Loss and Quality Change

The confidence in the 'risk of loss' scores was considered to be 80% as it is likely that the risk of loss is substantially reduced for the species following the establishment of the offset site in an area threatened by the expansion of quarrying activities. A 20% margin of error has been applied to this score.

The confidence in the 'habitat quality' scores was considered to be 80% as there is no predicted change in habitat quality. A 20% margin of error has been applied to this score.

7.4.1.6 Summary and Conclusion

The Offset Calculator generated an offset percentage of 234% for the proposed Tinda Biodiversity Offset Site. The habitat for the small-flower grevillea is considered to be much higher quality to that of the Proposed Disturbance Area, due to lower levels of disturbance and a much higher density of the species occurring in the habitats of the Offset Site. Additionally, the Offset Site contains a larger area of woodland and forest habitat for the species than the Proposed Disturbance Area. A cluster of 390 individuals in the Offset Site is considered to be a substantial population of this species which often occurs in smaller isolated numbers. Moreover, the proposed Tinda Biodiversity Offset Site is of high conservation value proximate to the connectivity associated with Yengo National Park and the Greater Blue Mountains World Heritage property and National Heritage place. The averted loss associated with the proposed Tinda Biodiversity Offset Site relates to the reduction in the risk of loss from 75% to 1% resulting from the implementation of the in-perpetuity Offset.

The results of the EPBC Offset Assessment Guide indicate that the proposed Tinda Biodiversity Offset Site provides 234% of the offsetting requirements for the predicted impacts of the Project on the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). This exceeds the 100% offset requirement for this species as specified by the EPBC Offsets Assessment Guide.

7.4.2 EPBC Calculator Assessment for the Alternative Biodiversity Offset Area

The Offset Assessment Guide indicated that the alternative Biodiversity Offset Site would provide a 394% offset for the impacts on small-flower grevillea as a result of the Project. The Offset Assessment Guide input values used in the assessment are listed in **Table 7.4**.

Table 7.4 – Small-flower Grevillea Offset Assessment Guide Values for the Proposed Alternative Biodiversity Offset Site

	Woodland/Forest Areas to Offset Impacts on Woodland/Forest Habitat
Impact Area	16.9 ha
Impact Quality	6
Offset Area	87.9 ha
Offset Site Start Quality	8
Without Offset Quality	8
With Offset Quality	8
Risk of Loss Without Offset	75%
Risk of Loss With Offset	1%
Time Over Which Loss is Adverted	20 years
Time Until Ecological Benefit	1 year
Confidence in Loss	80%
Confidence in Quality Change	80%
% of Impact Offset	394%

7.4.2.1 Habitat Quality for Small-flower Grevillea

Impact Area

Habitat quality for the small-flower grevillea was assessed as 6 out of 10 for the proposed disturbance area with moderate scores across the range of habitat quality parameters (site condition, site context, species stocking rate). The habitat quality scores were based on the known and potential habitats that occurred which included all woodland and forest habitat across the impact site.

The species has been recorded at 91 locations within the proposed disturbance area for the alternative Project during surveys undertaken for this assessment and 849 individuals were recorded within the broader Project area. The habitat for the species within the proposed disturbance area is limited, with most vegetation communities conforming to Derived Native Grassland variants that do not provide known or likely habitat for this species. Where habitat does occur (in woodland and forest communities), the habitat condition is considered good with variable structure and moderate diversity of species known to occur in association with small-flower grevillea. The proposed disturbance area is currently well connected to surrounding vast habitats within the Greater Blue Mountains World Heritage Area and located in proximity to a known population of the species in the Putty area. However, the species has been recorded in low numbers in the proposed disturbance area, despite the large population occurring in the wider Project area. Known threats to the species in the proposed disturbance area are high and include habitat fragmentation, clearing and disturbance from quarry activities and the impacts of high frequency fires.

Alternative Biodiversity Offset Site

Habitat quality for the small-flower grevillea was assessed as 8 out of 10 for the alternative Biodiversity Offset Site with high scores across the range of habitat quality parameters (site condition, site context, species stocking rate). The habitat quality scores were based on the known and potential habitats that occurred which included all woodland and forest habitat across the offset site.

The species has been recorded within the alternative Biodiversity Offset Site for the Project during surveys undertaken for this assessment, with 629 individuals recorded. The habitat for the species within the alternative Biodiversity Offset Site is vast, with most vegetation communities comprising woodland or forest communities that provide known or likely habitat for this species. The habitat condition is considered good with variable structure and moderate diversity of species known to occur in association with small-flower grevillea. The alternative Biodiversity Offset Site is well connected to surrounding vast habitats within the Greater Blue Mountains World Heritage Area and located in proximity to a known population of the species in the Putty area. The species has been recorded in high numbers in the alternative Biodiversity Offset Site. Known threats to the species in the alternative Biodiversity Offset Site are currently high and include habitat fragmentation, clearing and disturbance from quarry activities and the impacts of high frequency fires. It is considered that the inclusion of this area as a Biodiversity Offset Site would reduce the threats to the species and provide in-perpetuity conservation for a large population of the species in the local area.

7.4.2.2 Time over which Loss is Averted

The 'time over which loss is averted' was entered as 20 years for the small-flower grevillea at the alternative Biodiversity Offset Site. As it is intended for the alternative Biodiversity Offset Site to be transferred into in-perpetuity protection to NPWS, the highest value that can be entered into the calculator is 20 years. This is consistent with the approach in the 'How to Use the Offset Assessment Guide' (DSEWPC, 2012b).

7.4.2.3 Time until Ecological Benefit

The 'time until ecological benefit' was entered as 1 year for the small-flower grevillea at the alternative Biodiversity Offset Site as the establishment of the site would immediately reduce the threats to the population posed by the potential expansion of quarrying activities.

7.4.2.4 Risk of Loss With and Without the Offset

The 'risk of loss without the offset' percentage score was entered as 75% due to the potential loss of known and potential habitat due to the expansion of quarrying activities within the Project area. A large known and inferred sand resource is located within the area that is proposed as the alternative Biodiversity Offset Site. The Site is proximate to an existing approved quarry and for there is substantial demand for the quarried material. These factors combine to result in a 'high risk of loss without the offset'.

The 'risk of loss with the offset' percentage score was entered as 1% due to the reduced risk of quarry activities disturbing the population once the offset site is established.

7.4.2.5 Confidence in Loss and Quality Change

The confidence in the 'risk of loss' scores was considered to be 80% as it is likely that the risk of loss is substantially reduced for the species following the establishment of the offset site in an area threatened by the expansion of quarrying activities. A 20% margin of error has been applied to this score.

The confidence in the 'habitat quality' scores was considered to be 80% as there is no predicted change in habitat quality. A 20% margin of error has been applied to this score.

7.4.2.6 Summary and Conclusion

The Offset Calculator generated an offset percentage of 394% for the alternative Biodiversity Offset Site. The habitat for the small-flower grevillea is considered to be much higher quality to that of the Proposed Disturbance Area, due to lower levels of disturbance and a much higher density of the species occurring in the habitats of the Offset Site. Additionally, the Offset Site contains a larger area of woodland and forest habitat for the species than the Proposed Disturbance Area. A cluster of 629 individuals in the Offset Site is considered to be a substantial population of this species which often occurs in smaller isolated numbers. Moreover, the alternative Biodiversity Offset Site is of high conservation value proximate to the connectivity associated with Yengo National Park and the Greater Blue Mountains World Heritage property and National Heritage place. The averted loss associated with the alternative Biodiversity Offset Site relates to the reduction in the risk of loss from 75% to 1% resulting from the implementation of the in-perpetuity Offset.

The results of the EPBC Offset Assessment Guide indicate that the alternative Biodiversity Offset Site provides 394% of the offsetting requirements for the predicted impacts of the Project on the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). This exceeds the 100% offset requirement for this species as specified by the EPBC Offsets Assessment Guide.

7.5 Summary of Biodiversity Offset Strategy

The Project DGRs identified the need for a comprehensive Biodiversity Offset Strategy to compensate for the residual impacts of the Project that could not be avoided or mitigated. The Biodiversity Offset Strategy described in this document has outlined the proposed offsetting components that have demonstrated an appropriate and valuable offsetting outcome in achieving the goals to:

- avoid and minimise potential impacts on ecological values as a result of the Project;
- mitigate potential impacts within the project area;
- maintain or improve the biodiversity values of the surrounding region in the medium to long term;
- maintain or improve the viability of threatened species that could be significantly affected by the Project through the conservation of habitat; and
- ensure that there are no residual net impacts on key threatened species and ecological communities in the long term as a result of the construction and operation of the Project.

The Biodiversity Offset Strategy will be implemented only if the Project is approved and constructed. The alternative Biodiversity Offset Area is considered to also provide an appropriate and valuable offset to compensate for the residual impacts of the Project on ecological values.

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APPENDIX A

Threatened Species Assessment

Appendix A – Threatened Species Assessment

Threatened species, endangered populations, and threatened ecological communities (TECs) listed under the TSC Act and/or EPBC Act recorded or considered likely to occur within 10 km of the Project area have been identified based on the results of the searches of the OEH Atlas of NSW Wildlife Database (OEH, 2013a), Fisheries records viewer (DPI, 2013b) and the Commonwealth Department of the Environment Protected Matters Search Tool (Department of the Environment, 2013a) as well as the results of the literature review described in **Section 3.2** of the Ecological Assessment report.

- **Table 1** contains the results of these searches for threatened flora species, TECs and endangered flora populations;
- **Table 2** contains the results of the searches for threatened fauna species and endangered fauna populations; and
- **Table 3** contains the results of the searches for migratory and marine species listed under international conventions.

Tables 1, 2 and 3 contain the relevant ecological details for threatened flora, TECs, threatened fauna and migratory species (as described in OEH 2013a, Department of the Environment, 2013a and DPI, 2013b). These tables contain information including habitat requirements, known range and reservation within conservation reserves in the region, as well as an assessment as to whether the entity is likely to occur in the Project area and whether there is the potential for the entity to be impacted by the Project. It should be noted that some species are listed in both **Tables 2 and 3** as they are listed under both threatened species legislation and international migratory conventions. In these cases the information presented is identical, except for the legal listing (which are relevant to the table under which they are listed).

An assessment of significance was prepared in accordance with the requirements of the TSC and EPBC Acts for each threatened and migratory species or ecological community recorded or for which there is the potential for impact as a result of the Project. These assessments of significance are provided in **Appendices D and E**.

Table 1 – Threatened Flora Species, Threatened Flora Populations and Endangered Ecological Communities known or predicted to occur within the Project Area

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED FLORA SPECIES						
Bynoes wattle <i>Acacia bynoeana</i>	E (TSC) V (EPBC) 3VC- (ROTAP)	Occurs in heath or dry sclerophyll forest on sandy soils. Often prefers open, sometimes slightly disturbed sites such as track margins, edges of roadside spoil mounds and in recently burnt areas.	Occurs in central eastern NSW, from Morisset to the Illawarra region and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra, and in the Kurri Kurri, Cessnock and Ellalong areas in the lower Hunter Valley. The Project area is within the distribution range of this species.	Yengo NP Wollemi NP Parr SCA	This species has not been recorded within the Project area despite substantial field survey, however it has been recorded within 1 km of the Project area in similar habitat. There is potential this species occurs within the Project area.	Yes, refer to Appendices D and E.
<i>Eucalyptus</i> sp. Howes Swamp Creek	E (TSC) E (EPBC)	This species grows as part of a wetland complex, comprising eight swamps. In these swamps it occurs in areas with a sheltered south facing aspect on alluvium. The surface of these wetlands dry out after three months of drought.	This species is only known to grow in a small area of alluvium on Howes Swamp Creek in the Mellong Swamp Complex in Wollemi National Park. It is restricted in distribution to a small area of NSW. The Project area is outside the known distribution of this species.	Wollemi NP Yengo NP	This species has not been recorded within the Project area despite substantial field survey, although it is known to occur approximately 3 km north. The species is considered unlikely to occur as the Project area does not contain the known restricted habitat of this species and therefore the potential for a significant impact on this species is unlikely.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
White-flowered wax plant <i>Cynanchum elegans</i>	E (TSC) E (EPBC)	This species usually occurs on the edge of dry rainforest vegetation.	Restricted to eastern NSW where it is distributed from Brunswick Heads on the North Coast to Gerroa in the Illawarra region.	Wollemi NP	This species was not recorded during field surveys of the Project area, however it has been recorded approximately 9 km to the south west of the Project area. Despite this, no suitable habitat occurs within the Project area for this species.	No.
<i>Olearia cordata</i>	V (TSC) V (EPBC) 2VCi (ROTAP)	Populations are typically small and scattered. Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges.	A NSW endemic with a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. The Project area is outside the known distribution of this species.	Yengo NP Wollemi NP	This species was not recorded during field surveys of the Project area, however it has been recorded approximately 5 km to the south west of the Project area in similar habitat. There is potential this species occurs within the Project area.	Yes, refer to Appendices D and E.
<i>Zieria involuocrata</i>	E (TSC) V (EPBC) 2VCa (ROTAP)	This species grows in neutral to slightly acid, shallow sandy soils, derived from Hawkesbury Sandstone with preferences for wet sclerophyll forest.	This species is endemic to NSW and has a highly restricted geographic distribution. It is currently only known to 20 populations located between Yengo NP in the north and Marramarra NP in the south. It was once known to the Katoomba area but this population has not been recently confirmed.	Yengo NP Wollemi NP Parr SCA	This species was not recorded during field surveys of the Project area, however it has been recorded approximately 5 km to the east of the Project area. Despite this, no suitable habitat occurs within the Project area for this species.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Dillwynia tenuifolia</i>	V (TSC) 2RCa (ROTAP)	This species is typically associated with dry shrubby/heath, in particular in areas transitioning to Castlereagh Scribbly Gum Woodland (when found west of Sydney), or in disturbed escarpment woodlands (when found in Yengo NP).	This species is mostly found in the Cumberland Plains between Deans Park, Penrith east and Windsor. However, it can also be found in the Bulga Mountains, the lower Blue Mountains (Kurrajong Heights and Woodford), Baulkham Hills Shire, Liverpool LGA and Penrith LGA.	Wollemi NP	This species was not recorded during field surveys of the Project area, however it has been recorded within 7 km of the Project area in similar habitat. There is potential this species occurs within the Project area.	Yes, refer to Appendix D.
<i>Allocasuarina glareicola</i>	E (EPBC) 2E (ROTAP)	This species is typically found in open forest on lateritic soil.	This species is restricted to a few small populations in or near Castlereagh State Forest, north-east of Penrith.	Wollemi NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. No suitable habitat occurs within the Project area for this species.	No.
Leafless tongue orchid <i>Cryptostylis hunteriana</i>	V (TSC) V (EPBC) 3VC- (ROTAP)	This species appears to favour moist soils on the flat coastal plains. Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing hard-leaved scribbly gum (<i>Eucalyptus haemastoma</i>), brown stringybark (<i>E. capitellata</i>) and red bloodwood (<i>Corymbia gummifera</i>).	This species is known to occur in the Karuah Manning and Wyong CMA sub-regions in the Hunter Central Rivers region. The Project area is outside the known distribution of this species.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys (including targeted surveys during the flowering period) of the Project area and is not known to occur in the immediate surrounds. No suitable habitat occurs within the Project area for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Asterolasia elegans</i>	E (EPBC) 2ECa (ROTAP)	Grows in wet sclerophyll forest on moist hillsides.	Known from only one locality, north of Maroota.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. No suitable habitat areas occur for this species.	No.
<i>Euphrasia arguta</i>	CE (EPBC) 3X (ROTAP)	Grows in grassy areas near rivers.	Recorded from Bathurst to Walcha area (possibly extinct).	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.
Square raspwort <i>Haloragis exalata</i> <i>subsp. exalata</i>	V (TSC) V (EPBC)	The species is known from a range of vegetation types, all of which appear to have a history of recurrent disturbance. It appears to be a post-disturbance coloniser, based on observations of large numbers of plants on disturbed roadsides, cleared power-line easements, and recently burnt or flooded areas.	In NSW this species is known from the areas of western Sydney, Kosciuszko National Park, the Bega Valley, Bungonia Gorge east of Goulburn on the Central Tablelands, the Shoalhaven River and Lake Illawarra on the Central Coast, the North Coast and the Northern Tablelands.	Marramarra NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.
<i>Lasiopetalum joyceae</i>	V (TSC) V (EPBC)	The species grows in heath on sandstone, on lateritic to shaley ridgetops.	This species occurs within the Hawkesbury–Nepean region of NSW.	Parr SCA Dharug NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Deanes melaleuca <i>Melaleuca deanei</i>	V (TSC) V(EPBC) 3RC- (ROTAP)	Grows in wet heath on sandstone; uncommon.	In coastal districts from Berowra to Nowra.	Parr SCA Dharug NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.
Hairy persoonia <i>Persoonia hirsuta</i>	E (TSC) E (EPBC)	Occurs in dry sclerophyll forest and woodland with a shrubby understorey. It also favours disturbed heath, shrubby thickets and sandstone scrubs.	Occurs on the Central Coast and Tablelands of NSW, in an area bounded by Putty, Glen Davis and Gosford in the north, and Royal National Park (NP) and Hill Top in the south.	Yengo NP Wollemi NP Parr SCA Dharug NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.
Brown pomaderris <i>Pomaderris brunnea</i>	V (TSC) PD E (TSC) V (EPBC) 2VC- (ROTAP)	Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	Found in a very limited area around the Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England Tablelands and in far eastern Gippsland in Victoria. The Project area is outside the known distribution of this species.	Wollemi NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.
Omeo storks-bill <i>Pelargonium</i> sp. <i>Striatellum</i> (G.W.Carr 10345)	E (TSC) E (EPBC)	It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. The Project area is outside the known distribution of this species.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys of the Project area. The Project area is outside the known distribution of this species. This species is unlikely to occur within the Project area.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Mount Vincent mintbush <i>Prostanthera stricta</i>	V (TSC) V (EPBC)	Occurs primarily at the geological interface of fertile basalt caps and infertile sandstones at elevations of 800–1050 m. It is found in a range of environments, from steep rocky side-slopes and cliff lines to gentle slopes with exposed sandstone	Is known from the NSW Central Tablelands and Central Western Slopes.	Wollemi NP Goulburn River NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.
Siahs backbone, Sias backbone, Isaac Wood <i>Streblus pendulinus</i>	E (EPBC)	In warmer rainforest, chiefly along watercourses, north from Milton.	In coastal subdivisions north from Milton.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys of the Project area. The Project area is outside the known distribution of this species. This species is unlikely to occur within the Project area.	No.
Wollemi pine <i>Wollemia nobilis</i>	E (TSC) E (EPBC)	Occurs in warm-temperate rainforest and rainforest margins on remote sandstone canyons.	This species has a distribution which is limited to remote canyons of Wollemi NP to the north-west of Sydney.	Wollemi NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. No suitable habitat occurs for this species within the Project area.	No.
Glandular pink-bell <i>Tetrateca glandulosa</i>	V (TSC) V (EPBC) 2VC- (ROTAP)	Grows in sandy or rocky heath or scrub.	Known to occur from Mangrove Mountain to the Blue Mountains and Sydney in coastal subdivisions.	Wollemi NP Yengo NP Parr SCA Dharug NP Murrumbidgee NP	This species was not recorded during field surveys of the Project area and is not known to occur in the immediate surrounds. This species is unlikely to occur within the Project area.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Small-flower grevillea <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V (EPBC) V (TSC)	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 and 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.	Sporadically distributed throughout the Sydney Basin mainly occurring around Picton, Appin, Bargo and possibly Moss Vale, as well as in the north from Putty to Wyong, Lake Macquarie, Cessnock and Kurri Kurri in the lower Hunter. The Project area is within the distribution range of this species.	Yengo NP	This species was recorded during field surveys of the Project Area. A total of 849 individuals were recorded within the Project Area, of which three were recorded within the proposed disturbance area and 89 in the alternative disturbance area.	Yes, refer to Appendices D and E.
ENDANGERED FLORA POPULATIONS						
<i>Keraudrenia corollata</i> var. <i>denticulata</i> in the Hawkesbury local government area	E (TSC)	Occurs in tall open forest with <i>Eucalyptus deanei</i> , <i>Tristaniopsis laurina</i> , <i>Backhousia myrtifolia</i> , <i>Commersonia fraseri</i> , <i>Rulingia dasyphylla</i> , <i>Hibiscus heterophyllus</i> . All locations for this species within the Hawkesbury local government area are associated with the endangered Sydney Coastal River-flat Forest. Occurs on sandy soil on sandstone banks, edge of floodplains or on road verges. Soils are low in nutrients and well drained.	Occurs in the Hawkesbury local government area, disjunct from other populations and at the southern limit of the species' geographic range. Collections of the endangered population from the Colo River area between Lower Portland and Morans Rock and near Gees Lagoon. Known sub-populations are very small and generally less than 5 plants.	This species is not known to occur in any reserves in the region.	The Project area is outside the known distribution of this population and the species, or its co-dominant species were not recorded in the Project area. This population is unlikely to occur within the Project area.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED ECOLOGICAL COMMUNITIES						
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	CEEC (EPBC)	The Turpentine-Ironbark Forest of the Sydney Basin Bioregion is limited to the Sydney Basin Bioregion. The Turpentine – Ironbark Forest typically occurs in areas of moderately wet sites, with an annual rainfall of 800-1100 mm and on clay soils derived from Winiamatta shales.	Known from the Sydney Basin Bioregion.	Not known	This community was not recorded during field surveys of the Project area. The project area does not provide suitable habitat for this community.	No
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	EEC (EPBC)	Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion is generally a tall open eucalypt forest found on igneous rock, most often dominated by bown barrel (<i>Eucalyptus fastigata</i>), ribbon gum (<i>E. viminalis</i>) and narrow-leaved peppermint (<i>E. radiata</i> subsp. <i>radiata</i>). It typically occurs as an open to tall open forest with a sparse, dense layer of shrubs and vines and a diverse understorey.	Known in the Sydney Basin Bioregion on basalt derived soils.	Not known	This community was not recorded during field surveys of the Project area. The project area does not provide suitable habitat for this community.	No

Note

- 2: found over < 100 km
3: found over > 100 km

- a: adequately reserved
C: in a conservation reserve
E: endangered

CEEC: critically endangered ecological community
EEC: endangered ecological community
EP: endangered population
EPBC: *Environment Protection and Biodiversity Conservation Act 1999*
FM: *Fisheries Management Act 1994*
i: inadequately reserved
K: poorly known
LCA: Landscape Conservation Area

LGA: Local Government Area
MAR: marine
MIG: migratory
NR: Nature Reserve
NP: National Park
PD: preliminary determination
R: rare
SCA: State Conservation Area
TSC: *Threatened Species Conservation Act 1995*
V: vulnerable

Table 2 – Threatened Fauna Species and Threatened Fauna Populations known or predicted to occur within of the Project Area

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
AMPHIBIANS						
Giant burrowing frog <i>Heleioporus australiacus</i>	V (TSC) V (EPBC)	Found in heath, woodland and open forest with sandy soils.	Occurs from the NSW Central Coast to eastern Victoria, but is most common on the Sydney sandstone. It has been found from the coast to the Great Dividing Range. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Putty SF	This species was not recorded during field surveys. Potentially suitable habitat is present for this species and this species may occur.	Yes, refer to Appendices D and E.
Stuttering frog <i>Mixophyes balbus</i>	E (TSC) V (TSC)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Occur along the east coast of Australia from southern Queensland to the north-eastern Victoria. The Project area is within this species' distribution range.	Killarney NR Watagans NP	This species was not recorded during field surveys. The project area does not provide suitable habitat for this species.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Giant barred frog <i>Mixophyes iteratus</i>	E (TSC)	This species forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams.	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold. The Project area is within this species' distribution range.	Watagans NP	This species was not recorded during field surveys. The project area does not provide suitable habitat for this species.	No.
Red-crowned toadlet <i>Pseudophryne australis</i>	V (TSC)	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters.	This species is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. The Project area is within this species' distribution range.	Yengo NP Dharug NP Coricudgy SF Parr SCA Putty SF	This species was not recorded during field surveys, however suitable habitat was identified in the Project area. The species is potential susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Green and golden bell frog <i>Litoria aurea</i>	E (TSC) V (EPBC)	Occurs amongst emergent aquatic or riparian vegetation and amongst vegetation, fallen timber, including grassland, cropland and modified pastures. Breeds in still or slow flowing waterbodies with some vegetation such as <i>Typha</i> spp. and <i>Eleocharis</i> spp.	NSW North Coast near Brunswick Heads, southwards along the NSW Coast to Victoria where it extends into east Gippsland. The Project area is within this species' distribution range.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys. While a small farm dam occurs within the Project area, its lack of emergent vegetation suggests that this species is unlikely to occur.	No.
Booroolong frog <i>Litoria booroolongensis</i>	E (TSC) E (EPBC)	This species occurs along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins, or near slow-flowing connected or isolated pools that contain suitable rock habitats.	The species range extends from Tamworth in northern NSW to the Southern Highlands in Victoria.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys. The Project area does not provide suitable habitat for this species.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Littlejohns treefrog <i>Litoria littlejohni</i>	V (TSC) V (EPBC)	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria. The Project area is within this species' distribution range.	Olney SF	This species was not recorded during field surveys. The project area does not provide suitable habitat for this species.	No.
REPTILES						
Rosenbergs goanna <i>Varanus rosenbergi</i>	V (TSC)	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat.	Occurs on the Sydney Sandstone in Wollemi NP to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River.	Yengo NP Wollemi NP Parr SCA Putty SF Dharug SF	Four Rosenberg's goannas were recorded during field surveys. Potential burrows were also identified. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Broad-headed snake <i>Hoplocephalus bungaroides</i>	E (TSC) V (EPBC)	This species is nocturnal and shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	The broad-headed snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Dharug NP	This species was not recorded during field surveys, however suitable habitat was identified in the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.
BIRDS						
Australian painted snipe <i>Rostratula australis</i>	E (TSC) V (EPBC)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowal, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. The Project area is within this species' distribution range.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys. No suitable habitat exists for this species. Due to the lack of emergent vegetation, the small farm dam in the northeast domain is unlikely to provide habitat for this species.	No.
Australasian bittern <i>Botaurus poiciloptilus</i>	E (TSC) E (EPBC)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spikerushes (<i>Eleocharis</i> spp.).	This species may be found over most of the state except for the far north-west.	Dharug NP	The Project area does not provide suitable habitat for this species and it has not been recorded in the proposed disturbance area. There is no potential for a significant impact on this species.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Red goshawk <i>Erythrotriorchis radiates</i>	CE (TSC) V (EPBC)	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, <i>Melaleuca</i> swamp forest and riparian <i>Eucalyptus</i> forest of coastal rivers.	This species is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens.	This species is not known to occur in any reserves in the region.	The Project area does not provide suitable habitat for this species and it has not been recorded in the proposed disturbance area. There is no potential for a significant impact on this species.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V (TSC)	Habitat for this species includes forests on low-nutrient soils, specifically those containing key <i>Allocasuarina</i> feed species. They will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required.	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Coricudgy SF Putty SF	This species was not recorded during field surveys, however a historic record of the species occurs in the north of the Project area. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.
Gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V (TSC)	In summer this species occurs in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter this species moves to drier more open eucalypt forests and woodlands. It favours old growth trees for nesting and roosting.	In NSW this species occurs from the south east coast to the Hunter region and inland to the Central Tablelands and South-west Slopes. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Coricudgy SF Putty SF	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Swift parrot <i>Lathamus discolor</i>	E (TSC) E (EPBC)	This species often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which it forages include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box. This bird is a migratory species that breeds in Tasmania during the spring and summer, and migrates to the mainland during the cooler months of the year.	In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW. The project area is within the known distribution of this species. The Project area is within this species' distribution range.	Wollemi NP	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.
Turquoise parrot <i>Neophema pulchella</i>	V (TSC)	This species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. It nests in tree hollows, logs or posts, from August to December.	The turquoise parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Little lorikeet <i>Glossopsitta pusilla</i>	V (TSC)	This species can be found in dry-open eucalypt forests and woodlands, and have been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. The little lorikeet usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples.	This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Putty SF	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Powerful owl <i>Ninox strenua</i>	V (TSC)	The powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Coricudgy SF Putty SF	The powerful owl was recorded during the November 2010 and February 2011 survey of the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Masked owl <i>Tyto novaehollandiae</i>	V (TSC)	This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land.	The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Putty SF	The masked owl was recorded during the February 2011 survey of the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.
Eastern bristlebird <i>Dasyornis brachypterus</i>	E (TSC) E (EPBC)	Dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone.	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys. The project area does not provide suitable habitat for this species.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Brown treecreeper (eastern subsp.) <i>Climacteris picumnus victoriae</i>	V (TSC)	Typical habitat for this species includes drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas. This species prefers areas without a dense understorey.	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Newnes SF	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Black-chinned honeyeater (eastern subspecies) <i>Melithreptus gularis</i>	V (TSC)	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially mugga ironbark, white box, grey box, yellow box and forest red gum. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Newnes SF	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Scarlet robin <i>Petroica boodang</i>	V (TSC)	This robin can be found in woodlands and open forests from the coast through to inland slopes. The birds can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of its habitat. It forages from low perches on invertebrates either on the ground or in woody debris or tree trunks.	The scarlet robin can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and south SA. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Coricudgy SF Putty SF	This species was recorded during the February 2011 and November 2012 surveys of the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis temporalis</i>	V(TSC)	Open box-gum woodlands on the slopes. Box-cypress-pine and open box woodlands on alluvial plains. Also found in acacia shrubland and adjoining areas.	Occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Newnes SF	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.
Varied sittella <i>Daphoenositta chrysoptera</i>	V (TSC)	The varied sittella can typically be found in eucalypt forests and woodlands, especially of rough-barked species and mature smooth-barked gums with dead branches, it can also be identified in mallee and acacia woodlands. This species builds a cup shaped nest made of plant fibres and spiders webs which is placed at the canopy level in the fork of a living tree.	The varied sittella is a sedentary species that inhabits the majority of mainland Australia with the exception of the treeless deserts and open grasslands. Its NSW distribution is basically continuous from the coast to the far west. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Coricudgy SF Putty SF	This species was recorded during the February 2011 survey of the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Regent honeyeater <i>Anthochaera phrygia</i>	CE (TSC) E (EPBC)	This species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine casuarina woodlands. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Coricudgy SF Dharug NP	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
MAMMALS						
Spotted-tailed quoll <i>Dasyurus maculatus</i>	V (TSC) E (EPBC)	Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops. Suitable den sites including hollow logs, tree hollows, rocky outcrops or caves.	In NSW the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north east of the state. It occurs from the coast to the snowline and inland to the Murray River. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF Putty SF	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Brush-tailed rock-wallaby <i>Petrogale penicillata</i>	E (TSC) V (EPBC)	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. It browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species shelters or bask during the day in rock crevices, caves and overhangs and is most active at night.	The brush-tailed rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia. Its distribution roughly followed the Great Dividing Range for 2500km from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the divide, and the slopes and plains as far west as Cobar in NSW and Injune (500 km NW of Brisbane) in Queensland.	Yengo NP Wollemi NP Parr SCA Newnes SF Coricudgy SF	This species was not recorded during field surveys. Records of the species occur in the vicinity of the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.
New Holland mouse <i>Pseudomys novaehollandiae</i>	V (EPBC)	This species inhabits a range of habitats from open heathlands, open woodlands with a heath understorey, as well as vegetated dunes. The New Holland mouse lives in a burrow which is shared with other individuals.	This species has a disjunct distribution across Tasmania, Victoria, Queensland and NSW.	Wollemi NP Newnes SF	This species was recorded during the February 2011 survey of the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix E.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Koala <i>Phascolarctos cinereus</i>	V (TSC) V (EPBC)	This species inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns. The species is known to feed on a large number of eucalypt and non-eucalypt species; however it tends to specialise on a small number in different areas. <i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i> , <i>E. microcorys</i> , <i>E. robusta</i> , <i>E. albens</i> , <i>E. camaldulensis</i> and <i>E. populnea</i> are some preferred species.	The koala has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. It is known to occur along inland rivers on the western side of the Great Dividing Range. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Newnes SF	This species was recorded during field surveys of the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Long-nosed potoroo <i>Potorous tridactylus</i>	V (TSC) V (EPBC)	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	This species is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.
Eastern pygmy possum <i>Cercartetus nanus</i>	V (TSC)	Found in a broad range of habitats from rainforest through sclerophyll (including box-ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	This species 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 Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Coricudgy SF Putty SF	This species was recorded during field surveys in the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Squirrel glider <i>Petaurus norfolcensis</i>	V (TSC)	Inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forest, and blackbutt-bloodwood forest with heath understorey. It prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites.	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Dharug NP Newnes SF Coricudgy SF Putty SF	This species was recorded during field surveys. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendix D.
Yellow-bellied glider <i>Petaurus australis</i>	V (TSC)	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.	The yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP Coricudgy SF Putty SF	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Grey-headed flying-fox <i>Pteropus poliocephalus</i>	V (TSC) V (EPBC)	This species occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Grey-headed flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	Yengo NP Wollemi NP Putty SF Dharug NP	This species was recorded during the February 2011 survey of the Project area. The species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendices D and E.
Eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V (TSC)	This species hunts in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. It forms discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Eastern bent-wing bats occur along the east and north-west coasts of Australia. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Dharug NP Putty SF Newnes SF	This species was recorded during field surveys. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Eastern cave bat <i>Vespadelus troughtoni</i>	V (TSC)	This species is a cave-roosting bat that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. It has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals, and is occasionally found along cliff-lines in wet eucalypt forest and rainforest.	The eastern cave bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT.	Yengo NP Wollemi NP	This species was recorded during field surveys. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendix D.
Eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V (TSC)	Habitat for this species includes sclerophyll forest. It prefers wet habitats, with trees over 20 m high, and generally roosts in tree hollows or trunks.	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast.	Yengo NP Wollemi NP Putty SF Newnes SF Coricudgy NP	This species was recorded during field surveys. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendix D.
East coast freetail-bat <i>Mormopterus norfolkensis</i>	V (TSC)	This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.	The eastern freetail-bat is found along the east coast from south Queensland to southern NSW. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Dharug NP	This species was recorded during field surveys. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Greater broad-nosed bat <i>Scoteanax rueppellii</i>	V (TSC)	The greater broad-nosed bat appears to prefer moist environments such as moist gullies in coastal forests, or rainforest. They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland. It roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings.	The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 m. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Dharug NP Putty SF Newnes SF	This species was recorded during field surveys. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendix D.
Large-eared pied bat <i>Chalinolobus dwyeri</i>	V (TSC) V (EPBC)	The large-eared pied bat is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands, however, it probably tolerates a wide range of habitats. It tends to roost in the twilight zones of mines and caves, generally in colonies or common groups.	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range. The Project area is within this species' distribution range.	Yengo NP Wollemi NP Parr SCA Newnes SF Coricudgy SF Putty SF	This species was recorded during field surveys. Individuals of this species may be impacted by the proposed development.	Yes, refer to Appendices D and E.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Southern myotis <i>Myotis macropus</i>	V (TSC)	This species generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, and storm-water channels, buildings, under bridges and in dense foliage. It forages over streams and pools catching insects and small fish by raking its feet across the water surface.	The large-footed myotis is found in the coastal band from the north-west of Australia, across the Top-End and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. The Project area is within this species' distribution range.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.
Little bentwing bat <i>Miniopterus australis</i>	V (TSC)	Prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Occurs in coastal north-eastern NSW and eastern Queensland.	Wollemi NP Parr SCA	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Yellow-bellied sheathtail bat <i>Saccolaimus flaviventris</i>	V (TSC)	This species forages for insects, flies high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees; and appears to defend an aerial territory. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows.	The yellow-bellied sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. The Project area is at the eastern edge of this species' distribution.	Wollemi NP	This species was not recorded during field surveys. Potential foraging habitat was identified in the Project area and the species is potentially susceptible to the impacts of the Project.	Yes, refer to Appendix D.
FISHES						
Macquarie perch <i>Macquaria australasica</i>	E (EPBC) E (FM)	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks.	The species was once widespread through the cooler upper reaches of the southern tributaries of the Murray-Darling river system. It now considered isolated to the upper reaches of the Lachlan and Murrumbidgee Rivers in southern NSW.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys, however it has been previously recorded in Wollemi Creek and Colo River downstream of the Project area. Due to the ephemeral nature of the aquatic habitats in the Project area, it is unlikely that this species occurs.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Australian grayling <i>Prototroctes maraena</i>	V (EPBC)	The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones.	This species 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.	This species is not known to occur in any reserves in the region.	This species was not recorded during field surveys and suitable habitat was not identified. The Project area does not provide suitable habitat for this species.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to Project Area	Reservation in the Region	Occurrence in Project Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
ENDANGERED POPULATIONS						
Gang-gang cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E (TSC)	Occurs within a variety of forest and woodland types. Usually frequents forested areas with old growth attributes required for nesting and roosting purposes. Also utilises less heavily timbered woodlands and urban fringe areas to forage, but appears to favour well timbered country through which it habitually flies as it moves about. Individuals of this population are likely to move outside the 'defined' population boundary in the general area and should still be considered of this population.	This endangered population is found in the Ku-ring-gai and Hornsby local government areas. The population is believed to be largely confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east. It is known to inhabit areas of Lane Cove National Park, Pennant Hills Park and other forested gullies in the area. The Project Area is outside the known distribution of this species.	Ku-ring-gai Chase NP Marramarra NP	This species/population was not recorded during field surveys. While suitable habitat exists for this species, the Project area is outside the known distribution of this population and the population is unlikely to occur.	No.

Notes

CE critically endangered
E: endangered
EPBC: *Environment Protection and Biodiversity Conservation Act 1999*
FM *Fisheries Management Act 1994*
LGA: Local Government Area
MAR marine

MIG migratory
NR: Nature Reserve
NP: National Park
PD: preliminary determination
SCA State Conservation Area
TSC: *Threatened Species Conservation Act 1995*
V: vulnerable

Table 3 – Migratory Species Listed under International Treaties and Recorded or with Potential to Occur within the Project Area or Local Area

Species	Legal Status	Specific Habitat	Distribution in relation to the Project area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
Fork-tailed swift <i>Apus pacificus</i>	MAR (EPBC) MIG (EPBC) CAMBA JAMBA ROKAMBA	This species is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas.	The fork-tailed swift can be found throughout Australia during migrating. In Australia it is most common west of the Great Dividing Range. This species is uncommon in Tasmania.	Yengo NP Wollemi NP Dharug NP	This species is commonly recorded on the east coast of NSW. The species has not been recorded within the Project area and it is unlikely to utilise the habitats of the proposed disturbance area.	No.
White-bellied sea-eagle <i>Haliaeetus leucogaster</i>	MAR (EPBC) MIG (EPBC) CAMBA	These birds are typically sighted perched in tall trees and soaring above bodies of water and land. They are territorial and form permanent breeding pairs.	This species is distributed across Australia, China, India, Indonesia, New Guinea, and South-east Asia. Within Australia it is distributed along and near the coast.	Yengo NP Parr SCA Dharug NP	This species is commonly recorded on the east coast of NSW. The species was recorded flying over the Project area during the field surveys.	Yes, refer to Appendix E.
White-throated needletail <i>Hirundapus caudacutus</i>	MAR (EPBC) MIG (EPBC) CAMBA JAMBA ROKAMBA	This species only occurs in Australia between the months of October and May. It forages on flying insects and drinks whilst in flight. Feeding is typically associated with rising thermal currents typical with storm fronts and bushfires.	This species is distributed over eastern and northern Australia	Yengo NP Wollemi NP Dharug NP Putty SF Parr SCA	This species is commonly recorded across NSW. The species has been previously recorded near the Project area.	Yes, refer to Appendix E.

Species	Legal Status	Specific Habitat	Distribution in relation to the Project area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
Rainbow bee-eater <i>Merops ornatus</i>	MAR (EPBC) MIG (EPBC) JAMBA	The preferred habitat of the rainbow bee-eater is open forests and woodlands, shrublands, and cleared or semi-cleared areas (commonly farmland). These areas are usually in proximity to permanent water, however, during migration this bird may fly over areas of non-preferential habitat.	This species is distributed throughout most of mainland Australia as well as several near-shore islands. It is not found in Tasmania and has only been identified in a thin strip in the most arid regions of central WA.	Yengo NP Wollemi NP Dharug NP Parr SCA	This species is commonly recorded in the Lower and Central Hunter regions. The species has been previously recorded near the Project area.	Yes, refer to Appendix E.
Black-faced monarch <i>Monarcha melanopsis</i>	MAR (EPBC) MIG (EPBC) Bonn	This bird occurs in coastal scrub, damp gullies, eucalypt woodlands and rainforests. It can be seen foraging for insects amongst foliage, and builds a deep, cup-shaped nest in a tree fork (3 to 6 m above the ground) which is made up of cobwebs, casuarinas needles, bark, moss and roots.	The black-faced monarch is distributed along the eastern coast of Australia, gradually becoming less common towards the south.	Yengo NP Wollemi NP Dharug NP Putty SF	This species is commonly recorded on the east coast of NSW. The species has been previously recorded near the Project area.	Yes, refer to Appendix E.

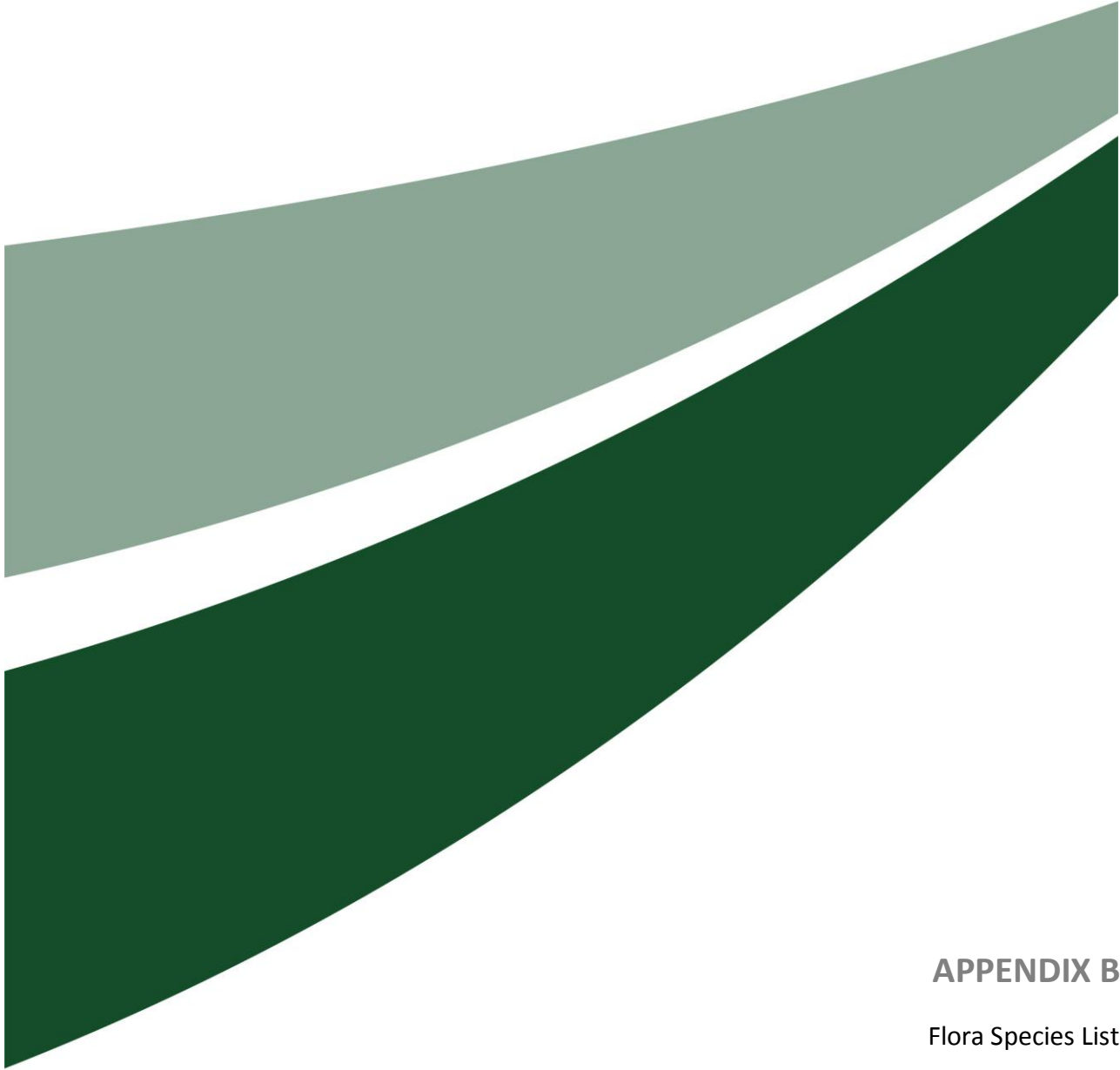
Species	Legal Status	Specific Habitat	Distribution in relation to the Project area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
Spectacled monarch <i>Monarcha trivirgatus</i>	MAR (EPBC) MIG (EPBC) Bonn	This species prefers a thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	This species is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south.	Wollemi NP	This species is recorded on the east coast of NSW. The species has not been recorded within or near the Project and the species is not expected to occur.	No.
Satin flycatcher <i>Myiagra cyanoleuca</i>	MAR (EPBC) MIG (EPBC) Bonn	This species typically inhabits wet areas of tall forests, particularly in gullies. The satin flycatcher moves north in the winter and is seldom seen in NSW, Tasmania, Victoria or SA during these times. It nests in loose colonies in broad-based cup-shaped nests on a bare horizontal branch. These nests are constructed from bark, grass, lichen and cobwebs.	The satin flycatcher can be found in both Australia and New Guinea. In Australia it is distributed along the east coast from Cape York through to Tasmania, also covering parts of south-eastern SA.	Wollemi NP Putty SF	This species is commonly recorded on the east coast of NSW. The species has been previously recorded near the Project area.	Yes, refer to Appendix E.

Species	Legal Status	Specific Habitat	Distribution in relation to the Project area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
Rufous fantail <i>Rhipidura rufifrons</i>	MAR (EPBC) MIG (EPBC) Bonn	The rufous fantail typically inhabits areas of dense wet forest, mangrove, rainforest or swamp woodlands. It prefers areas where there is intense shade available and is often seen close to ground. In winter it is seldom found in NSW or Victoria. Nests are about 5 m from the ground in a small cup shape and constructed from thin grasses held together by cobwebs.	This species is distributed across the north and eastern coast of Australia, but is also found in Guam, New Guinea, the Solomon Islands and Sulawesi.	Wollemi NP Yengo NP Putty SF	This species is commonly recorded in the Lower and Central Hunter regions. The species has been previously recorded near the Project area.	Yes, refer to Appendix E.
Eastern great egret <i>Ardea modesta</i>	MAR (EPBC) MIG (EPBC) CAMBA JAMBA	The eastern great egret typically inhabits areas of shallow, flowing waters, but also uses damp grasslands and other watered areas. It can be observed both in flocks and on its own, and roost during the night in groups.	The eastern great egret is distributed throughout the world, and is common throughout most areas of Australia, with the exception of extremely arid areas.	Parr SCA	This species is commonly recorded across NSW. The species has not been recorded within or near the Project and the species is not expected to occur.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to the Project area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
Cattle egret <i>Ardea ibis</i>	MAR (EPBC) MIG (EPBC) CAMBA JAMBA	The cattle egret can be found in grasslands, wetlands and woodlands and has never been identified in arid areas. These birds are commonly sighted at garbage dumps and pastures in croplands (especially where poor drainage is present).	The cattle egret is distributed throughout Asia, Africa, Europe and Australia. It is most commonly found in north-eastern WA, the NT and in south-eastern Australia from Bundaberg Queensland through to Port Augusta SA. It has also been identified in Tasmania.	Blue Mountains NP Dharug NP	This species is commonly recorded on the east coast of NSW. The species has not been recorded within or near the Project and the species is not expected to occur.	No.
Lathams snipe <i>Gallinago hardwickii</i>	MAR (EPBC) MIG (EPBC) Bonn CAMBA JAMBA ROKAMBA	Lathams snipe can be found in permanent and ephemeral wetlands up to 2000 m above sea level. These water bodies are usually freshwater with low, dense vegetation. It forages in areas of mud with some vegetation cover and roosts nearby. Lathams snipe does not breed in Australia, only passing through for migration.	This species has been recorded from Cape York through to south-east SA. The range of this species extends from inland of the eastern tablelands in south-east Queensland to west of the Great Dividing Range in NSW. Richmond River, NSW is a favourite area for non-breeding birds.	Dharug NP	This species is mainly recorded on the east coast in NSW. The species has not been recorded within or near the Project and the species is not expected to occur.	No.

Species	Legal Status	Specific Habitat	Distribution in relation to the Project area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
Australian painted snipe <i>Rostratula benghalensis australis</i>	MAR (EPBC) MIG (EPBC) CAMBA	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowall, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	This species is not known from any conservation reserves in the region.	This species is mainly recorded in selected areas of east coast in NSW. The species has not been recorded within or near the Project and the species is not expected to occur.	No.

Bonn	Bonn Convention
CAMBA	China-Australia Migratory Bird Agreement
EPBC	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
JAMBA	Japan-Australia Migratory Bird Agreement
MAR	marine
MIG	migratory
NP	National Park
ROKAMBA	Republic of Korea Migratory Bird Agreement
SCA	State Conservation Area
SF	State Forest



APPENDIX B

Flora Species List

Appendix B – Flora Species List

The following list was developed from surveys of the Project area as detailed in Section 3.3 of the main report. It includes all species of vascular plants observed during fieldwork completed by Umwelt in 2010, 2011 and 2012. Although substantial, the list will not be comprehensive, because not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp. specimens that are identified to genus level only;

The following abbreviations or symbols are used in the list:

1 to 6	modified Braun-Blanquet cover-abundance score (see Section 3.3.4.1 of main report);
X	species recorded in proximity to, but outside of, quantitative floristic quadrat; and species recorded opportunistically during surveys;
asterisk (*)	denotes species not native to the Tinda Creek area;
subsp.	subspecies;
var.	variety; and
Bold	font denotes threatened plant species or populations.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler et al. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust, 2013), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS		
Cycadopsida																																
Zamiaceae	<i>Macrozamia spiralis</i>															2																
Filicopsida																																
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	poison rock fern																		2							2					
Blechnaceae	<i>Blechnum</i> sp.																															
Dennstaedtiaceae	<i>Pteridium esculentum</i>	bracken	3		2			2	2																	2	3		X			
Gleicheniaceae	<i>Gleichenia dicarpa</i>	pouched coral fern		1																												
Lindsaeaceae	<i>Lindsaea linearis</i>	screw fern							1		2																					
Polypodiaceae	<i>Platycerium</i> sp.													2																		
Lycopsida																																
Selaginellaceae	<i>Selaginella uliginosa</i>									1			2																			
Magnoliopsida (Liliidae)																																
Alliaceae	<i>*Nothoscordum borbonicum</i>	onion weed				1																										
Anthericaceae	<i>Arthropodium milleflorum</i>	vanilla lily										2																				
Anthericaceae	<i>Arthropodium</i> sp.							1																								
Anthericaceae	<i>Caesia parviflora</i>	pale grass-lily																								2			X			
Anthericaceae	<i>Dichopogon strictus</i>	chocolate lily										1																				
Anthericaceae	<i>Laxmannia gracilis</i>	slender wire lily									1																					
Colchicaceae	<i>Burchardia umbellata</i>	milkmaids	1			2	2					1			2		2															
Cyperaceae	<i>*Cyperus aggregatus</i>																													1		
Cyperaceae	<i>*Cyperus reflexus</i>																													2		
Cyperaceae	<i>Baumea articulata</i>	jointed twig-rush																						1								
Cyperaceae	<i>Chorizandra cymbaria</i>						2																								X	
Cyperaceae	<i>Cyathochaeta diandra</i>		3									2						4					3	4								
Cyperaceae	<i>Cyperus gracilis</i>																														X	
Cyperaceae	<i>Eleocharis sphacelata</i>	tall spike rush		4									1																		X	
Cyperaceae	<i>Eleocharis</i> sp.																							3	2							
Cyperaceae	<i>Lepidosperma laterale</i>	variable saw-sedge								2															2						X	
Cyperaceae	<i>Lepidosperma limicola</i>					1																										
Cyperaceae	<i>Lepidosperma</i> sp.																													X		
Cyperaceae	<i>Ptilothrix deusta</i>					1																										
Cyperaceae	<i>Schoenus brevifolius</i>		1			1	3			2					1		4				3											
Haemodoraceae	<i>Haemodorum planifolium</i>								1					1																	X	
Hypoxidaceae	<i>Hypoxis</i> sp.				1																											
Iridaceae	<i>Patersonia longifolia</i>							2																								
Iridaceae	<i>Patersonia sericea</i>	silky purple-flag							2		2	2		2																		
Juncaceae	<i>Juncus continuus</i>												4											1				2				
Juncaceae	<i>Juncus planifolius</i>			2																											X	

Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS				
Juncaceae	<i>Juncus</i> sp.		3			5				4		2						3	2		5	2								X				
Lomandraceae	<i>Lomandra confertifolia</i>																													X				
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>											2				2								2	3									
Lomandraceae	<i>Lomandra glauca</i>	pale mat-rush			2		1	3				2			1	2										2								
Lomandraceae	<i>Lomandra longifolia</i>	spiny-headed mat-rush	1		2			3				2								2					2		2	1	X					
Lomandraceae	<i>Lomandra obliqua</i>													2		2									2	2								
Orchidaceae	<i>Caleana major</i>	flying duck orchid																													X			
Orchidaceae	<i>Caleana</i> sp.								1																									
Orchidaceae	<i>Calochilus</i> sp.	bearded orchid										1																						
Orchidaceae	<i>Dipodium roseum</i>	hyacinth orchid									X																							
Orchidaceae	<i>Genoplesium</i> sp. aff. <i>sagittiferum</i>	midge orchid			1																													
Orchidaceae	<i>Glossodia major</i>	waxlip orchid																														X		
Orchidaceae	<i>Thelymitra</i> sp.				1																													
Philydraceae	<i>Philydrum lanuginosum</i>	frogsmouth		2																				2										
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>											2	2			2				2				2	2	2				X				
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>		1						2					1																				
Phormiaceae	<i>Dianella revoluta</i> var. <i>revoluta</i>				2			3																										
Phormiaceae	<i>Dianella</i> sp.										2																					X		
Poaceae	* <i>Andropogon virginicus</i>	whisky grass		2		1							3		3						2											X		
Poaceae	<i>Anisopogon avenaceus</i>	oat speargrass						2	2		2																			2				
Poaceae	<i>Aristida ramosa</i>	purple wiregrass																				2				1		3						
Poaceae	<i>Aristida</i> sp.		2		3							3											2				2			X				
Poaceae	<i>Austrostipa aristiglumis</i>	plains grass																										2						
Poaceae	<i>Austrostipa rudis</i>										1																							
Poaceae	<i>Austrostipa</i> sp.				2																					2								
Poaceae	* <i>Axonopus fissifolius</i>	narrow-leafed carpet grass			3																							2	X	X				
Poaceae	* <i>Briza maxima</i>	quaking grass			1																													
Poaceae	<i>Cleistochloa rigida</i>							3			2																							
Poaceae	<i>Cynodon dactylon</i>	common couch																														X		
Poaceae	<i>Dichelachne micrantha</i>	shorthair plumegrass																						2			2							
Poaceae	<i>Echinopogon caespitosus</i>	bushy hedgehog-grass																		2							2							
Poaceae	<i>Echinopogon</i> sp.																						2											

Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS						
Poaceae	<i>Entolasia marginata</i>	bordered panic																						2												
Poaceae	<i>Entolasia stricta</i>	wiry panic	2			3	2		2	4		2	2	2	3	2	4		3	1	3	3	3	2	2	2	2		X							
Poaceae	<i>Eragrostis brownii</i>	Browns lovegrass																								3	2		X							
Poaceae	<i>Eragrostis</i> sp.				3																						3		X							
Poaceae	<i>Imperata cylindrica</i>	blady grass			3		2													3								3		X						
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	weeping grass										2								4				3			4	4								
Poaceae	<i>Oplismenus imbecillis</i>	basket grass																		4							3			X						
Poaceae	<i>Panicum simile</i>	two-colour panic											2	2	2					2			2													
Poaceae	* <i>Paspalum dilatatum</i>	paspalum											2															4		X						
Poaceae	<i>Paspalum</i> sp.																														X					
Poaceae	<i>Rytidosperma fulvum</i>	wallaby grass														2									2	2										
Poaceae	<i>Rytidosperma</i> sp.						2						2	2	2		3										2			X						
Poaceae	<i>Themeda australis</i>	kangaroo grass	3				1					3		2											2	2	2			X						
Poaceae	<i>Urochloa subquadripara</i>	green summer grass										2																								
Restionaceae	<i>Baloskion fimbriatum</i>							3			2																									
Restionaceae	<i>Leptocarpus tenax</i>		1	4	2	1	4	3		5	2	1	4		4		3	1	3		3	2	1							X						
Restionaceae	<i>Lepyrodia anarthria</i>																						3	2												
Restionaceae	<i>Lepyrodia scariosa</i>									2			2		3		3	4	4		4	3														
Xanthorrhoeaceae	<i>Xanthorrhoea</i> sp.				2								1	2		1			2			2	1			1				X						
Xyridaceae	<i>Xyris complanata</i>				1																															
Xyridaceae	<i>Xyris operculata</i>																						2													
Magnoliopsida (Magnoliidae)																																				
Acanthaceae	<i>Brunoniella australis</i>	blue trumpet																																		
Apiaceae	<i>Hydrocotyle laxiflora</i>	stinking pennywort																		2				2												
Apiaceae	<i>Platysace ericoides</i>							2	2		2	2														2				X						
Apiaceae	<i>Platysace</i> sp.		2																																	
Apiaceae	<i>Xanthosia atkinsoniana</i>							2	2		3													1		1										
Araliaceae	<i>Polyscias sambucifolia</i>	elderberry panax																		2																
Asteraceae	* <i>Aster subulatus</i>	wild aster																													2					
Asteraceae	<i>Chrysocephalum semipapposum</i>	clustered everlasting																												2						
Asteraceae	* <i>Conyza bonariensis</i>	flaxleaf fleabane																																	X	
Asteraceae	<i>Epaltes australis</i>	spreading nut-heads										1																								
Asteraceae	<i>Euchiton involucreatus</i>	star cudweed																																	X	
Asteraceae	* <i>Hypochaeris radicata</i>	catsear			3																											X				
Asteraceae	* <i>Hypochaeris</i> sp.																																		2	
Asteraceae	<i>Minuria leptophylla</i>																																		1	

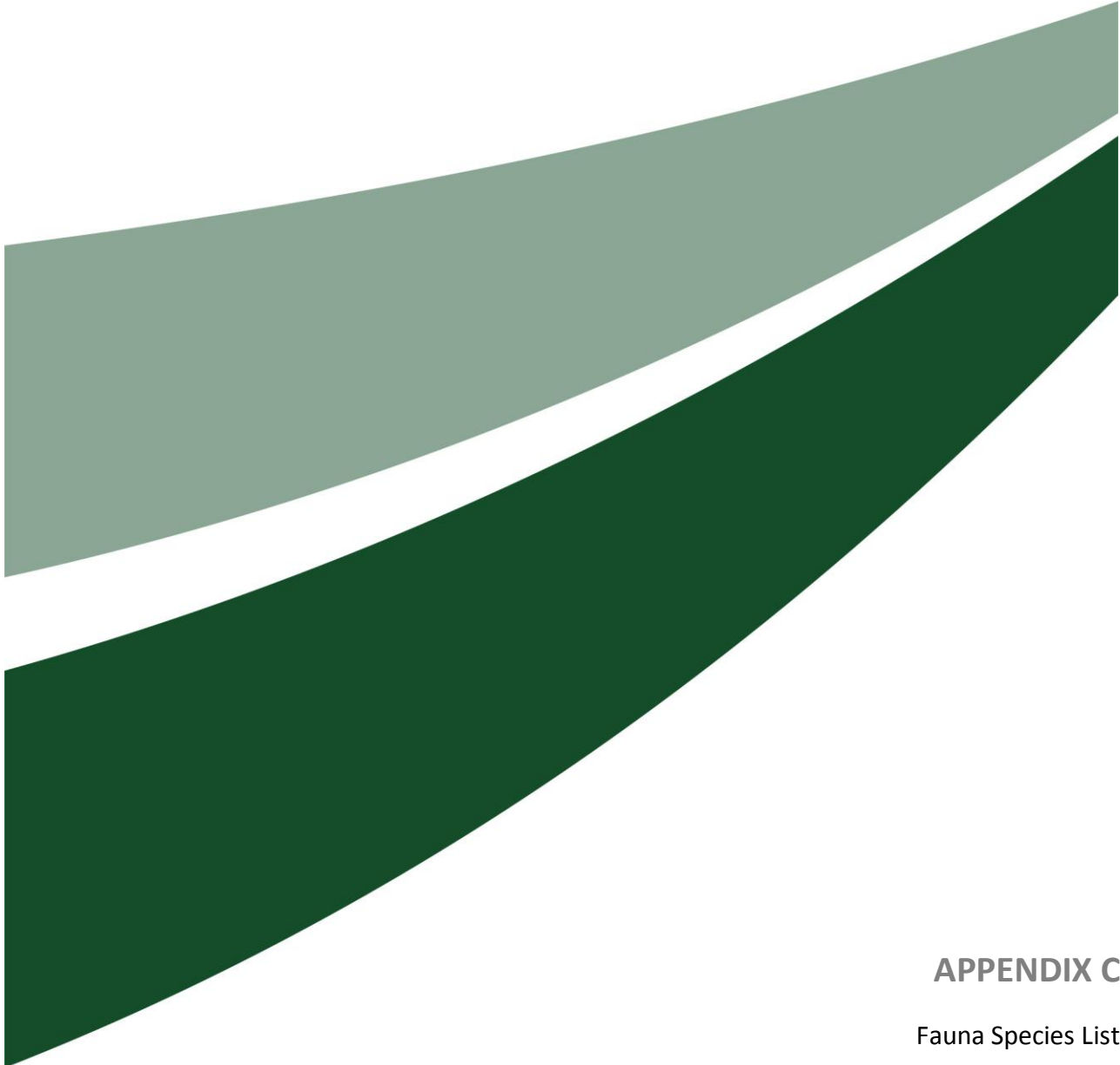
Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS
Asteraceae	<i>Ozothamnus diosmifolius</i>	white dogwood																		1					2		1		X	
Campanulaceae	<i>Wahlenbergia luteola</i>								1																					
Campanulaceae	<i>Wahlenbergia</i> sp.																												X	
Casuarinaceae	<i>Allocasuarina gymnanthera</i>																													X
Casuarinaceae	<i>Allocasuarina littoralis</i>	black sheoak											1		1		2			2									X	
Casuarinaceae	<i>Allocasuarina paludosa</i>				X			4																						
Casuarinaceae	<i>Allocasuarina</i> sp.																								2				X	
Casuarinaceae	<i>Allocasuarina torulosa</i>	forest oak								1																				
Clusiaceae	<i>Hypericum gramineum</i>	small St Johns wort			2	2						1										2						2		
Convolvulaceae	<i>Dichondra repens</i>	kidney weed																		2							2			
Dilleniaceae	<i>Hibbertia aspera</i>	rough guinea flower	2																					2						
Dilleniaceae	<i>Hibbertia fasciculata</i>		1																											
Dilleniaceae	<i>Hibbertia obtusifolia</i>	hoary guinea flower	2						2																					
Dilleniaceae	<i>Hibbertia pedunculata</i>																													X
Dilleniaceae	<i>Hibbertia riparia</i>																												X	
Dilleniaceae	<i>Hibbertia rufa</i>														2															
Dilleniaceae	<i>Hibbertia</i> sp.							2			2																			
Droseraceae	<i>Drosera burmannii</i>				1																									
Epacridaceae	<i>Brachyloma daphnoides</i>	daphne heath						3	1			1	1			2										1			X	
Epacridaceae	<i>Epacris obtusifolia</i>					1																								
Epacridaceae	<i>Leucopogon juniperinus</i>	prickly beard-heath												1																
Epacridaceae	<i>Leucopogon lanceolatus</i>		2																											
Epacridaceae	<i>Leucopogon microphyllus</i> var. <i>pilibundus</i>																						2							
Epacridaceae	<i>Leucopogon muticus</i>	blunt beard-heath					1				3															1				
Epacridaceae	<i>Leucopogon</i> sp.								2			2		2		2													X	
Epacridaceae	<i>Melichrus procumbens</i>	jam tarts												1																
Epacridaceae	<i>Monotoca elliptica</i>	tree broom-heath													1															
Epacridaceae	<i>Styphelia</i> sp.		1																											
Euphorbiaceae	<i>Amperea xiphoclada</i>							2																						
Euphorbiaceae	<i>Poranthera ericifolia</i>								1			1												2	1					
Fabaceae (Faboideae)	<i>Bossiaea ensata</i>							2						2															X	
Fabaceae (Faboideae)	<i>Bossiaea heterophylla</i>	variable bossiaea							2		2													1	2				X	
Fabaceae (Faboideae)	<i>Bossiaea scolopendria</i>								2																					
Fabaceae (Faboideae)	<i>Bossiaea</i> sp.													2																

Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS	
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	broom bitter pea					1																						X		
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	gorse bitter pea																		1										X	
Fabaceae (Faboideae)	<i>Dillwynia elegans</i>																													X	
Fabaceae (Faboideae)	<i>Dillwynia floribunda</i>								2		3																				
Fabaceae (Faboideae)	<i>Dillwynia retorta</i>		2		2			2	1		3	2		2												1		1	X		
Fabaceae (Faboideae)	<i>Dillwynia sericea</i>								2																						
Fabaceae (Faboideae)	<i>Glycine clandestina</i>																			2										X	
Fabaceae (Faboideae)	<i>Glycine tabacina</i>																										2				
Fabaceae (Faboideae)	<i>Gompholobium grandiflorum</i>	large wedge pea												2		1									2	2			X		
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	false sarsaparilla												2											2		1		X		
Fabaceae (Faboideae)	<i>Hovea linearis</i>										1																				
Fabaceae (Faboideae)	<i>Hovea longifolia</i>								2					1		2										1					
Fabaceae (Faboideae)	<i>Podolobium ilicifolium</i>	prickly shaggy pea												2		3									2						
Fabaceae (Faboideae)	<i>Pultenaea scabra</i>													1		4									1	2					
Fabaceae (Faboideae)	<i>Pultenaea</i> sp.							2																							
Fabaceae (Mimosoideae)	<i>Acacia brownii</i>	heath wattle	1					1			2						1								1	1			X		
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	black wattle, green wattle																												X	
Fabaceae (Mimosoideae)	<i>Acacia filicifolia</i>	fern-leaved wattle												1										3						X	
Fabaceae (Mimosoideae)	<i>Acacia linifolia</i>	flax-leaved wattle												1																	
Fabaceae (Mimosoideae)	<i>Acacia longissima</i>	narrow-leaved wattle																												X	
Fabaceae (Mimosoideae)	<i>Acacia parvipinnula</i>	silver-stemmed wattle											2	1		1	2				3						3	1			
Fabaceae (Mimosoideae)	<i>Acacia penninervis</i> var. <i>penninervis</i>	mountain hickory												1												1				X	
Fabaceae (Mimosoideae)	<i>Acacia rubida</i>	red-leaved wattle																						4							
Fabaceae (Mimosoideae)	<i>Acacia</i> sp.													1																X	
Fabaceae (Mimosoideae)	<i>Acacia stricta</i>	straight wattle																							1	1					
Fabaceae (Mimosoideae)	<i>Acacia terminalis</i> subsp. <i>aurea</i>	sunshine wattle												1																	
Fabaceae (Mimosoideae)	<i>Acacia ulicifolia</i>	prickly Moses							2			1																		X	

Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS
Gentianaceae	<i>*Centaurium tenuiflorum</i>				2																									
Goodeniaceae	<i>Cooperookia barbata</i>													2		2														
Goodeniaceae	<i>Dampiera purpurea</i>								1																					
Goodeniaceae	<i>Dampiera stricta</i>		2			2		2			2	2		2	2		3					2	2						X	
Goodeniaceae	<i>Goodenia gracilis</i>				1																									
Goodeniaceae	<i>Goodenia heterophylla</i>	ivy-leaved goodenia												2											2					
Goodeniaceae	<i>Goodenia paniculata</i>														1							2	2	2					X	
Goodeniaceae	<i>Goodenia</i> sp.																							2						
Goodeniaceae	<i>Scaevola ramosissima</i>	purple fan-flower							2					1		2						1				2				
Haloragaceae	<i>Gonocarpus elatus</i>														1															
Haloragaceae	<i>Gonocarpus micranthus</i>				1																									
Haloragaceae	<i>Gonocarpus micranthus</i> subsp. <i>ramosissimus</i>												2				2													
Haloragaceae	<i>Gonocarpus</i> sp.																												X	
Haloragaceae	<i>Gonocarpus tetragynus</i>				2																									
Haloragaceae	<i>Gonocarpus teucrioides</i>	raspwort	2						1			2													2				X	X
Lauraceae	<i>Cassythia glabella</i>	devils twine												1																
Lauraceae	<i>Cassythia pubescens</i>	devils twine									2																			
Lauraceae	<i>Cassythia</i> sp.																							2					X	
Lobeliaceae	<i>Pratia purpurascens</i>	whiteroot																		1							2			
Loganiaceae	<i>Mitrasacme alsinoides</i>				1			2			1																			
Loganiaceae	<i>Mitrasacme</i> sp.								1			2																		
Myrtaceae	<i>Angophora bakeri</i>	narrow-leaved apple					1																							
Myrtaceae	<i>Angophora costata</i>	smooth-barked apple														2									4	3				
Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple	3		1			3	3		4	3				2				3						2			X	
Myrtaceae	<i>Callistemon citrinus</i>	crimson bottlebrush			2																	1								X
Myrtaceae	<i>Callistemon linearis</i>	narrow-leaved bottlebrush		1						1			2		1		1													
Myrtaceae	<i>Callistemon</i> sp.																						2	2						
Myrtaceae	<i>Corymbia eximia</i>	yellow bloodwood																							3	2			X	
Myrtaceae	<i>Eucalyptus fibrosa</i>	red ironbark																			3				2		2			
Myrtaceae	<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	Parramatta red gum		1			3			3			3		3		3	1			1	1		4					X	X
Myrtaceae	<i>Eucalyptus punctata</i>	grey gum												2											1				X	
Myrtaceae	<i>Eucalyptus racemosa</i>	narrow-leaved scribbly gum																											X	
Myrtaceae	<i>Eucalyptus resinifera</i>	red mahogany																											X	

Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS
Myrtaceae	<i>Eucalyptus sclerophylla</i>	hard-leaved scribbly gum	4						3		2	3	1		2									4		3			X	
Myrtaceae	<i>Eucalyptus sparsifolia</i>	narrow-leaved stringybark												2		3									3		3			X
Myrtaceae	<i>Eucalyptus tereticornis</i>	forest red gum					1																							
Myrtaceae	<i>Leptospermum arachnoides</i>						1			1			2		2		1		2										X	
Myrtaceae	<i>Leptospermum continentale</i>	prickly teatree				1																								
Myrtaceae	<i>Leptospermum juniperinum</i>	prickly tea-tree	1		2							2																	X	
Myrtaceae	<i>Leptospermum polygalifolium</i>			2									2		1									4					X	
Myrtaceae	<i>Leptospermum sp.</i>							3																					X	
Myrtaceae	<i>Leptospermum trinervium</i>		1		3			3	3		3														2		1		X	
Myrtaceae	<i>Melaleuca linariifolia</i>												1																	
Myrtaceae	<i>Melaleuca thymifolia</i>	thyme-leaved paperbark	3	1	3		2	3		2		3	2		2					2				1	2				X	
Myrtaceae	<i>Micromyrtus ciliata</i>		2			3	2					2					2		2			1	2						X	
Myrtaceae	<i>Micromyrtus sp.</i>							1																						
Oxalidaceae	<i>Oxalis perennans</i>																											1		
Pittosporaceae	<i>Billardiera scandens</i>	appleberry								1																1				
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	native blackthorn																		1				2			2		X	
Polygonaceae	* <i>Acetosella vulgaris</i>	sorrel, sheep sorrel			1																									
Polygonaceae	* <i>Persicaria strigosa</i>																													X
Proteaceae	<i>Banksia paludosa</i>										4																			
Proteaceae	<i>Banksia serrata</i>	old-man banksia							3								1												X	
Proteaceae	<i>Banksia spinulosa</i>	hairpin banksia	3						1			1																	X	
Proteaceae	<i>Banksia spinulosa</i> var. <i>collina</i>						3			2					2		2													
Proteaceae	<i>Conospermum ellipticum</i>																	1					1							X
Proteaceae	<i>Conospermum ericifolium</i>					1						2																		
Proteaceae	<i>Conospermum longifolium</i> subsp. <i>longifolium</i>																								1					
Proteaceae	<i>Conospermum sp.</i>																												X	
Proteaceae	<i>Conospermum taxifolium</i>		2					4	2		2												1		1				X	
Proteaceae	<i>Grevillea mucronulata</i>													2		2														X
Proteaceae	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>								2		1																	X	X	
Proteaceae	<i>Hakea dactyloides</i>	broad-leaved hakea					1		2																				X	
Proteaceae	<i>Hakea laevipes</i> subsp. <i>laevipes</i>										3																			

Family	Scientific Name	Common Names	Q1	Q1b	Q1k	Q2	Q2b	Q2k	Q3	Q3b	Q3k	Q4	Q4b	Q5	Q5b	Q6	Q6b	Q7	Q7b	Q8	Q8b	Q9	Q10	Q11	Q12	Q13	Q14	Q15	RAPIDS	OPPS
Proteaceae	<i>Isopogon anemonifolius</i>	borad-leaf drumsticks	2		2		2	2	2		2																		X	
Proteaceae	<i>Isopogon</i> sp.																												X	
Proteaceae	<i>Lambertia formosa</i>	mountain devil									4			2												1				
Proteaceae	<i>Lomatia silaifolia</i>	crinkle bush							2		2															2			X	
Proteaceae	<i>Persoonia chamaepitys</i>	mountain geebung	1	1								2			1															
Proteaceae	<i>Persoonia laurina</i>														2		3	1			1					2			X	
Proteaceae	<i>Persoonia levis</i>	broad-leaved geebung							2					1															X	
Proteaceae	<i>Persoonia linearis</i>	narrow-leaved geebung	1				1		2	1	2	1		2	1	2	1			2				2		2	2		X	
Proteaceae	<i>Persoonia oblongata</i>		1				1	1	1	1	3	1	1	1		1						1	1		2					X
Proteaceae	<i>Xylomelum pyriforme</i>	woody pear												2												1				
Rubiaceae	<i>Pomax umbellata</i>													2											2					
Rutaceae	<i>Boronia parviflora</i>	swamp boronia																				1	2							
Santalaceae	<i>Exocarpos cupressiformis</i>	native cherry													1		1					1	2	1						
Stackhousiaceae	<i>Stackhousia nuda</i>																													X
Stackhousiaceae	<i>Stackhousia</i> sp.		1																											
Stylidiaceae	<i>Stylidium graminifolium</i>	grass triggerplant	1		3							2																		
Stylidiaceae	<i>Stylidium</i> sp.																									2			X	
Thymelaeaceae	<i>Pimelea curviflora</i> var. <i>gracilis</i>																						2							
Thymelaeaceae	<i>Pimelea linifolia</i>		2						2																				X	
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>							2			2				1															
Violaceae	<i>Hybanthus monopetalus</i>	slender violet-bush							2																					



APPENDIX C

Fauna Species List

Appendix C – Fauna Species List

The following list was developed following field surveys of the Project area detailed in Section 3.0 of the Ecology Assessment. It includes all species of vertebrate fauna recorded within the Project area during fieldwork and also includes those species that have been previously recorded in the Project area based on the results of the OEH Atlas of NSW Wildlife and EPBC Protected Matters database searches.

The following abbreviations or symbols are used in the list:

asterisk (*)	denotes species not indigenous to the Project area
subsp.	subspecies
MAR	Listed as marine under the EPBC Act
MIG	Listed as migratory under the EPBC Act
V	Listed as vulnerable under the TSC or EPBC Act
E	Listed as endangered under the TSC or EPBC Act
CE	Listed as critically endangered under the TSC or EPBC Act
C	Confident level of identification by Fly by Night Surveys Pty Ltd
P	Probable level of identification by Fly by Night Surveys Pty Ltd
Po	Possible level of identification by Fly by Night Surveys Pty Ltd
Opps	Opportunistic record
PMST	EPBC Act Protected Matters Search Tool
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
TSC Act	<i>Threatened Species Conservation Act 1994</i>

Birds recorded were identified using descriptions in Slater et al. (2003) and the scientific and common name nomenclature of Birds Australia. Reptiles recorded were identified using keys and descriptions in Cogger (2000), Swan et al. (2004), Weigel (1990) and Wilson & Swan (2008) and the scientific and common name nomenclature of Cogger (2000).

Amphibians recorded were identified using keys and descriptions in Cogger (2000), Robinson (1998), Anstis (2002) and Barker et al. (1995) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Strahan (2002), Churchill (2008) and Menkhorst & Knight (2004) and the scientific and common name nomenclature of Strahan (2002) for non bat species and Churchill (2008) for bats.

Scientific Name	Common Name	Conservation Status		Atlas of NSW Wildlife	PMST	Nov 2010	Feb 2011	Nov 2012	Opps
		TSC Act	EPBC Act						
BIRDS									
Phasianidae									
<i>Coturnix ypsilophora</i>	brown quail					x			x
Anatidae									
<i>Chenonetta jubata</i>	Australian wood duck								x
<i>Anas superciliosa</i>	Pacific black duck					x			
Columbidae									
<i>Phaps chalcoptera</i>	common bronzewing					x			x
<i>Ocyphaps lophotes</i>	crested pigeon					x			x
Aegothelidae									
<i>Aegotheles cristatus</i>	Australian owl-nightjar						x		
Phalacrocoracidae									
<i>Phalacrocorax sulcirostris</i>	little black cormorant					x			
Accipitridae									
<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle		MIG			x			
Charadriidae									
<i>Vanellus miles</i>	masked lapwing					x			x
Cacatuidae									
<i>Calyptorhynchus funereus</i>	yellow-tailed black-cockatoo								x
<i>Cacatua galerita</i>	sulphur-crested cockatoo								x
<i>Calyptorhynchus lathami</i>	glossy black-cockatoo	V		x					
Psittacidae									
<i>Glossopsitta concinna</i>	musk lorikeet						x		
<i>Platycercus elegans</i>	crimson rosella					x			
<i>Platycercus eximius</i>	eastern rosella					x			
Cuculidae									
<i>Scythrops novaehollandiae</i>	channel-billed cuckoo					x			
<i>Chalcites lucidus</i>	shining bronze-cuckoo					x			x
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo					x			x
<i>Cacomantis variolosus</i>	brush cuckoo					x			

Scientific Name	Common Name	Conservation Status		Atlas of NSW Wildlife	PMST	Nov 2010	Feb 2011	Nov 2012	Opps
		TSC Act	EPBC Act						
Strigidae									
<i>Ninox strenua</i>	powerful owl	V				x			
<i>Ninox novaeseelandiae</i>	southern boobook					x	x		
Tytonidae									
<i>Tyto novaehollandiae</i>	masked owl	V					x		
Halcyonidae									
<i>Dacelo novaeguineae</i>	laughing kookaburra					x	x		x
<i>Todiramphus macleayii</i>	forest kingfisher					x	x		x
Climacteridae									
<i>Corombates leucophaea</i>	white-throated treecreeper						x		
Ptilonorhynchidae									
<i>Ptilonorhynchus violaceus</i>	satin bowerbird					x			
Maluridae									
<i>Malurus cyaneus</i>	superb fairy-wren					x	x		x
Acanthizidae									
<i>Sericornis frontalis</i>	white-browed scrubwren								x
<i>Hylacola pyrrhopygia</i>	chestnut-rumped heathwren						x		x
<i>Smicronis brevirostris</i>	weebill					x			
<i>Gerygone fusca</i>	western gerygone						x		
<i>Gerygone albogularis</i>	white-throated gerygone					x			x
<i>Acanthiza nana</i>	yellow thornbill								x
<i>Acanthiza reguloides</i>	buff-rumped thornbill					x	x		
<i>Acanthiza pusilla</i>	brown thornbill					x	x		
Pardalotidae									
<i>Pardalotus punctatus</i>	spotted pardalote					x			x
<i>Pardalotus striatus</i>	striated pardalote						x		
Meliphagidae									
<i>Acanthorhynchus tenuirostris</i>	eastern spinebill					x	x		x
<i>Lichenostomus chrysops</i>	yellow-faced honeyeater					x	x		x
<i>Lichenostomus leucotis</i>	white-eared honeyeater					x	x		

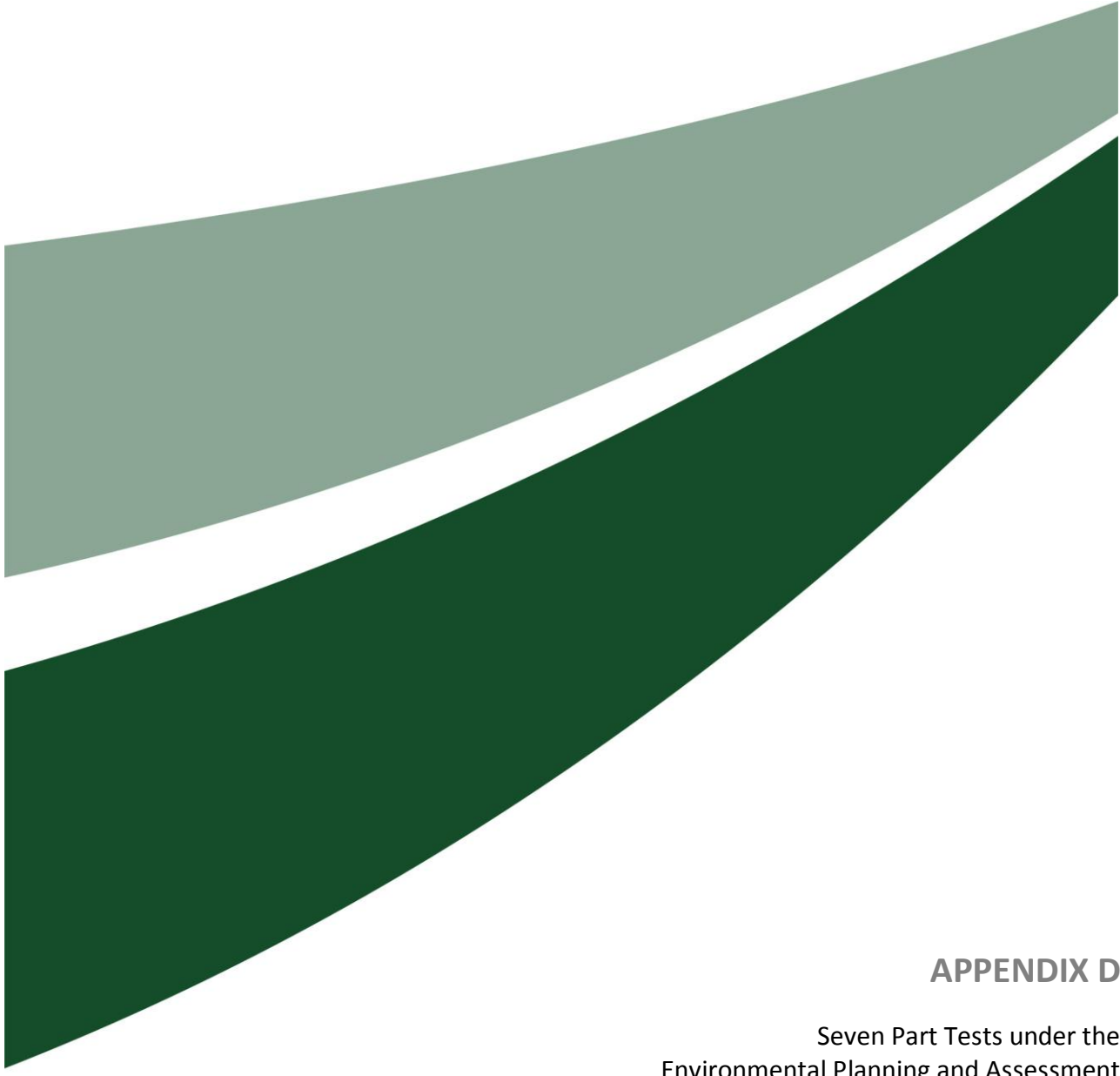
Scientific Name	Common Name	Conservation Status		Atlas of NSW Wildlife	PMST	Nov 2010	Feb 2011	Nov 2012	Opps
		TSC Act	EPBC Act						
<i>Lichenostomus melanops</i>	yellow-tufted honeyeater					x	x		x
<i>Manorina melanocephala</i>	noisy miner					x			x
<i>Anthochaera chrysoptera</i>	little wattlebird						x		
<i>Anthochaera carunculata</i>	red wattlebird						x		
<i>Entomyzon cyanotis</i>	blue-faced honeyeater			x					
<i>Phylidonyris novaehollandiae</i>	New Holland honeyeater						x	x	
<i>Phylidonyris niger</i>	white-cheeked honeyeater					x	x		x
<i>Melithreptus albogularis</i>	white-throated honeyeater						x		
<i>Melithreptus brevirostris</i>	brown-headed honeyeater						x		
<i>Melithreptus lunatus</i>	white-naped honeyeater						x		x
<i>Philemon buceroides</i>	helmeted friarbird						x		
<i>Philemon corniculatus</i>	noisy friarbird					x	x		x
Neosittidae									
<i>Daphoenositta chrysoptera</i>	varied sittella	V							x
Campephagidae									
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike					x	x		
Pachycephalidae									
<i>Falcunculus frontatus</i>	crested shrike-tit					x			x
<i>Pachycephala rufiventris</i>	rufous whistler					x	x		x
<i>Colluricincla harmonica</i>	grey shrike-thrush					x	x		
Oriolidae									
<i>Oriolus sagittatus</i>	olive-backed oriole					x			
Artamidae									
<i>Artamus cyanopterus</i>	dusky woodswallow						x		x
<i>Cracticus tibicen</i>	Australian magpie					x			
<i>Strepera graculina</i>	ped currawong					x			x
Rhipiduridae									
<i>Rhipidura albiscapa</i>	grey fantail					x	x		x
<i>Rhipidura leucophrys</i>	willie wagtail					x	x		x

Scientific Name	Common Name	Conservation Status		Atlas of NSW Wildlife	PMST	Nov 2010	Feb 2011	Nov 2012	Opps
		TSC Act	EPBC Act						
Corvidae									
<i>Corvus coronoides</i>	Australian raven					x			x
Monarchidae									
<i>Myiagra rubecula</i>	leaden flycatcher						x		x
Petroicidae									
<i>Microeca leucophaea</i>	jacky winter					x			x
<i>Petroica boodang</i>	scarlet robin	V					x	x	
<i>Eopsaltria australis</i>	eastern yellow robin						x		x
Hirundinidae									
<i>Petrochelidon nigricans</i>	tree martin					x	x		
Estrildidae									
<i>Neochmia temporalis</i>	red-browed finch								x
Motacilidae									
<i>Anthus novaeseelandiae</i>	Australasian pipit								x
AMPHIBIANS									
Myobatrachidae									
<i>Crinia signifera</i>	brown froglet					x			x
<i>Limnodynastes dumerilii</i>	banjo frog, eastern pobblebonk					x	x		
<i>Limnodynastes ornatus</i>	ornate burrowing frog					x			x
<i>Limnodynastes peronii</i>	striped marsh frog								x
<i>Uperoleia laevigata</i>	smooth toadlet						x		x
Hylidae									
<i>Litoria caerulea</i>	green tree frog					x			x
<i>Litoria dentata</i>	bleating tree frog					x	x		x
<i>Litoria fallax</i>	dwarf tree frog					x	x		x
<i>Litoria latopalmata</i>	broad-palmed frog					x	x		x
<i>Litoria peronii</i>	Perons tree frog								x
<i>Litoria tyleri</i>	Tylers tree frog					x			

Scientific Name	Common Name	Conservation Status		Atlas of NSW Wildlife	PMST	Nov 2010	Feb 2011	Nov 2012	Opps
		TSC Act	EPBC Act						
REPTILES									
Gekkonidae									
<i>Diplodactylus vittatus</i>	wood gecko							x	
Varanidae									
<i>Varanus rosenbergi</i>	Rosenbergs goanna	V				x		x	
<i>Varanus varius</i>	lace monitor								x
Agamidae									
<i>Amphibolurus muricatus</i>	jacky lizard							x	x
<i>Pogona barbata</i>	eastern bearded dragon							x	
Scincidae									
<i>Carlia tetradactyla</i>	southern rainbow skink					x	x		
<i>Ctenotus robustus</i>	striped skink					x			
<i>Egernia cunninghami</i>	Cunninghams skink						x		
Typhlopidae									
<i>Ramphotyphlops wiedii</i>	blind or worm snake							x	
MAMMALS									
Dasyuridae									
<i>Antechinus stuartii</i>	brown antechinus								x
Phascolarctidae									
<i>Phascolarctos cinereus</i>	koala	V	V		x	x	x		
Vombatidae									
<i>Vombatus ursinus</i>	common wombat								x
Burramyidae									
<i>Cercartetus nanus</i>	eastern pygmy-possum	V					x		x
Petauridae									
<i>Petaurus norfolcensis</i>	squirrel glider	V				x	x		
Acrobatidae									
<i>Acrobates pygmaeus</i>	feathertail glider								x
Phalangeridae									
<i>Trichosurus vulpecula</i>	common brushtail possum					x	x		x

Scientific Name	Common Name	Conservation Status		Atlas of NSW Wildlife	PMST	Nov 2010	Feb 2011	Nov 2012	Opps
		TSC Act	EPBC Act						
Macropodidae									
<i>Macropus giganteus</i>	eastern grey kangaroo						x	x	x
<i>Macropus rufogriseus</i>	red-necked wallaby						x	x	x
Rhinolophidae									
<i>Rhinolophus megaphyllus</i>	eastern horseshoe-bat						C		
Molossidae									
<i>Mormopterus norfolkensis</i>	eastern freetail-bat	V				Po	P		
<i>Mormopterus planiceps</i>	southern freetail-bat						C		
<i>Tadarida australis</i>	white-striped freetail-bat					x, C	x, C		
Vespertilionidae									
<i>Miniopterus schreibersii oceanensis</i>	eastern bentwing-bat	V				P	C		
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat						x		
<i>Nyctophilus gouldi</i>	Goulds long-eared bat						x		
<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V		x		P		
<i>Chalinolobus gouldii</i>	Gould's wattled bat					C	C		
<i>Chalinolobus morio</i>	chocolate wattled bat					C	C		
<i>Falsistrellus tasmaniensis</i>	eastern false pipistrelle	V					Po		
<i>Scoteanax rueppellii</i>	greater broad-nosed bat	V				C	P		
<i>Scotorepens balstoni</i>	inland broad-nosed bat						P		
<i>Scotorepens orion</i>	eastern broad-nosed bat					P	P		
<i>Vespadelus pumilus</i>	eastern forest bat					x			
<i>Vespadelus troughtoni</i>	eastern cave bat	V					Po		
<i>Vespadelus vulturnus</i>	little forest bat					P	x, P		
Muridae									
<i>Pseudomys novaehollandiae</i>	New Holland mouse		V		x		x		
<i>*Mus musculus</i>	house mouse					x			x
<i>Rattus lutreolus</i>	swamp rat					x			x
Canidae									
<i>Canis lupus</i>	dingo, domestic dog								x

Scientific Name	Common Name	Conservation Status		Atlas of NSW Wildlife	PMST	Nov 2010	Feb 2011	Nov 2012	Opps
		TSC Act	EPBC Act						
Leporidae									
* <i>Oryctolagus cuniculus</i>	rabbit					x			
Cervidae									
* <i>Dama dama</i>	fallow deer					x	x		x



APPENDIX D

Seven Part Tests under the
Environmental Planning and Assessment
Act 1979

Appendix D – Seven Part Tests under the *Environmental Planning and Assessment Act 1979*

Seven Part Tests are provided below for those threatened species considered (refer to **Appendix A**) to have the potential to be impacted by the Project.

The Seven Part Tests provided below assume a worst case scenario based on the level of impact associated with the currently proposed Project. As discussed in Section 1.1.1 of the main text, an alternative biodiversity offset strategy and disturbance area has been proposed following feedback from OEH, DOE and the NSW NPWS. This proposed alternative results in a slightly different impact to that of the Project and these differences are described in Section 5.10 of the main text. The impacts of the alternative project and biodiversity offset strategy were reviewed in light of the results of the assessment of significance detailed below and in summary, the alternative biodiversity offset strategy results in a comparable level of impact for the majority of vegetation communities and fauna habitats and therefore, the Seven Part Tests below are considered to be applicable to both proposals.

The following species are assessed:

Critically Endangered Species

- Regent honeyeater (*Anthochaera phrygia*).

Endangered Species

- Bynoes wattle (*Acacia bynoeana*);
- Broad-headed snake (*Hoplocephalus bungaroides*);
- Swift parrot (*Lathamus discolor*); and
- Brush-tailed rock wallaby (*Petrogale penicillata*).

Vulnerable Species

- *Dillwynia tenuifolia*;
- Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*);
- *Olearia cordata*;
- Giant burrowing frog (*Heleioporus australiacus*);
- Red-crowned toadlet (*Pseudophryne australis*);
- Rosenbergs goanna (*Varanus rosenbergi*);
- Glossy black-cockatoo (*Calyptorhynchus lathamii*);
- Gang-gang cockatoo (*Callocephalon fimbriatum*);
- Turquoise parrot (*Neophema pulchella*);
- Little lorikeet (*Glossopsitta pusilla*);
- Powerful owl (*Ninox strenua*);
- Masked owl (*Tyto novaehollandiae*);

-
- Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
 - Black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*);
 - Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
 - Varied sittella (*Daphoenositta chrysoptera*);
 - Scarlet robin (*Petroica boodang*);
 - Spotted-tailed quoll (*Dasyurus maculatus*);
 - Koala (*Phascolarctos cinereus*);
 - Long-nosed potoroo (*Potorous tridactylus*);
 - Eastern pygmy-possum (*Cercartetus nanus*);
 - Squirrel glider (*Petaurus norfolcensis*);
 - Yellow-bellied glider (*Petaurus australis*);
 - Grey-headed flying-fox (*Pteropus poliocephalus*);
 - Large-eared pied bat (*Chalinolobus dwyeri*).
 - Little bentwing-bat (*Miniopterus australis*);
 - Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
 - Eastern cave bat (*Vespadelus troughtoni*);
 - Eastern false pipistrelle (*Falsistrellus tasmaniensis*);
 - East coast freetail-bat (*Mormopterus norfolkensis*);
 - Southern myotis (*Myotis macropus*);
 - Yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*); and
 - Greater broad-nosed bat (*Scoteanax rueppellii*).

All assessments are undertaken without any consideration of impact mitigation or offsetting opportunities or commitments. Impact mitigation and biodiversity offsetting commitments are addressed in Sections 6.0 and 7.0 of the main report. Species descriptions are referenced from the Office of Environment and Heritage (OEH, 2013a) and Department of the Environment (2013a) online species profiles, unless otherwise noted.

Critically Endangered Species

Regent honeyeater (*Anthochaera phrygia*)

- 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;***

The regent honeyeater (*Anthochaera phrygia*) has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Scattered records of the species occur within the surrounding Yengo and Wollemi National Parks (OEH, 2013a).

The species is known to occur in a patchy distribution in the temperate woodlands and open forests of the inland slopes of south-east Australia. The species is mainly known from three key breeding sites from the Bundarra-Barraba area of NSW, the Capertee Valley in NSW, and north-eastern Victoria. The direction and extent of movements, including evidence of movement between breeding sites, and a lack of discernible genetic differences between the sites suggest that the regent honeyeater occurs as a single, contiguous population (Garnett and Crowley, 2000). Breeding and nesting is regularly recorded within the Capertee Valley which is located approximately 30 km west of the Project area. The regent honeyeater has potential to make use of the eucalypt forest and woodland habitats of the proposed disturbance area. It is likely that the habitat in the wider Yengo and Wollemi National Parks provides suitable foraging and movement habitat adjacent to the known breeding areas in the Capertee Valley.

The Project will result in the loss of approximately 44.5 ha of potential eucalypt foraging habitat for the species within the proposed disturbance area that includes derived native grasslands that have scattered, remnant overstorey species. Given the availability of over 600,000 ha of suitable foraging habitat is known to occur in the surrounding Yengo and Wollemi National Parks it is not considered that the loss of potential habitat within the proposed disturbance area will result in a significant reduction in potential foraging habitat for the local population, and a local viable population of the species will not be placed at risk of extinction.

- 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;***

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;***

Not applicable.

- 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;***

The Project will result in the loss of approximately 44.5 ha of potential eucalypt foraging habitat for the species and derived native grasslands that have scattered, remnant overstorey species. Given there are no known records of the species within the proposed disturbance area it is unlikely that the species depends on the habitats within the proposed disturbance area for foraging. The wider area of Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known foraging and potential breeding habitat for this species.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation resulting from the Project is unlikely to significantly impact on this species.

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

The Project will result in the loss of approximately 44.5 ha of potential eucalypt foraging habitat for the species within 30 km of known breeding areas in the Capertee Valley. The closest record of the species occurs approximately 15 km to the north-west of the Project area in Wollemi National Park. The species has not been recorded utilising the habitats within the Project area despite targeted seasonal surveys and while box-gum woodlands have become increasingly important resources for this species due to ongoing habitat loss, the proposed disturbance area is not important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species at the State level. A National Recovery Plan for the regent honeyeater was prepared for the years 1999-2003 (Menkhorst et al., 1999) and the *2011 Action Plan for Australian Birds* outlines current conservation objectives particularly for the regent honeyeater (Garnett and Crowley, 2000). The Project is unlikely to contravene the recovery plan as the species has not been recorded within the Project area and the Project will remove potential habitat only.

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.

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Removal of dead wood and dead trees (TSC Act).
- Aggressive exclusion by abundant noisy miners (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the regent honeyeater (*Anthochaera phrygia*).

Endangered Species

Bynoes wattle (*Acacia bynoeana*)

- 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;***

Bynoes wattle (*Acacia bynoeana*) has not been recorded within the Project area despite targeted seasonal surveys undertaken as part of the investigation for the Project. The species has been recorded in the immediate vicinity approximately 1 km to the east of the Project area in similar habitat (OEH, 2013a). Few records occur in the surrounding Yengo National Park. More regionally, the species occurs in strongholds near the Blue Mountains National Park, near Penrith and Murrumbidgee National Park to the south of the Project area (OEH, 2013a).

The species is found in central eastern NSW, from the Hunter district (Ellalong) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at each location being very small (1-5 plants). The species occurs in heath or dry sclerophyll forest on sandy soils and tends to prefer slightly disturbed sites. The proposed disturbance area provides potential woodland habitat for this species.

The Project will result in the loss of approximately 18.7 ha of potential habitat for the species within the proposed disturbance area. Given the availability of suitable habitat in the wider area, it is not considered that the loss of this area will result in a significant reduction in potential habitat for the species, and the species will not be placed at risk of extinction as a result of the Project.

- 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;***

Not applicable.

- 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; and***

Not applicable.

- 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;***

Not applicable.

- 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;***

The Project would result in the loss approximately 18.7 ha of potential woodland habitat for this species. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area as the species has not been recorded in the proposed disturbance area and the surrounding Yengo and Wollemi National Parks provides extensive areas of suitable habitat.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the loss of approximately 18.7 ha of potential habitat for the species. Consequently the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project would result in the loss of approximately 18.7 ha of potential woodland habitat for this species. As few known sites contain more than 30 individuals, sites of particular significance for the species include any population with a large number of plants. No individuals are known to occur within the proposed disturbance area and those occurring outside the Project area will not be disturbed as a result of the Project. Additionally, suitable surrounding habitats occur extensively outside the Project area into Yengo and Wollemi National Parks. The small area of potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

The Project area is not located in proximity to any areas of declared or recommended critical habitat areas.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on Bynoes wattle (*Acacia bynoeana*).

Swift parrot (*Lathamus discolor*)

- 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;**

The swift parrot (*Lathamus discolor*) has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Records of the species generally occur outside the Yengo and Wollemi National Park estates in the Capertee Valley to the west and around Kurrajong to the south (OEH, 2013a).

The species is known to occur in a patchy distribution in the temperate woodlands and open forests of the inland slopes of south-east Australia. The swift parrot occurs as a single population within Australia and migrates annually from breeding grounds in Tasmania to the winter foraging grounds on the coastal plains and slope woodlands of mainland eastern Australia (Saunders, 2002). This species has potential to make use of the eucalypt forest and woodland habitats of the proposed disturbance area, particularly where there are prolific flowering eucalypts and this migratory species is likely to move throughout the area in response to mass flowering events. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that provides likely foraging habitat for the species.

The Project will result in the loss of approximately 44.5 ha of potential eucalypt foraging habitat for the species within the proposed disturbance area that includes derived native grasslands that have scattered, remnant overstorey species. Given the availability of suitable foraging habitat in the wider area, it is not considered that the loss of this area will result in a significant reduction in foraging habitat for the population, and the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 44.5 ha of potential eucalypt foraging habitat for the species and derived native grasslands that have scattered, remnant overstorey species. Given there are no known records of the species within the proposed disturbance area it is unlikely that the species depends on the habitats within the proposed disturbance area for foraging. Additionally, the Project area does not provide breeding habitat for the species. The wider area provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some potential foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this

species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of potential eucalypt foraging habitat for the species within 40 km of known winter foraging areas in the west and south. The closest record of the species however occurs approximately 30 km to the south of the Project area near Kurrajong. The species has not been recorded utilising the habitats within the Project area despite targeted seasonal surveys and while box-gum woodlands have become increasingly important resources for this species due to ongoing habitat loss, the proposed disturbance area is not important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species at the State level. A National Recovery Plan for the swift parrot has been prepared for the years 2006-2010 (Saunders, 2005). The Project is unlikely to contravene the recovery plan as the species has not been recorded within the Project area and the Project will remove potential habitat only.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Aggressive exclusion by abundant noisy miners (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the swift parrot (*Lathamus discolor*).

Broad-headed snake (*Hoplocephalus bungaroides*)

- 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;**

The broad-headed snake (*Hoplocephalus bungaroides*) has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Records of the species occur within 3 km to the south and 5 km to the north of the Project area in the Wollemi and Yengo National Parks (OEH, 2013a).

The broad-headed snake is restricted to the sandstone ranges in the Sydney Basin and within a radius of approximately 200 km of Sydney (Cogger et al., 1993). The current distribution of this species extends from Wollemi National Park in the north, the Clyde River catchment in ranges south-west of Nowra in the south, east to the Royal National Park and near Illawarra, and west to the upper Blue Mountains at Blackheath and Newnes. They are found in rocky outcrops and adjacent sclerophyll forest and woodland (Cogger et al., 1993). This species has potential to make use of the sandstone woodland habitats of the proposed disturbance area, although this has not been recorded. The wider area contains in excess of 600,000 ha of known and potential habitat within Yengo and Wollemi National Parks.

The Project will result in the loss of approximately 23.5 ha of suitable sandstone woodland habitat for the species within the proposed disturbance area. Although the species has not been recorded within the Project area, it has potential to occur given the suitable habitat present and the known records of the species in the locality. However, due to the availability of extensive habitat in the wider Project area and within Yengo and Wollemi National Parks, it is not considered that the loss of this area will result in a significant reduction in habitat for the local population, and the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of potential habitat for the species. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area, as the species has not been recorded within the Project area. The wider area provides in excess of 600,000 ha of forests and woodlands that provide known and potential habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. As some foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential habitat for the species. The species has been recorded utilising the habitats within 3 km of the Project area in 2008 (OEH, 2013a), however has not been recorded using the habitats of the proposed disturbance area. Wollemi National Park, surrounding the Project area represents the northern limit of the species distribution. Due to the small area of the Project area and the extensive availability of other habitat in the wider area, it is unlikely to be important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Removal of bushrock (TSC Act).
- Removal of hollow-bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the broad-headed snake (*Hoplocephalus bungaroides*).

Brush-tailed rock-wallaby (*Petrogale penicillata*)

- 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;***

The brush-tailed rock-wallaby (*Petrogale penicillata*) has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Recent records from 2007 of the species occur within 5 km to the west and 9 km to the south of the Project area in the Wollemi National Park (OEH, 2013a).

The range of the brush-tailed rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. They occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. The species shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. They forage on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Previous records in the locality suggest that the species has the potential to make use of the woodland habitats of the proposed disturbance area, although no appropriate cliff line or escarpment habitat has been identified.

The Project will result in the loss of approximately 44.5 ha of potential woodland and grassland habitat for the species within the proposed disturbance area. Due to the lack of recent records in the Project area, it is likely that local records do not represent a currently persisting population of the species in the Project area. Additionally, the surrounding habitat includes in excess of 600,000 ha of suitable woodland and forested habitats in Yengo and Wollemi National Parks. It is considered unlikely that the Project would disrupt the life cycle of this species and a viable local population would not be placed at risk of extinction.

- 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;***

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;***

Not applicable.

- 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;***

The Project will result in the loss of approximately 44.5 ha of potential woodland and grassland habitat for the species. Given the lack of records of the species and lack of rocky habitat, it is unlikely that this species would depend on the habitats within the proposed disturbance area. The habitats in the surrounding Yengo and Wollemi National Parks provide in excess of 600,000 ha of eucalypt forests and woodlands that provide likely habitat for this species.

- ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***

The Project will not introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. As some potential habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However,

given the extensive area of suitable habitat in the surrounding area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of potential woodland and grassland habitat for the species. The species has been recently recorded within 5 km of the Project area (OEH, 2013a). The species live in family groups that have strong site fidelity with home ranges estimated to be around 15 ha. The small area of only potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

The 'Recovery Plan for the brush-tailed rock wallaby (*Petrogale penicillata*) (DECC, 2008b) is applicable to this species. The Project is unlikely to contravene the recovery plan as the species has not been recorded within the Project area and the Project will remove potential habitat only.

There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the brush-tailed rock-wallaby (*Petrogale penicillata*).

Vulnerable Species

Dillwynia tenuifolia

- 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;***

Dillwynia tenuifolia has not been recorded within the Project area despite targeted surveys undertaken as part of the investigation for the Project. The species has been recorded in the vicinity, approximately 7 km to the north-west of the Project area in similar habitat (OEH, 2013a). Few records occur in the surrounding Wollemi and Yengo National Park. More regionally the species occurs in high numbers near Penrith and the Cumberland Plain in western Sydney to the south of the Project area (OEH, 2013a).

The core distribution for the species occurs in the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. The species occurs within scrubby/dry heath areas in western Sydney and escarpment woodland in the north of Yengo National Park. Local abundances are influenced by past disturbance history, particularly after fire disturbance. The proposed disturbance area provides potential woodland habitat for this species.

The Project will result in the loss of approximately 18.7 ha of potential habitat for the species within the proposed disturbance area. Given the availability of suitable habitat in the wider area, it is not considered that the loss of this area will result in a significant reduction in area of potential habitat for the species, and the species will not be placed at risk of extinction as a result of the Project.

- 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;***

Not applicable.

- 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; and***

Not applicable.

- 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;***

Not applicable.

- 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;***

The Project would result in the loss approximately 18.7 ha of potential woodland habitat for this species. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area as the species has not been recorded in the proposed disturbance area and the surrounding Yengo and Wollemi National Park provides extensive areas of suitable habitat.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the loss of approximately 18.7 ha of potential habitat for the species. Consequently the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project would result in the loss of approximately 18.7 ha of potential woodland habitat for this species. No individuals are known to occur within the proposed disturbance area and those occurring outside the Project area will not be disturbed as a result of the Project. Additionally, suitable surrounding habitats occur extensively outside the Project area into Yengo National Park. The small area of potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

The Project area is not located in proximity to any areas of declared or recommended critical habitat areas.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on *Dillwynia tenuifolia*.

Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)

- 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;***

Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) has been recorded within the proposed disturbance area for the Project during surveys undertaken for this assessment. 849 individuals were recorded within the Project area with three of these occurring within the proposed disturbance area. Disjunct populations of the species occur in the Putty area approximately 15 km north of the Project area (Fairley, 2004). More regionally the species occurs in two distinct areas around the Lower Hunter and Picton areas to the east and south of the Project area, respectively (OEH, 2013a).

The species is known to occur in sporadic populations throughout the Sydney Basin on ridge crests, upper slopes and flat plains. The species inhabits a range of vegetation types from heath and shrubby woodland to open forest. The proposed disturbance area provides known sandstone woodland habitat for this species. Substantial targeted flora surveys were undertaken in the Project area where individual specimens were recorded.

The Project will involve the disturbance of three individuals and 18.7 ha of known and potential eucalypt woodland habitat for the species. It is likely that the records within the Project area constitute part of a viable local population of the species occurring in the wider area. Despite this, 846 known individuals occur outside the proposed disturbance area and will not be disturbed as a result of the Project. Additionally, it is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. Therefore it is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;***

Not applicable.

- 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; and***

Not applicable.

- 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;***

Not applicable.

- 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;***

The Project would result in the loss approximately 18.7 ha of known and potential woodland habitat for this species. This will include the loss of three small-flower grevillea individuals out of 849 recorded within the wider Project area. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides extensive areas of suitable habitat.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the loss of approximately 18.7 ha of known and potential habitat for the species. Consequently the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project would result in the loss of three individuals and approximately 18.7 ha of known and potential woodland habitat for this species. Sites of particular significance for the species include any population with greater than 50 plants, a population with a varied age structure including active recruitment of seedlings and an area of intact habitat away from high disturbance areas (NPWS, 2002). It is likely that the population within the Project area is part of the disjunct population known to occur in the Putty area. Despite this, 846 individuals occur outside the proposed disturbance area and will not be disturbed as a result of the Project. Additionally, it is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo National Park. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

The Project area is not located in proximity to any areas of declared or recommended critical habitat areas.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*).

Olearia cordata

- 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;***

Olearia cordata has not been recorded within the Project area despite targeted surveys undertaken as part of the investigation for the Project. The species has been recorded in the vicinity, approximately 5 km to the south-west of the Project area in similar habitat (OEH, 2013a). Clustered records occur in the surrounding Wollemi and Yengo National Park (OEH, 2013a).

The species has a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. Most known populations occur within Wollemi National Park, Yengo National Park and Wisemans Ferry Historic Site. The species grows in dry open sclerophyll forest and open shrubland, on sandstone ridges. Local abundances are influenced by past disturbance history, particularly after fire disturbance. The proposed disturbance area provides potential woodland habitat for this species.

The Project will result in the loss of approximately 18.7 ha of potential habitat for the species within the proposed disturbance area. Given the availability of suitable habitat in the wider area, it is not considered that the loss of this area will result in a significant reduction in the area of potential habitat for the species, and the species will not be placed at risk of extinction as a result of the Project.

- 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;***

Not applicable.

- 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; and***

Not applicable.

- 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;***

Not applicable.

- 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;***

The Project would result in the loss approximately 18.7 ha of potential woodland habitat for this species. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area as the species has not been recorded in the proposed disturbance area and the surrounding Yengo and Wollemi National Park provides extensive areas of suitable habitat.

- ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***

The Project will result in the loss of approximately 18.7 ha of potential habitat for the species. Consequently, the level of fragmentation and isolation will slightly increase for this species. However,

given the extensive area of suitable habitat in the surrounding area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project would result in the loss of approximately 18.7 ha of potential woodland habitat for this species. No individuals are known to occur within the proposed disturbance area and those occurring outside the Project area will not be disturbed as a result of the Project. Additionally, suitable surrounding habitats occur extensively outside the Project area into Yengo National Park. The small area of potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

The Project area is not located in proximity to any areas of declared or recommended critical habitat areas.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on *Olearia cordata*.

Giant burrowing frog (*Heleioporus australiacus*)

- 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;**

The giant burrowing frog (*Heleioporus australiacus*) has not been recorded within the Project area or immediate surrounds despite targeted surveys undertaken as part of the investigation for the Project. The closest record of the species occurs approximately 9 km to the south-west of the Project area (OEH, 2013a). Other records of the species in the locality occur within the surrounding habitats of Yengo and Wollemi National Park estates.

The species is known to occur in heath, woodland and open dry sclerophyll forest habitats and is restricted to the eastern slopes of the Great Dividing Range and coastal regions from near Mt Coridudgy and Kings Cross in Wollemi National Park in New South Wales to Walhalla in the central highlands of eastern Victoria. The species has been found from near sea level up to 1000 m, from the coast to almost 100 km inland along the escarpment of the Great Dividing Range. The species has been observed occurring away from riparian or moist habitat. This species has potential to make use of the heath and woodland habitats of the proposed disturbance area, although this has not been recorded. The wider area contains in excess of 600,000 ha of known and potential habitat within Yengo and Wollemi National Parks.

The Project will result in the loss of approximately 44.5 ha of suitable heath, grassland and woodland habitat for the species within the proposed disturbance area. Although the species has not been recorded within the Project area, it has potential to occur given the suitable habitat present and the known records of the species in the locality. However, due to the availability of extensive habitat in the wider area within Yengo and Wollemi National Parks, it is not considered that the loss of this area will result in a significant reduction in habitat for the population, and a local viable population of the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will remove approximately 44.5 ha of heath, grassland and woodland that provides potential habitat for the species. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area, as the species has not been recorded within the Project area. The wider area provides in excess of 600,000 ha of forests and woodlands that provide known and potential habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project is not expected to introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. The species can move between 200 and 300 m a night in favourable conditions and home ranges are considered to be around 0.04 ha (OEH, 2013b). As some habitat will be removed as part of the Project, the level of fragmentation and

isolation within the Project area will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the lack of records in the immediate area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of potential habitat for the species. The species has been recorded utilising the habitats within 9 km of the Project area in 1997 (OEH, 2013a), however has not been recorded using the habitats of the proposed disturbance area. Due to the small area of the Project area and the extensive availability of other habitat in the wider area, it is unlikely to be important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species. The Project will not have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species.

The 'Threat Abatement Plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis' (DEH, 2006) is pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on giant burrowing frog (*Heleioporus australiacus*).

Red-crowned toadlet (*Pseudophryne australis*)

- 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;**

The red-crowned toadlet (*Pseudophryne australis*) has not been recorded within the Project area despite targeted surveys undertaken as part of the investigation for the Project. The closest record of the species occurs approximately 2 km to the east of the Project area in Yengo National Park (OEH, 2013a). Other records of the species in the locality occur within the surrounding habitats of Yengo and Wollemi National Park estates.

The species is known to occur in open forests particularly on the Hawkesbury and Narrabeen sandstone habitats and is restricted to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. The species inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. They are 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. This species has potential to make use of the riparian and swamp habitats of the proposed disturbance area, although this has not been recorded. The wider area contains in excess of 600,000 ha of known and potential habitat within Yengo and Wollemi National Parks.

The Project will result in the loss of approximately 5.4 ha of suitable sedge and swamp habitat for the species within the proposed disturbance area. Although the species has not been recorded within the Project area, it has potential to occur given the suitable habitat present and the known records of the species in the locality. However, due to the availability of extensive habitat in the wider area within Yengo and Wollemi National Parks, it is not considered that the loss of this area will result in a significant reduction in habitat for the population, and the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will remove approximately 5.4 ha of sedge and swamp vegetation that provides potential habitat for the species. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area, as the species has not been recorded within the Project area. The wider area provides in excess of 600,000 ha of conservation land that provide known and potential habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project is not expected to introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. As some potential habitat will be removed as part of the Project, the level of fragmentation and isolation within the Project area will

slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the lack of records in the immediate area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 5.4 ha of potential habitat for the species. The species has been recorded utilising the habitats within 2 km of the Project area in 2006 (OEH, 2013a), however has not been recorded using the habitats of the proposed disturbance area. Due to the small area of suitable, potential habitat in the Project area and the extensive availability of other habitat in the wider area, it is unlikely to be important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species. The Project will not have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species.

The 'Threat Abatement Plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis' (DEH, 2006) is pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act).
- Bushrock removal (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on red-crowned toadlet (*Pseudophryne australis*).

Rosenbergs Goanna (*Varanus rosenbergi*)

- 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;**

Rosenbergs goanna (*Varanus rosenbergi*) has been recorded within the proposed disturbance area for the Project during targeted surveys undertaken for this assessment. The species was recorded on four occasions during the 2011 and 2012 surveys along with 18 potential burrow sites across the Project area. Further records of the species occur within 1 km of the Project area and are scattered throughout the wider area into Yengo and Wollemi National Parks (OEH, 2013a).

The species is known to occur on the Sydney sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. The species occurs in heath, open forest and woodland and is associated with termite mounds which provide suitable nesting resources. They shelter in hollow logs, rock crevices and in burrows. The species is known to utilise the burrow and mound sites occurring in the Project area. The wider area contains in excess of 600,000 ha of known and potential habitat within Yengo and Wollemi National Parks.

The Project is likely to involve the disturbance of seven potential burrow sites, including one that was recorded to be in use during the 2012 surveys of the Project area. Additionally, 44.5 ha of known habitat within the proposed disturbance area will be disturbed as a result of the Project. It is likely that the records within the Project area constitute part of a viable local population of the species occurring in the wider area. Despite this, it is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. Although there is likely to be some localised impacts, it is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project would result in the loss approximately 44.5 ha of known habitat for this species. This will include the loss of seven potential burrow sites out of 18 recorded within the wider Project area. It is unlikely that the species would depend exclusively on the habitats within the proposed disturbance area as the wider Project area and Yengo and Wollemi National Parks provides extensive areas of suitable habitat.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the loss of approximately 44.5 ha of known habitat for the species. Consequently the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the small area to be disturbed, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project would result in the loss of seven potential burrow sites and approximately 44.5 ha of known habitat for this species. Termite mounds, in particular, are vital habitat for the species as incubators for eggs laid inside the mounds. Termite mounds across the proposed disturbance area will be removed as a result of the Project. Mound and burrow sites also occur in the Project area which will not be disturbed as part of the Project. It is likely that this population extends into the suitable surrounding habitats occurring within and outside the Project area into Yengo and Wollemi National Park. The small area of habitat, including a small number potential burrows and nesting mounds, to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

The Project area is not located in proximity to any areas of declared or recommended critical habitat areas.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on Rosenbergs goanna (*Varanus rosenbergi*).

Glossy black-cockatoo (*Calyptorhynchus lathamii*)

- 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;**

The glossy black-cockatoo (*Calyptorhynchus lathamii*) has been previously recorded in 1998 in the north-east corner of the Project area in 1998, and additional records are known in the immediate vicinity of the project area, from 2008 (OEH, 2013a). Additionally, chewed cones which are characteristic feeding remains of the species from an *Allocasuarina* were identified in the broader Project area during the surveys undertaken for this assessment. Further records of the species occur widely within the surrounding Yengo and Wollemi National Park estates.

The species is uncommon but widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW. The species inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black sheoak (*Allocasuarina littoralis*) and forest sheoak (*A. torulosa*) are important food trees. This species is likely to make use of the forest and woodland habitats of the proposed disturbance area, particularly in vegetation where *Allocasuarina* species occur. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland foraging habitat for the species within the proposed disturbance area. It is likely that the records within the Project area constitute part of a viable local population of the species occurring in the wider area. Despite this, it is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland foraging habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high

mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland foraging habitat for the species. The species has been previously recorded within the Project area and is likely to forage in the *Allocasuarina* species occurring within the proposed disturbance area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Park. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the glossy black-cockatoo (*Calyptorhynchus lathamii*).

Gang-gang cockatoo (*Callocephalon fimbriatum*)

- 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;**

The gang-gang cockatoo (*Callocephalon fimbriatum*) has not been previously recorded in Project area however records occur in the immediate vicinity approximately 1 km to the east and the south of the Project area (OEH, 2013a). Further records of the species occur widely within the surrounding Yengo and Wollemi National Park estates.

In NSW, the species is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. The species inhabits tall mountain forests and woodlands in the summer and open forests and woodlands in lower altitudes in the winter. They feed mainly on seed of native trees and shrubs. This species is likely to make use of the forest and woodland habitats of the proposed disturbance area for foraging habitat. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland foraging habitat for the species within the proposed disturbance area. It is likely that the records near the Project area constitute part of a viable local population of the species occurring in the wider area. Despite this, it is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Park. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland foraging habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland foraging habitat for the species. The species has been previously recorded in proximity to the Project area and is likely to forage in the eucalypt woodland occurring within the proposed disturbance area. It is likely that this population utilises the Project area as part of a wider range of suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the gang-gang cockatoo (*Callocephalon fimbriatum*).

Turquoise parrot (*Neophema pulchella*)

- 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;**

The turquoise parrot (*Neophema pulchella*) has not been previously recorded in Project area however records occur in the immediate vicinity approximately 1 km to the west, north and the south of the Project area (OEH, 2013a). Further records of the species occur both locally and widely within the surrounding Yengo and Wollemi National Park estates.

The species is known to live on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland from southern Queensland through to northern Victoria. The species is usually seen in pairs or small family groups and forages on seeds or grasses and herbaceous plants, or browsing on vegetable matter. This species is likely to make use of the forest and woodland habitats of the proposed disturbance area. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 44.5 ha of likely forest, woodland and derived native grassland foraging habitat for the species within the proposed disturbance area. It is likely that the records near the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 44.5 ha of likely forest, woodland and derived native grassland foraging habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Park provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of likely forest, woodland and derived native grassland foraging habitat for the species. The species has been previously recorded within the 1 km of the Project area and is likely to forage in the woodland and shrub lands occurring within the proposed disturbance area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the turquoise parrot (*Neophema pulchella*).

Little lorikeet (*Glossopsitta pusilla*)

- 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;**

The little lorikeet (*Glossopsitta pusilla*) has not been previously recorded in Project area however records occur in the immediate vicinity approximately 1 km to the east and west of the Project area (OEH, 2013a). Further records of the species occur both locally and widely within the wider Yengo and Wollemi National Park estates.

In NSW, the species is known from dry open woodlands and forests from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. The species forage in small flocks and feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. Nesting habitat includes small tree hollows in smooth-barked eucalypts. This species is likely to make use of the forest and woodland habitats of the proposed disturbance area as foraging habitat. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 44.5 ha of likely forest and woodland foraging habitat that includes derived native grasslands that have scattered, remnant overstorey species, and potential breeding habitat for the species within the proposed disturbance area. It is likely that the records near the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Park. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 44.5 ha of likely forest and woodland foraging habitat, that includes derived native grasslands that have scattered, remnant overstorey species, and potential breeding habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area, as the wider area in Yengo and Wollemi National Park provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat and potential breeding habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in

the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of likely forest and woodland foraging habitat and potential breeding habitat for the species. The species has been previously recorded within the 1 km of the Project area and is likely to forage in the woodland and shrub lands occurring within the proposed disturbance area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the little lorikeet (*Glossopsitta pusilla*).

Powerful Owl (*Ninox strenua*)

- 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;***

The powerful owl (*Ninox strenua*) has been recorded on two occasions within the Project area during the November 2010 and February 2011 Umwelt surveys undertaken for this assessment. During the 2010 survey the species was detected using call play back techniques, flying into the central area of Lot 2. A visual confirmation was made of the species during the 2011 surveys while spotlighting, approximately 150 m north of the previous sighting. Scattered records of the species also occur in the wider area within Yengo and Wollemi National Parks (OEH, 2013a).

This species is endemic to eastern and south-eastern Australia. In NSW, it is widely but uncommonly distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains. The powerful owl requires large tracts of forest or woodland habitat but can also occur in fragmented landscapes. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It is likely that the species utilises the Project area as foraging and potentially nesting habitat.

The Project will result in the removal of approximately 44.5 ha of foraging habitat and potential roosting and nesting habitat for the species. It is likely that the powerful owls that use the habitats of the Project area form part of a larger home range for the species that are known to be in excess of 1000 ha (DEC, 2006). The habitats in the Project area are likely to constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Park. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;***

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

Not applicable.

- 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;***

The Project will result in the loss of approximately 44.5 ha of likely foraging habitat and potential roosting habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides extremely large areas of continuous native vegetation that provides known and potential foraging habitat for this species. The Project area is likely to comprise a small portion of a much larger home range that is likely to be in excess of 1000 ha (DEC, 2006).

- ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat and potential breeding habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in

the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of woodland foraging habitat and potential roosting/nesting habitat for the species. The species has been recorded within the proposed disturbance area and is likely to forage in the woodland and open habitats occurring within the proposed disturbance area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

The 'NSW Recovery Plan for the Large Forest Owls' (DEC, 2006) is applicable to this species. The Project is not consistent with this recovery plan as it contravenes the following objective: "*Manage and protect habitat off reserves and state forest*". However the proposed disturbance area is dominated by areas that have been historically disturbed and provide low foraging habitat value for this species. The known foraging and potential roosting habitats impacted within the proposed disturbance area comprise 45 ha which is not considered large enough to adversely affect the survival of the species in the locality.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the powerful owl (*Ninox strenua*).

Masked owl (*Tyto novaehollandiae*)

- 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;**

The masked owl (*Tyto novaehollandiae*) was identified on one occasion by its characteristic call while responding to call playback during the February 2011 Umwelt surveys undertaken for this assessment. Scattered records of the species also occur in the wider area within Yengo and Wollemi National Parks (OEH, 2013a).

This species is known to occur along the east coast to the western plains of NSW. The masked owl occurs in dry eucalypt forests and woodlands and can have home ranges between 500 and 1000 ha. The species roosts and breeds in moist eucalypt forested gullies generally using large tree hollows for nesting. It is likely that the species utilises the Project area as foraging and potentially as roosting and nesting habitat, although potential nest trees were not identified.

The Project will result in the removal of approximately 44.5 ha of likely foraging habitat and potential roosting habitat for the species. It is likely that the masked owls that use the habitats of the Project area form part of a larger home range that are known to be in excess of 1000 ha (DEC, 2006). It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

Not applicable.

- 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;**

The Project will result in the loss of approximately 44.5 ha of likely foraging habitat and potential roosting habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides extremely large areas of continuous native vegetation that provides known and potential foraging habitat for this species. The Project area is likely to comprise a small portion of a much larger home range that is likely to be in excess of 1000 ha (DEC, 2006).

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat and potential breeding habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of likely woodland foraging habitat and potential roosting habitat for the species. The species has been recorded within the proposed disturbance area and is likely to forage in the woodland and open habitats occurring within the proposed disturbance area. The area of habitat to be removed is likely to comprise foraging habitat only, as large hollows suitable for breeding and dense vegetation suitable for roosting were not identified during surveys. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Park. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

The 'NSW Recovery Plan for the Large Forest Owls' (DEC, 2006) is applicable to this species. The Project is not consistent with this recovery plan as it contravenes the following objective: "*Manage and protect habitat off reserves and state forest*". However the proposed disturbance area is dominated by areas that have been historically disturbed and provide low foraging habitat value for this species.

The known foraging and potential roosting habitats impacted within the proposed disturbance area comprise 45 ha which is not considered large enough to adversely affect the survival of the species in the locality.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the masked owl (*Tyto novaehollandiae*).

Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)

- 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;***

The brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) has not been previously recorded in Project area however records occur in the immediate vicinity approximately 1 km north of the Project area (OEH, 2013a). Further records of the species occur both locally and widely within the wider Yengo and Wollemi National Park estates.

The species is known to occur in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. The species is sedentary and considered to be resident in many locations throughout its range. The species is territorial year-round and forage in small flocks amongst the litter, tussocks and fallen timber, and along trunks and lateral branches. Hollows in standing dead or live trees and tree stumps are essential for nesting. This species is likely to make use of the forest and woodland habitats of the proposed disturbance area as foraging habitat. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging habitat for the species. It is likely that the records near the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population extends into the extensive suitable surrounding habitats occurring within and outside the Project area into Yengo and Wollemi National Parks. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;***

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;***

Not applicable.

- 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;***

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging habitat for the species. It is unlikely that this mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***

The Project will not introduce significant barriers for this mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland foraging habitat for the species. The species has been previously recorded within 1 km of the Project area and has the potential to forage in the woodland occurring within the proposed disturbance area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Park. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Aggressive exclusion by abundant noisy miners (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*).

Black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)

- 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;***

The black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*) has not been previously recorded in Project area however records occur within 5 km of the Project area (OEH, 2013a). Further records of the species in the wider region occur on the western and northern portions of Wollemi National Park and within Yengo National Park.

In NSW the eastern subspecies species is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range. The species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. The species is usually seen in pairs and small groups of up to 12 birds and can occupy foraging home ranges of at least 5 ha. This species will potentially make use of the forest and woodland habitats of the proposed disturbance area as foraging habitat. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides potential foraging habitat for the species.

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and breeding habitat for the species. It is likely that the records near the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population extends into the extensive suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;***

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;***

Not applicable.

- 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;***

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and breeding habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Park provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some potential foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and breeding habitat for the species. The species has been previously recorded within 5 km of the Project area and has the potential to forage in the woodland occurring within the proposed disturbance area. There is potential that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Park. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Aggressive exclusion by abundant noisy miners (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*).

Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)

- 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;**

The grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) has not been previously recorded in Project area however records occur within 2 km south of the Project area (OEH, 2013a). Further records of the species in the wider region occur mainly on the eastern limits of Yengo National Park with few scattered records within the wider Yengo and Wollemi National Parks.

In NSW, the eastern subspecies occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. The species inhabits open box-gum woodlands on the slopes and box-cypress pine and open box woodlands on alluvial plains. The species lives in family groups that consist of a breeding pair and young from previous breeding seasons. Nests are constructed in shrubs or young sapling eucalypts. This species has the potential to make use of the forest and woodland habitats of the proposed disturbance area as foraging and nesting habitat. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides potential foraging habitat for the species.

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and nesting habitat for the species. There is potential that the records near the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population extends into the extensive suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Park. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and nesting habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Territories range between 1 and 50 ha for this species. As some likely foraging habitat and will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of

suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and breeding habitat for the species. The species has been previously recorded 2 km south of the Project area and has the potential to forage in the woodland occurring within the proposed disturbance area. There is potential that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Aggressive exclusion by abundant noisy miners (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*).

Varied Sittella (*Daphoenositta chrysoptera*)

- 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;**

Eight varied sittellas (*Daphoenositta chrysoptera*) were recorded at two locations within the Project area during the February 2011 Umwelt surveys undertaken for this assessment. Other previous records of the species occur within 1 km of the Project area and throughout Wollemi National Park and within Yengo National Park (OEH, 2013a).

Distribution of the species in NSW is nearly continuous from the coast to the far west. This species inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. The species is known to feed on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. They build a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy. It is likely that the species utilises the Project area as foraging and potential nesting habitat, although no nests have been recorded.

The Project will result in the removal of approximately 23.5 ha of known foraging and potential nesting habitat for the species. It is likely that the individuals that use the habitats of the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of known woodland foraging and potential nesting habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known woodland foraging and potential breeding habitat for the species. The species has been recorded utilising the habitats of the proposed disturbance area and previously recorded within 1 km of the Project area. No varied sittella nests have been recorded in the Project area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Removal of dead wood and dead trees (TSC Act).
- Aggressive exclusion by abundant noisy miners (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the varied sittella (*Daphoenositta chrysoptera*).

Scarlet robin (*Petroica boodang*)

- 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;**

The scarlet robin (*Petroica boodang*) was recorded on two occasions in the Project area during the surveys undertaken for this assessment. Other previous records of the species occur within 1 km of the Project area with other scattered records throughout Wollemi and Yengo National Parks (OEH, 2013a).

Distribution of the species in NSW occurs from the coast to the inland slopes. This species inhabits dry eucalypt forests and woodlands with open and grassy understoreys with few scattered shrubs and are known to make local migrations in winter. They are known from mature and regrowth vegetation where they forage from low perches or logs on insects and other invertebrates. Nests are built in a fork of a tree as a small open cup made of plant fibres and cobwebs. It is likely that the species utilises the Project area as foraging and potential nesting habitat, although no nests have been recorded.

The Project will result in the removal of approximately 23.5 ha of known foraging and potential nesting habitat for the species. It is likely that the individuals that use the habitats of the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of known woodland foraging and potential nesting habitat for the species. It is unlikely that this highly mobile species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known woodland foraging and potential nesting habitat for the species. The species has been recorded utilising the habitats of the proposed disturbance area and previously recorded within 1 km of the Project area. No scarlet robin nests have been recorded in the Project area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Removal of dead wood and dead trees (TSC Act).
- Aggressive exclusion by abundant noisy miners (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the scarlet robin (*Petroica boodang*).

Spotted-tailed quoll (*Dasyurus maculatus*)

- 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;**

An historical record of the spotted-tailed quoll (*Dasyurus maculatus*) occurs within 1 km to the south of the Project area (OEH, 2013a) dated in 1980. No evidence of spotted-tailed quolls was recorded within the Project area during the Umwelt surveys undertaken for this assessment. Further records of the species occur sporadically within the surrounding Yengo and Wollemi National Park estates.

The species is known mainly from the east coast of NSW, Victoria and south-eastern Queensland. The species has been recorded across a range of habitat types including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites for the species can include hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Riparian vegetation is often utilised as movement habitat within an individual's home range. This species has the potential to make use of the forest and woodland habitats of the proposed disturbance area. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 44.5 ha of potential habitat for the species within the proposed disturbance area. Due to the lack of recent records in the vicinity of the Project area, it is likely that the historic record does not represent a currently persisting population of the species utilising the Project area. Despite this, the surrounding habitat includes in excess of 600,000 ha of suitable woodland and forested habitats in Yengo and Wollemi National Parks. It is considered unlikely that the Project would disrupt the life cycle of this species and a viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 44.5 ha of potential habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area as the species has not been recorded within the Project area or the surrounding area since the 1980s. The habitats in the surrounding Yengo and Wollemi National Parks provide in excess of 600,000 ha of eucalypt forests and woodlands that provide likely habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. As some potential habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of potential habitat for the species. The species has not been historically recorded within the Project area. Females occupy home ranges up to about 750 ha and males up to 3500 ha. The small area of potential habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

The 'Recovery Plan for *Dasyurus maculatus* (Spotted-tailed Quoll) 2005 – 2009' (Long and Nelson, 2004) is applicable to this species. The Project contravenes with the following objective of the recovery plan: '*Reduce the rate of loss and fragmentation of spotted-tailed quoll habitat*'. The Project will contribute to the loss of potential spotted-tailed quoll habitat.

There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Bushrock removal (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the spotted-tailed quoll (*Dasyurus maculatus*).

Koala (*Phascolarctos cinereus*)

- 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;**

The koala (*Phascolarctos cinereus*) has been recorded on two occasions in the south-east portion of the Project area during the February and November 2011 surveys undertaken for this assessment. The species was not recorded in the proposed disturbance area. Other previous records of the species occur immediately around the Project area with other scattered records throughout Wollemi and Yengo National Park (OEH, 2013a).

The species is known to occur in eucalypt woodlands and forests of the central and north coasts of NSW with few populations occurring west of the Great Dividing Range. The species primarily feeds on the foliage of eucalypt species and spends the majority of their time in trees, occasionally descending to the ground to transverse habitats. Home ranges vary depending on habitat quality and often include a dominant male with a territory overlapping with several females. This species is likely to make use of the woodland habitats of the proposed disturbance area as foraging and dispersing habitat. The individuals recorded were identified as young males that were likely to be using the habitats within the Project area while dispersing into new breeding territories. The surrounding area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland habitat for the species within the proposed disturbance area. This includes areas containing known koala feed trees such as grey gum (*Eucalyptus punctata*), forest red gum (*Eucalyptus tereticornis*) and drooping red gum (*Eucalyptus parramattensis* subsp. *parramattensis*), listed as preferred feed trees in the Central Coast Management Area (DECC, 2008c). Despite this, the surrounding habitat includes in excess of 600,000 ha of suitable woodland and forested habitats in Yengo and Wollemi National Parks for this species. It is likely that the individuals that use the habitats of the Project area constitute part of a viable local population of the species occurring in the wider area. It is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of forest and woodland habitat and preferred feed trees for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area as the habitats in the surrounding Yengo and Wollemi National Parks provide in excess of 600,000 ha of eucalypt forests and woodlands that provide likely habitat for this species.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. As some potential habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging habitat for the species including preferred feed tree species such as grey gum (*Eucalyptus punctata*), forest red gum (*Eucalyptus tereticornis*) and drooping red gum (*Eucalyptus parramattensis* subsp. *parramattensis*). The species was recorded on two occasions by Umwelt in 2011 and previously in the habitats immediately surrounding the Project area. Home ranges vary between two and several hundred hectares for this species. There is potential that the Project area is used by dispersing males in search of new breeding territories out of a female home range. This may indicate that the area constitutes breeding habitat which may be important to the long-term survival of this species in the locality.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

The 'Recovery plan for the koala (*Phascolarctos cinereus*)' (DECC, 2008c) is relevant to this species. The proposed action does not contravene any of the objective or actions listed within this recovery plan as no koalas have been recorded within the proposed disturbance area.

No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the koala (*Phascolarctos cinereus*).

Long-nosed potoroo (*Potorous tridactylus*)

- 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;**

The long-nosed potoroo (*Potorous tridactylus*) has not been previously recorded in Project area or in the immediate surrounds. Records of the species in the wider region occur within the Watagans National Park and near Ourimbah State Forest approximately 50 km from the Project area (OEH, 2013a).

The eastern subspecies is known on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range. The species is known to inhabit coastal heaths and dry and wet sclerophyll forests with dense understoreys and occasional open areas are an essential part of habitat. They feed on fungi, roots, tubers and insects in the dense undergrowth. Home ranges vary between 2 and 5 ha. There is potential for this species to make use of the forest and woodland habitats of the proposed disturbance area as foraging habitat, although this has not been recorded. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides potential habitat for the species.

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland habitat for the species. Given that the species has not been recorded within the area and the availability of suitable habitat in the wider area, it is not considered that the loss of this area will result in a significant reduction in habitat for the population, and the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of potential forest and habitat for the species. Given there are no known records of the species within the proposed disturbance area it is unlikely that the species depends on the habitats within the proposed disturbance area for foraging. Additionally, the Project area does not provide breeding habitat for the species. The wider area provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. Given the extensive area of suitable habitat in the surrounding area and the lack of local records of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland habitat for the species within 50 km of the closest record of the species in the region. It is considered possible that long-nosed potoroo occurs within Wollemi and Yengo National Parks, however surveys of these areas has not confirmed this (DEC 2007, DECC 2008d). Given the species has not been recorded utilising the habitats within the Project area or within the immediate surrounds, the proposed disturbance area is not important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the long-nosed potoroo (*Potorous tridactylus*).

Eastern pygmy-possum (*Cercartetus nanus*)

- 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;**

The eastern pygmy-possum (*Cercartetus nanus*) was recorded on one occasion in the Project area during the February 2011 surveys undertaken for this assessment. The individual was recorded feeding on a *Banksia* flower in the south-east of the Project area approximately 200 m from the proposed disturbance area. Other records of the species in the wider area are sparse with the next closest record occurring approximately 11 km to the south-east of the Project area in Parr State Conservation Area (OEH, 2013a).

The species 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. The species is found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. They feed largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; and are an important pollinator of heath land plants such as banksias. Tree hollows, rotten stumps abandoned bird-nests, possum dreys or vegetation thickets are important habitat features for shelter and nesting. This species is known to make use of the forest and woodland habitats of the Project area and may also occur within the proposed disturbance area. The wider area includes Yengo and Wollemi National Parks which contain in excess of 600,000 ha of eucalypt forest and woodland that also provides likely foraging habitat for the species.

The Project will result in the loss of approximately 23.5 ha of likely habitat for the species within the proposed disturbance area. Although the species was recorded outside the proposed disturbance area and the species have very small (0.5 ha) home ranges, there is potential that it also occurs within the proposed disturbance area. However, as the surrounding habitat includes in excess of 600,000 ha of suitable woodland and forested habitats in Yengo and Wollemi National Park, it is considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of likely woodland for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area as the habitats in the surrounding Yengo and Wollemi National Parks provide in excess of 600,000 ha of eucalypt forests and woodlands that provide likely habitat for this species.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project is unlikely to introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. As some likely habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of likely woodland habitat for the species. The species was recorded on one occasion by Umwelt in 2011 in the south-east of the Project area. Home ranges for this species are small and estimated to be around 0.68 ha for males and about 0.35 ha for females. There is potential that the proposed disturbance area is used by dispersing individuals between home ranges however this has not been recorded. Given the small area of potential habitat to be disturbed and the availability of extensive areas of suitable habitat in the locality, it is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the eastern pygmy-possum (*Cercartetus nanus*).

Squirrel glider (*Petaurus norfolcensis*)

- 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;**

The squirrel glider (*Petaurus norfolcensis*) was recorded on four occasions within the Project area in the February and November 2011 Umwelt surveys undertaken for this assessment. Three were recorded in the south-east of the Project area and one on the southern limits of the existing quarry. The species was not recorded in the proposed disturbance area. Other previous records of the species occur within 2 km north of the Project area with few scattered records occurring throughout Wollemi and Yengo National Parks (OEH, 2013a).

The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. They inhabit mature or old growth box, box-ironbark woodlands and river red gum forest west of the Great Dividing Range and blackbutt-bloodwood forest with heath understorey in coastal areas. The species is known to feed on *Acacia* gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein. The species requires tree hollows for refuge and nest sites. It is likely that the species utilises the Project area as foraging and potential nesting habitat, although no nest sites have been recorded.

The Project will result in the removal of approximately 23.5 ha of likely forest and woodland habitat for the species. It is likely that the individuals that use the habitats of the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this species such that it will prevent movement of individuals between proximate areas of habitat. As some likely foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of likely forest and woodland habitat for the species. Home ranges for the species are estimated to vary between 0.65 and 8.5 ha in coastal areas. The species has been recorded utilising the habitats in the south-east of the Project area. It is likely that this population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the squirrel glider (*Petaurus norfolcensis*).

Yellow-bellied glider (*Petaurus australis*)

- 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;**

The yellow-bellied glider (*Petaurus australis*) has been immediately adjacent the north-west portion of the Project area in 1997 and 1998 (OEH, 2013a). The species has not been recorded in the proposed disturbance area. Other previous records of the species occur within 2 km of the Project area and throughout Wollemi National Park and within Yengo National Park.

The species is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. This species occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. The species is known to feed on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. The species lives in family groups that den in the hollows of large trees. There is potential that the species utilises the Project area as foraging and potentially denning habitat, although no den sites have been recorded.

The Project will result in the removal of approximately 23.5 ha of potential forest and woodland habitat for the species. It is likely that the individuals that have been previously recorded near the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Park. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some potential woodland habitat and will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland habitat for the species. The species is known to be highly mobile and home ranges are estimated to vary between 20 and 85 ha. The species is known to disperse into surrounding habitats for seasonal food resources. The species has been previously recorded adjacent to the north-west of the Project area in 1997 and 1998. It is likely that these records and other surrounding records indicate that the population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow bearing trees (TSC Act).

Conclusion

Based on the information provided above, the Project is considered unlikely to result in a significant impact on the yellow-bellied glider (*Petaurus australis*).

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

- 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;**

The grey-headed flying-fox (*Pteropus poliocephalus*) was recorded calling from outside the Project area during the February 2011 surveys undertaken for this assessment. Other previous records of the species occur approximately 15 km from the Project area, however records are few in Wollemi National Park and within Yengo National Park and occur mainly on the coastal side of the range (OEH, 2013a). The species was not recorded utilising the habitats within the Project area.

The species is known to occur within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. The species is known to occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Important sites for the species include roosting camps that can contain tens of thousands of individuals. From these camps, the species can travel up to 50 km in one night in search of food where they feed on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. There is potential that the species utilises the Project area as foraging habitat, as no flying-fox camps have been recorded.

The Project will result in the removal of approximately 23.5 ha of potential eucalypt habitat for the species. Given the species does not utilise the proposed disturbance area for roosting or breeding and the habitats provide only potential foraging habitat, it is not considered that the loss of this area will result in a significant reduction in foraging habitat for the local population, and a local viable population of the species will not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of potential eucalypt foraging habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential foraging habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some potential eucalypt foraging habitat and will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential eucalypt foraging habitat for the species. The species is known to be highly mobile and can travel up to 50 km per night in search of foraging resources. The species was recorded calling in adjacent habitat to the Project area. It is likely that this record indicates that the population utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species at the State level. The 'Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*' (DECCW, 2009b) has been prepared. The Project is unlikely to contravene the recovery plan as the species has not been recorded within the Project area and the Project will remove potential habitat only.

No threat abatement plans are pertinent to this threatened species.

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.

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on the grey-headed flying-fox (*Pteropus poliocephalus*).

Large-eared pied bat (*Chalinolobus dwyeri*)

- 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;**

The large-eared pied bat (*Chalinolobus dwyeri*) was recorded using call echolocation recording within the Project area during the 2011 surveys undertaken for this assessment. The species was recorded in the south-east of the Project area and in the central portion of the proposed disturbance area. Other previous records of the species occur within 1 km of the Project area with many other records occurring throughout Wollemi and Yengo National Parks (OEH, 2013a).

The species is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. The species mainly roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the fairy martin (*Petrochelidon ariel*). They are known to forage for small flying insects below the forest canopy in well timbered and gully habitats. It is likely that the species utilises the Project area as foraging habitat, as no suitable caves or roosting habitat have been recorded within the Project area.

The Project will result in the removal of approximately 23.5 ha of known forest and woodland foraging habitat for the species. Given the species does not utilise the proposed disturbance area for roosting or breeding and the extent of other suitable habitat in the surrounding Wollemi and Yengo National Parks, it is not considered that the loss of this area will result in a significant reduction in foraging habitat for the local population, and a local viable population of the species will not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat for the species. The species was recorded within the proposed disturbance area using echolocation recording. No suitable roosting or maternity habitat was recorded within the Project area. It is likely that this represents a population that utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on large-eared pied bat (*Chalinolobus dwyeri*).

Little bentwing-bat (*Miniopterus australis*)

- 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;**

The little bentwing-bat (*Miniopterus australis*) has not been recorded within the Project area despite targeted surveys undertaken as part of the investigation for the Project. Records of the species in the locality are few and occur sporadically within the surrounding habitats of Wollemi National Park approximately 11 km to the north-west of the Project area (OEH, 2013a).

The species is found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. The species occurs in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and banksia scrub. They roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. At night they forage for small insects beneath the canopy of densely vegetated habitats. The woodland habitats of the proposed disturbance area provide likely foraging and potential roosting habitat for the species.

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and roosting habitat for the species. Although the species has not been recorded within the Project area, it has potential to occur given the suitable habitat present and the known records of the species in the locality. However, due to the availability of extensive habitat in the wider area within Yengo and Wollemi National Parks, it is not considered that the loss of this area will result in a significant reduction in habitat for the population, and the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of potential forest and woodland foraging and roosting habitat for the species. Given the lack of records in the Project area, it is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some potential foraging and roosting habitat and will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential foraging and roosting habitat for the species. The species has been recorded utilising the habitats approximately 10 km north-west of the Project area in 1998 (OEH, 2013a), however it has not been recorded using the habitats of the proposed disturbance area. Due to the small area of the proposed disturbance area and the extensive availability of other habitat in the wider area, it is unlikely to be important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on little bentwing-bat (*Miniopterus australis*).

Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)

- 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;**

The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) was recorded using call echolocation recording on three occasions within the Project area during the surveys undertaken for this assessment. These records were within the proposed disturbance area. Other previous records of the species occur within 1 km to the south of the Project area and throughout Wollemi National Park and within Yengo National Park (OEH, 2013a).

The species is found along the east and north-west coasts of Australia. This species is dependent on caves for roosting and breeding but forage in forested areas for insects. They occur in discrete populations centred around maternity caves, however at non-breeding times of the year can travel up to 300 km from the caves. It is likely that the species utilises the Project area as foraging habitat, as no suitable caves or roosting habitat have been recorded.

The Project will result in the removal of approximately 23.5 ha of known forest and woodland foraging habitat for the species. Given the species does not utilise the proposed disturbance area for roosting or breeding and the extent of other suitable habitat in the surrounding Wollemi and Yengo National Parks, it is not considered that the loss of this area will result in a significant reduction in foraging habitat for the local population, and a local viable population of the species will not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat for the species. The species was recorded within the proposed disturbance area using echolocation recording. No suitable roosting or maternity habitat was recorded within the Project area. It is likely that this represents a population that utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Eastern cave bat (*Vespadelus troughtoni*)

- 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;**

The eastern cave bat (*Vespadelus troughtoni*) was recorded using call echolocation recording on four occasions within the Project area in 2011 during the surveys undertaken for this assessment. Two of these records were within the proposed disturbance area. Other previous records of the species occur approximately 15 km from the Project area in Wollemi National Park and scattered records on the northern limits of Wollemi and Yengo National Parks (OEH, 2013a).

The species is found in a band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. This species is cave-roosting and is usually found in dry open forest and woodland, near cliffs or rocky overhangs. Colonies can occasionally include up to 500 individuals. It is likely that the species utilises the Project area as foraging habitat, as no suitable caves or roosting habitat have been recorded within the Project area.

The Project will result in the removal of approximately 23.5 ha of known forest and woodland foraging habitat for the species. Given the species does not utilise the proposed disturbance area for roosting or breeding and the extent of other suitable habitat in the surrounding Wollemi and Yengo National Parks, it is not considered that the loss of this area will result in a significant reduction in foraging habitat for the local population, and a local viable population of the species will not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Park provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known foraging habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat for the species. The species was recorded within the proposed disturbance area using echolocation recording. No suitable roosting or maternity habitat was recorded within the Project area. It is likely that this represents a population that utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of foraging habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on the eastern cave bat (*Vespadelus troughtoni*).

Eastern false pipistrelle (*Falsistrellus tasmaniensis*)

- 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;**

The eastern false pipistrelle (*Falsistrellus tasmaniensis*) was recorded using call echolocation recording in the Project area during the 2011 surveys undertaken for this assessment. The species was recorded in the south-east of the Project area and within the central portion of the proposed disturbance area. Other previous records of the species occur approximately 11 km from the Project area within Wollemi National Park and within Yengo National Park (OEH, 2013a).

The species is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. This species generally prefers moist forested habitats and roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. They hunt for flying insects above and below the tree canopy. The woodland habitats of the proposed disturbance area provide likely foraging and potential roosting habitat for the species.

The Project will result in the removal of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. It is likely that the individuals that have been recorded within the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known foraging and potential roosting habitat and will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. The species was recorded within the proposed disturbance area using echolocation recording. It is likely that this represents a population that utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Park. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on the eastern false pipistrelle (*Falsistrellus tasmaniensis*).

East coast freetail-bat (*Mormopterus norfolkensis*)

- 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;***

The east coast freetail-bat (*Mormopterus norfolkensis*) was recorded using call echolocation recording in the Project area during the 2010 and 2011 surveys undertaken for this assessment. The species was recorded in the south-east of the Project area and within the central portion of the proposed disturbance area. Other previous records of the species occur within 2 km of the Project area with scattered records within Wollemi and Yengo National Parks (OEH, 2013a).

The species is distributed along the east coast from south Queensland to southern NSW. This species occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. They roost primarily in tree hollows but will also roost under bark or in man-made structures. The woodland habitats of the proposed disturbance area provide likely foraging and potential roosting habitat for the species.

The Project will result in the removal of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. It is likely that the individuals that have been recorded within the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;***

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;***

Not applicable.

- 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;***

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Park provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and habitat for this species.

- ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known foraging and potential roosting habitat and will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. The species was recorded within the proposed disturbance area using echolocation recording. It is likely that this represents a population that utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on the east coast freetail-bat (*Mormopterus norfolkensis*).

Southern myotis (*Myotis macropus*)

- 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;**

The southern myotis (*Myotis macropus*) has not been recorded within the Project area despite targeted surveys undertaken as part of the investigation for the Project. Records of the species in the locality occur sporadically within the surrounding habitats of the Yengo and Wollemi National Park estates. The closest record of the species occurs approximately 15 km to the north-west of the Project area in Wollemi National Park (OEH, 2013a).

The species is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. The species generally roost in groups of 10 – 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. They will forage over streams and waterbodies hunting for small insects and fish. The woodland and open water habitats of the proposed disturbance area provide likely foraging and potential roosting habitat for the species.

The Project will result in the loss of approximately 23.5 ha of suitable forest, woodland and one hectare of open water foraging habitat and associated potential roosting habitat for the species. Although the species has not been recorded within the Project area, it has potential to occur given the suitable habitat present and the known records of the species in the locality. However, due to the availability of extensive habitat in the wider area within Yengo and Wollemi National Parks, it is not considered that the loss of this area will result in a significant reduction in habitat for the population, and the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 23.5 ha of potential foraging and roosting habitat for the species. Given the lack of records in the Project area, it is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some potential foraging and roosting habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of potential foraging and roosting habitat for the species. The species has been recorded utilising the habitats approximately 15 km north-west of the Project area in 1998 (OEH, 2013a), however it has not been recorded using the habitats of the proposed disturbance area. Due to the small area of the proposed disturbance area and the extensive availability of other habitat in the wider area, it is unlikely to be important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on southern myotis (*Myotis macropus*).

Yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*)

- 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;**

The yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*) has not been recorded within the Project area despite targeted surveys undertaken as part of the investigation for the Project. Records of the species in the locality are few and occur sporadically within the surrounding habitats of Yengo National Park approximately 30 km to the north-east of the Project area (OEH, 2013a).

The species is found across northern and eastern Australia. The species roosts singly or in groups of up to six, in tree hollows and buildings. They forage for insects in woodland and open habitats. The woodland and open habitats of the proposed disturbance area provide likely foraging and potential roosting habitat for the species.

The Project will result in the loss of approximately 44.5 ha of potential forest, woodland and open foraging and roosting habitat for the species. Although the species has not been recorded within the Project area, it has potential to occur given the suitable habitat present and the known records of the species in the wider locality. However, due to the availability of extensive habitat in the wider area within Yengo and Wollemi National Parks, it is not considered that the loss of this area will result in a significant reduction in habitat for the population, and the species will not be placed at risk of extinction as a result of the Project.

- 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;**

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;**

Not applicable.

- 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;**

The Project will result in the loss of approximately 44.5 ha of potential foraging and roosting habitat for the species. Given the lack of records in the Project area, it is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and habitat for this species.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some potential foraging and roosting habitat will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 44.5 ha of potential foraging and roosting habitat for the species. The species has been recorded utilising the habitats approximately 10 km north-west of the Project area in 2000 (OEH, 2013a), however it has not been recorded using the habitats of the proposed disturbance area. Due to the small area of the proposed disturbance area and the extensive availability of other habitat in the wider area, it is unlikely to be important to the long-term survival of the species.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*).

Greater broad-nosed bat (*Scoteanax rueppellii*)

- 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;***

The greater broad-nosed bat (*Scoteanax rueppellii*) was recorded using call echolocation recording in the Project area during the 2010 and 2011 surveys undertaken for this assessment. The species was recorded in the south-east of the Project area and within the central portion of the proposed disturbance area. Other previous records of the species occur within 2 km to the north of the Project area with other scattered records within Wollemi and Yengo National Parks (OEH, 2013a).

In NSW, the species is widespread along and to the east of the Great Dividing Range. The species utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. They usually roost in tree hollows, but can also be found in buildings. They forage after sunset along riparian corridors and open woodland habitat. The woodland habitat of the proposed disturbance area provides likely foraging and potential roosting habitat for the species.

The Project will result in the removal of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. It is likely that the individuals that have been recorded within the Project area constitute part of a viable local population of the species occurring in the wider area. It is likely that this population also utilises the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Parks. It is therefore considered unlikely that the Project would disrupt the life cycle of this species and this viable local population would not be placed at risk of extinction.

- 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;***

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;***

Not applicable.

- 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;***

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. It is unlikely that this species would depend exclusively on the habitats within the proposed disturbance area for foraging as the wider area in Yengo and Wollemi National Parks provides in excess of 600,000 ha of eucalypt forests and woodlands that provide known and potential habitat for this species.

- ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***

The Project will not introduce significant barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. As some known foraging and potential roosting habitat and will be removed as part of the Project, the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

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

The Project will result in the loss of approximately 23.5 ha of known forest and woodland foraging habitat and potential roosting habitat for the species. The species was recorded within the proposed disturbance area using echolocation recording. It is likely that this represents a population that utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Parks. The small area of habitat to be disturbed is not considered to be important to the long-term survival of this species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Project area for this threatened species.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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.

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act).
- Loss of hollow-bearing trees (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

Conclusion

Based on the information provided above, the Project is unlikely to result in a significant impact on greater broad-nosed bat (*Scoteanax rueppellii*).



APPENDIX E

Assessment of Significance under the
Environment Protection and Biodiversity
Conservation Act 1999

Appendix E – Assessment of Significance under the *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires an Assessment of Significance relating to the potential impacts of an Action (the Project) on listed matters of national environmental significance (MNES).

Under the EPBC Act, the approval of the Commonwealth Minister responsible for the Department of the Environment is required for any action that may have a significant impact on MNES. These matters are:

- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park;
- nuclear actions; and
- a water resource, in relation to coal seam gas development and large coal mining development.

A search of the Department of the Environment Protected Matters Search Tool (June 2014) and collated information from literature reviews identified one World Heritage property, one National Heritage place, two threatened ecological communities (TECs), 37 threatened species and 12 migratory species known to occur, or considered to have the potential to occur on the basis of habitat modelling, around the Project area. Each of these has been included in tables in **Appendix A**, together with an indication of those species that warrant further assessment by way of an Assessment of Significance.

The Assessments of Significance provided below are based on the level of impact associated with the currently proposed Project. As discussed in Section 1.1.1 of the main text, an alternative biodiversity offset strategy and disturbance area has been proposed following feedback from OEH, DoE and the NSW NPWS. This proposed alternative results in a slightly different impact to that of the Project and these differences are described in Section 5.10 of the main text. The impacts of the alternative project and biodiversity offset strategy were reviewed in light of the results of the assessment of significance detailed below and in summary, the alternative biodiversity offset strategy results in a comparable level of impact for the majority of vegetation communities and fauna habitats and therefore, the Assessments of Significance below are considered to be applicable to both proposals.

The following EPBC Act listed species and heritage places are considered to have the potential to occur or be impacted by the Project and are subject to an Assessment of Significance below:

Critically Endangered and Endangered Species

- Regent honeyeater (*Anthochaera phrygia*);
- Swift parrot (*Lathamus discolor*); and
- Spotted-tailed quoll (*Dasyurus maculatus maculatus*) (SE mainland population).

Vulnerable Species

- Bynoes wattle (*Acacia bynoeana*);
- Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*);
- *Olearia cordata*;
- Giant burrowing frog (*Heleioporus australiacus*);
- Broad-headed snake (*Hoplocephalus bungaroides*);
- New Holland mouse (*Pseudomys novaehollandiae*);
- Koala (*Phascolarctos cinereus*) (populations of QLD, NSW and the ACT);
- Brush-tailed rock wallaby (*Petrogale penicillata*);
- Long-nosed potoroo (*Potorous tridactylus tridactylus*) (SE mainland);
- Grey-headed flying-fox (*Pteropus poliocephalus*); and
- Large-eared pied bat (*Chalinolobus dwyeri*).

Migratory Species Listed under International Conventions

- White-bellied sea eagle (*Haliaeetus leucogaster*);
- White-throated needletail (*Hirundapus caudacutus*);
- Rainbow bee-eater (*Merops ornatus*);
- Black-faced monarch (*Monarcha melanopsis*);
- Satin flycatcher (*Myiagra cyanoleuca*); and
- Rufous fantail (*Rhipidura rufifrons*).

World Heritage Properties and National Heritage Places

- Greater Blue Mountains World Heritage Area and National Heritage Place.

Critically Endangered and Endangered Species

Three critically endangered or endangered species have the potential to be impacted by the Project and have been subject to an assessment of significance below:

- Regent honeyeater (*Anthochaera phrygia*);
- Swift parrot (*Lathamus discolor*); and
- Spotted-tailed quoll (*Dasyurus maculatus maculatus*) SE mainland population.

In this case, a *population* means:

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

The regent honeyeater is known to occur in a patchy distribution in the temperate woodlands and open forests of the inland slopes of south-east Australia. The species is mainly known from three key breeding sites from the Bundarra-Barraba area of NSW, the Capertee Valley in NSW, and north-eastern Victoria. Although there appears to be minor behavioural differences between regent honeyeaters in the three main areas inhabited by the species (the Bundarra-Barraba area in NSW, the Capertee Valley in NSW, and north-eastern Victoria), the direction and extent of movements, including evidence of movement between breeding sites, and a lack of discernable genetic differences between the sites suggest that the regent honeyeater occurs as a single, contiguous population (Garnett and Crowley, 2000). The regent honeyeater has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Scattered records of the species occur within the surrounding Yengo and Wollemi National Parks (OEH, 2013a). Breeding and nesting is regularly recorded within the Capertee Valley which is located approximately 30 km west of the Project area. The regent honeyeater has potential to make use of the eucalypt forest and woodland habitats of the proposed disturbance area, however this has not been recorded.

The swift parrot is known to occur in a patchy distribution in the temperate woodlands and open forests of the inland slopes of south-east Australia. The species occurs as a single population in Australia, although it migrates annually from breeding grounds in Tasmania to the winter foraging grounds on the coastal plains and slope woodlands of mainland eastern Australia (Saunders, 2002). The swift parrot has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Records of the species generally occur outside the Yengo and Wollemi National Park estates in the Capertee Valley to the west and around Kurrajong to the south (OEH, 2013a). This species has potential to make use of the eucalypt forest and woodland habitats of the proposed disturbance area, particularly where there are prolific flowering eucalypts and this migratory species is likely to move throughout the area in response to mass flowering events, however this has not been recorded.

There is very little research-based literature that allows confident definition of population size or population boundaries of the spotted-tailed quoll. Spotted-tailed quoll records are generally confined to within 200 km of the NSW coast and ranges from the Queensland border to Kosciuszko National Park. According to the National Recovery Plan for the species (Long and Nelson, 2004) it is considered likely that the total number of mature adult spotted-tailed quolls is probably greater than 2000 but fewer than 10,000 individuals in Australia. Home range estimates vary considerably according to location and habitat quality, however

females can occupy home ranges up to 750 ha and males up to 3500 ha and both sexes usually traverse their ranges along densely vegetated creeklines. Extant populations are highly fragmented and declining. The geographic distribution of the species is contracting and its subpopulations are becoming increasingly fragmented. A historical record of the spotted-tailed quoll occurs within 1 km to the south of the Project area (OEH, 2013a) dated in 1980. No evidence of spotted-tailed quolls was recorded within the Project area during the surveys undertaken for this assessment. Further records of the species occur sporadically within the surrounding Yengo and Wollemi National Park estates, however, it is considered unlikely that a currently persisting population of the species is utilising the Project area.

It is not considered that a *population* of the swift parrot, regent honeyeater or spotted-tailed quoll as defined by the significant impact guidelines (DEWHA, 2009) occur in the Project area.

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

- **lead to a long-term decrease in the size of a population; or**

No populations of regent honeyeater, swift parrot or spotted-tailed quoll have been recorded within the Project area. The Project will result in the loss of approximately 44.5 ha of potential foraging habitat for the species'. The proposed disturbance area is not known as an important habitat area for these species. It is considered unlikely that the Project will lead to a decrease in the size of a *population* (as defined above) of the regent honeyeater, swift parrot or spotted-tailed quoll.

- **reduce the area of occupancy of the species; or**

The regent honeyeater, swift parrot and spotted-tailed quoll has not been recorded within the Project area, however all species are known to occur in the wider locality. The Project will result in the loss of approximately 44.5 ha of potential foraging habitat for the species'. While the Project will remove potential habitat for these species, it is not likely to lead to a significant reduction in known habitat in the region. The habitat available surrounding the Project area includes in excess of 600,000 ha of suitable woodland and forested habitats in Yengo and Wollemi National Park for these species.

The loss of approximately 44.5 ha of potential woodland and grassland habitat will result in a reduction of the potential area of occupancy for the regent honeyeater, swift parrot, and spotted-tailed quoll, however this is unlikely to substantially reduce the area of known occupancy in the locality and region.

- **fragment an existing *population* into two or more populations; or**

The regent honeyeater, swift parrot or spotted-tailed quoll has not been recorded within the Project area. All species are highly dispersive and it is unlikely that the Project will create a significant change to the species' dispersal capacity or create a significant barrier the movement of the species.

It is unlikely that the Project will result in the fragmentation of an existing *population* into two or more *populations*.

-
- **adversely affect habitat critical to the survival of a species; or**

The loss of approximately 44.5 ha of potential woodland and derived native grassland habitat within the proposed disturbance area is unlikely to affect habitat that is critical to the survival of the species due to the presence of known habitat for the species within south-eastern Australia.

- **disrupt the breeding cycle of a population; or**

The regent honeyeater mainly breeds in three key sites from the Bundarra-Barraba area NSW, the Capertee Valley in NSW, and north-eastern Victoria. The Capertee Valley is located approximately 30 km west of the Project area. There is potential for the species to make use of the eucalypt forest and woodland habitats of the proposed disturbance area as adjacent foraging resources near known breeding sites, however this has not been recorded.

The swift parrot breeds and nests exclusively in Tasmania and migrates to mainland Australia during the non-breeding season. There is no potential for breeding habitat to occur in the proposed disturbance area.

The spotted-tailed quoll generally dens in rock shelters, small caves, hollow logs or tree hollows and utilises numerous dens within its home range. The species has not been recorded breeding within the proposed disturbance area, and potential den sites have not been recorded during surveys. Known breeding habitat for the species will not be impacted by the Project.

The Project is not expected to disrupt the breeding cycle of the regent honeyeater, swift parrot or spotted-tailed quoll.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Project will involve the removal of approximately 44.5 ha of woodland and grassland communities that provides potential foraging habitat for these species. The wider locality includes Yengo and Wollemi National Park which contain in excess of 600,000 ha of eucalypt forest and woodland that provides likely habitat for these species.

It is considered unlikely that the Project will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the regent honeyeater, swift parrot or spotted-tailed quoll would decline.

- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; or**

The Project is not expected to result in invasive species that are harmful to the regent honeyeater, swift parrot or spotted-tailed quoll becoming established in the species' habitat.

- **introduce disease that may cause the species to decline; or**

Psittacine beak and feather disease (BFD) is a common and potentially deadly disease of parrots caused by a circovirus named beak and feather disease virus. The disease appears to have originated in Australia and is widespread and continuously present in wild populations of Australian parrots. BFD affecting endangered psittacine species (parrots and related species) was listed in April 2001 as a key threatening process under the EPBC Act.

It is considered unlikely that the Project will introduce BFD or any other disease that may cause the regent honeyeater or swift parrot to decline.

- **interfere with the recovery of the species.**

It is considered unlikely that the Project will interfere with the recovery of the regent honeyeater, swift parrot or spotted-tailed quoll throughout Australia.

Conclusion

The Project is unlikely to result in a significant impact on the regent honeyeater, swift parrot or spotted-tailed quoll.

Vulnerable Species

Nine vulnerable species have the potential to be impacted by the Project and have been subject to an assessment of significance below:

- Bynoes wattle (*Acacia bynoeana*);
- Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*);
- *Olearia cordata*;
- Giant burrowing frog (*Heleioporus australiacus*);
- Broad-headed snake (*Hoplocephalus bungaroides*);
- New Holland mouse (*Pseudomys novaehollandiae*);
- Koala (*Phascolarctos cinereus*);
- Brush-tailed rock wallaby (*Petrogale penicillata*);
- Long-nosed potoroo (*Potorous tridactylus tridactylus*) (SE mainland);
- Grey-headed flying-fox (*Pteropus poliocephalus*); and
- Large-eared pied bat (*Chalinolobus dwyeri*).

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

Bynoes wattle is found in central eastern NSW, from the Hunter district (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at each location being very small (1-5 plants). The species occurs in heath or dry sclerophyll forest on sandy soils and tends to prefer slightly disturbed sites. The species has not been recorded within the Project area despite targeted seasonal surveys undertaken as part of the investigation for the Project; however the species has been recorded in the immediate vicinity approximately 1 km to the east of the Project area in similar habitat (OEH, 2013a). Few records occur in the surrounding Yengo National Park. More regionally the species occurs in strongholds near the Blue Mountains National Park, near Penrith and Murrumurra National Park to the south of the Project area (OEH, 2013a). It is unlikely an important population of Bynoes wattle occurs in the Project area.

The small-flower grevillea is known to occur in sporadic populations throughout the Sydney Basin on ridge crests, upper slopes and flat plains. The species inhabits a range of vegetation types from heath and shrubby woodland to open forest. Records show two distinct population areas around the Lower Hunter and Picton areas to the east and south of the Project area, respectively (OEH, 2013a), however disjunct populations are known to occur in the Putty area within Wollemi and Yengo National Park (Fairley, 2004). The species has

been recorded within the proposed disturbance area for the Project during surveys undertaken for this assessment. 849 individuals were recorded within the Project area with three of these occurring within the proposed disturbance area. It is likely that the records within the Project area are part of the wider Putty population of the species which is a disjunct population from the larger populations known from the Lower Hunter and Picton areas approximately 60 km and 110 km from the Project area respectively. It is likely that the disjunct Putty population of the species, including the records within the Project area, is an important population due to its isolation from other known populations and as a key source for dispersal for the species in the Wollemi and Yengo National Park area.

Olearia cordata has a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. Most known populations occur within Wollemi National Park, Yengo National Park and Wisemans Ferry Historic Site. They grow in dry open sclerophyll forest and open shrubland, on sandstone ridges. The species has not been recorded within the Project area despite targeted surveys undertaken as part of the investigation for the Project. The species has been recorded in the vicinity approximately 5 km to the south-west of the Project area in similar habitat (OEH, 2013a). Clustered records occur in the surrounding Wollemi and Yengo National Park (OEH, 2013a). It is unlikely an important population of *Olearia cordata* occurs in the Project area.

The giant burrowing frog is known to occur in heath, woodland and open dry sclerophyll forest habitats and is restricted to the eastern slopes of the Great Dividing Range and coastal regions from near Mt Corridudgy and Kings Cross in Wollemi National Park in New South Wales to Walhalla in the central highlands of eastern Victoria. The giant burrowing frog has not been recorded within the Project area or immediate surrounds despite targeted surveys undertaken as part of the investigation for the Project. The closest record of the species occurs approximately 9 km to the south-west of the Project area (OEH, 2013a). Other records of the species in the locality occur within the surrounding habitats of Yengo and Wollemi National Park estates. It is unlikely an important population of giant burrowing frog occurs in the Project area.

The broad-headed snake is restricted to the sandstone ranges in the Sydney Basin and within a radius of approximately 200 km of Sydney (Cogger et al., 1993). The current distribution of this species extends from Wollemi National Park in the north, the Clyde River catchment in ranges south-west of Nowra in the south, east to the Royal National Park and near Illawarra, and west to the upper Blue Mountains at Blackheath and Newnes. The species has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Records of the species occur within 3 km to the south and 5 km to the north of the Project area in the Wollemi and Yengo National Parks (OEH, 2013a). This species has potential to make use of the sandstone woodland habitats of the proposed disturbance area, although this has not been recorded. It is unlikely an important population of broad-headed snake occurs in the Project area.

The New Holland mouse has a fragmented distribution across Tasmania, Victoria, NSW and Queensland. In NSW, the New Holland Mouse is known from Royal National Park and the Kangaroo Valley, Kuringai Chase National Park and Port Stephens to Evans Head near the Queensland border. The species was recorded during the 2011 surveys of the Project area undertaken for this assessment. It was recorded in the south-east of the Project area, but outside the proposed disturbance area. Further records in the wider Wollemi and Yengo National Parks are sparse. There is potential that the record of a New Holland mouse within the Project area indicates a population of the species that utilises the habitats of the proposed disturbance area. However, it is unlikely an important population of New Holland mouse occurs in the Project area.

The koala is known to occur in eucalypt woodlands and forests of the central and north coasts of NSW with few populations occurring west of the Great Dividing Range. The koala was recorded on two occasions in the south-east portion of the Project area during the February and November 2011 surveys undertaken for this assessment. The individuals recorded were identified as young males that were likely to be using the habitats within the Project area dispersing into new breeding territories from a female breeding territory. The species was not recorded in the proposed disturbance area. Other previous records of the species occur within and immediately around the Project area with other scattered records throughout Wollemi and Yengo National Park (OEH, 2013a). It is likely that the records in and around the Project area constitute part of a population that occurs across Wollemi and Yengo National Park, however it is unlikely that Project area contains an important population.

The range of the brush-tailed rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. The species has not been recorded within the Project area or immediate surrounds despite targeted seasonal surveys undertaken as part of the investigation for the Project. Recent records from 2007 of the species occur within 5 km to the west and 9 km to the south of the Project area in the Wollemi National Park (OEH, 2013a). Previous records in the locality suggest that the species has the potential to make use of the woodland habitats of the proposed disturbance area, although no appropriate cliff line or escarpment habitat has been identified. It is unlikely an important population of the brush-tailed rock-wallaby occurs in the Project area.

The south-east mainland population of long-nosed potoroo is sparsely distributed along the coast and Great Dividing Range of south-east Queensland through NSW. The species has not been previously recorded in Project area or in the immediate surrounds. Records of the species in the wider region occur within the Watagans National Park and near Ourimbah State Forest approximately 50 km from the Project area (OEH, 2013a). It is considered possible that long-nosed potoroo occurs within Wollemi and Yengo National Parks, however surveys of these areas has not confirmed this (DEC, 2007, DECC, 2008d). There is potential for this species to make use of the forest and woodland habitats of the proposed disturbance area as foraging habitat, although this has not been recorded. It is unlikely an important population of long-nosed potoroo occurs within the Project area.

The grey-headed flying-fox is known from 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. The species was recorded calling from outside the Project area during the February 2011 surveys undertaken for this assessment. Other previous records of the species occur approximately 15 km from the Project area, however records are few in Wollemi National Park and within Yengo National Park and occur mainly on the coastal side of the range (OEH, 2013a). There is potential that the species utilises the Project area as foraging habitat, as no flying-fox camps have been recorded. It is likely that this represents a population that utilises the Project area as part of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Park. It is unlikely an important population of grey-headed flying-fox occurs in the Project area.

The large-eared pied bat is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. The species was recorded using call echolocation recording within the Project area during the 2011 surveys undertaken for this assessment. The species was recorded in the south-east of the Project area and in the central portion of the proposed disturbance area. Other previous records of the species occur within 1 km of the Project area with many other records occurring throughout Wollemi and Yengo National Parks (OEH, 2013a). It is likely that the species utilises the Project area as foraging habitat, as no suitable caves or roosting habitat have been recorded within the Project area. It is likely that this represents a population that utilises the Project area as part

of a wider range into the suitable surrounding habitats in Yengo and Wollemi National Park. It is unlikely an important population of large-eared pied bat occurs in the Project area.

It is not considered that an important population of the Bynoes wattle, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat occur in the Project area as the Project area has not been identified as containing a key source population either for breeding or dispersal; populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species' range.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species; or**

The Project would result in the loss of approximately 18.7 ha of known and potential woodland habitat for the small-flower grevillea. This will include the loss of three small-flower grevillea individuals out of 849 recorded within the wider Project area. It is likely that the population within the Project area is part of the disjunct important population known to occur in the Putty area. Despite this, 846 individuals occur outside the proposed disturbance area and will not be disturbed as a result of the Project. Additionally, it is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo National Park. The reduction of three individuals is unlikely to have short term impacts to the population of small-flower grevillea in the Project area, and it is not considered to lead to a long-term decrease in the size of the *important population* occurring in the wider Putty area.

Given that there is not considered to be an *important population* of Bynoes wattle, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat present within the Project area, the Project will not lead to a long-term decrease in the size of an *important population* of these species.

- **reduce the area of occupancy of an important population; or**

The Project would result in the loss approximately 18.7 ha of known and potential woodland habitat for the small-flower grevillea, including the loss of three small-flower grevillea individuals out of 849 recorded within the wider Project area. The wider Putty important population of the species is known to occur outside the Project area and the Yengo and Wollemi National Parks provide extensive areas of suitable habitat. The Project will slightly reduce the area of occupancy for the important population of small-flower grevillea in the wider Putty area.

The Project area does not contain an *important population* of Bynoes wattle, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat and therefore will not reduce the area of occupancy of an *important population* of these species.

- **fragment an existing important population into two or more populations; or**

The important population of small-flower grevillea is known to occur in the Putty area approximately 15 km north of the Project area (Fairley, 2004). It is likely that the records of the species within the Project area are part of this population occurring within and around Wollemi and Yengo National Park. Consequently the level of fragmentation and isolation will slightly increase for this species. However, given the extensive area of suitable habitat in the surrounding area, the level of fragmentation and isolation increase is unlikely to significantly impact this species.

The Project area does not contain an *important population* of Bynoes wattle, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat and therefore the Project will not result in the fragmentation of an *important population* of these species.

- **adversely affect habitat critical to the survival of a species; or**

The Project will involve the disturbance of approximately 18.7 ha of known and potential eucalypt woodland habitat for the small-flower grevillea. It is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Park and records of the species are known from the Putty area, to the north of the Project area. It is considered unlikely that the Project would adversely affect habitat critical to the survival of the small-flower grevillea.

The habitat in the Project area is not known to provide core habitat for Bynoes wattle, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat and the Project is not expected to interfere with any dispersal pathways for these species. Given the above, the Project area is not considered to be critical habitat for the above species and consequently the Project is not expected to adversely affect habitat critical to the survival of these species.

- **disrupt the breeding cycle of an important population; or**

The Project would result in the loss of three small-flower grevillea individuals out of 849 recorded within the wider Project area and approximately 18.7 ha of known and potential woodland habitat for the species. It is likely that the population within the Project area is part of the disjunct important population known to occur in the Putty area. 846 individuals occur outside the proposed disturbance area and will not be disturbed as a result of the Project. Additionally, it is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo National Park. The reduction of three individuals is unlikely to disrupt the breeding cycle of the important population of the species in the Putty area.

No important populations of Bynoes wattle, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat have been identified in the Project area, nor have any breeding populations of these species been recorded. Consequently, the Project is not expected to disrupt the breeding cycle of an important population of these species.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Project will involve the disturbance of approximately 18.7 ha of known and potential eucalypt woodland habitat for the small-flower grevillea. It is likely that this population extends into the suitable surrounding habitats occurring outside the Project area into Yengo and Wollemi National Park and records of the species are known from the Putty area, to the north of the Project area. It is considered unlikely that the Project will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the small-flower grevillea is likely to decline.

Given the lack of core habitat in the Project area for Bynoes wattle, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat the Project will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that these species are likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; or**

There are not any invasive species that are likely to become established as a result of the Project that may have an impact upon any habitat relevant to the Bynoes wattle, small-flower grevillea, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat.

- **introduce disease that may cause the species to decline; or**

There are no diseases associated with the decline of Bynoes wattle, small-flower grevillea, *Olearia cordata*, broad-headed snake, New Holland mouse, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat.

Giant burrowing frogs can be affected by the amphibian chytrid fungus *Batrachochytrium dendrobatidis*. The 'infection of amphibians with chytrid fungus resulting in chytridiomycosis' is listed under the EPBC Act as a key threatening process for amphibian species. The disease has been recorded in four regions of Australia, namely the east coast, south-west Western Australia, Adelaide, and more recently Tasmania. This highly virulent fungal pathogen of amphibians is capable at the minimum of causing sporadic deaths in some populations, and 100% mortality in other populations. Lowered population numbers as a result of habitat reduction may increase the susceptibility of the population to the disease.

The koala is known to be affected by chlamydia and while many koalas carry chlamydia, they do not always show clinical symptoms (known as chlamydiosis) (Department of the Environment, 2013). The symptoms include eye, urinary tract, respiratory tract and reproductive tract infections, and the latter can lead to infertility in female koalas (Department of the Environment, 2013). Koala Retrovirus (KoRV) has been identified and is thought to be responsible for a range of conditions, including leukaemia (Tarlinton et al., 2005) and an immunodeficiency syndrome. Up to 100% of koalas in Queensland and NSW have KoRV (Department of the Environment, 2013). The effects of this disease on the koala is of growing concern (Department of the Environment, 2013).

The Project is not expected to introduce or exacerbate any diseases that may cause these species to decline.

- **interfere substantially with the recovery of the species.**

No significant effect on the recovery of Bynoes wattle, small-flower grevillea, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat is expected to occur as a result of the Project as the known and potential areas of habitat that will be impacted as a result of the Project are not expected to impact an important population of these species.

Conclusion

The Project is unlikely to result in a significant impact upon an *important population* of Bynoes wattle, small-flower grevillea, *Olearia cordata*, giant burrowing frog, broad-headed snake, New Holland mouse, koala, brush-tailed rock wallaby, long-nosed potoroo, grey-headed flying-fox or large-eared pied bat as the Project area is not considered to support an important population of these species.

Migratory Species

Seven migratory species have the potential to be impacted by the Project and have been subject to an assessment of significance below:

- White-bellied sea eagle (*Haliaeetus leucogaster*);
- White-throated needletail (*Hirundapus caudacutus*);
- Rainbow bee-eater (*Merops ornatus*);
- Black-faced monarch (*Monarcha melanopsis*);
- Satin flycatcher (*Myiagra cyanoleuca*);
- Rufous fantail (*Rhipidura rufifrons*).

An area of *important habitat* is:

- **habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; or**
- **habitat utilised by a migratory species which is at the limit of the species range; or**
- **habitat within an area where the species is declining.**

The habitats within the Project area for migratory species listed under international conventions is not considered to meet the criteria listed above, and important habitat is not likely to occur. The EPBC Act lists additional criteria that are used to determine whether an action is likely to have a significant impact on migratory species:

The proposed Project is considered likely to result in a *significant impact* on migratory species if there is a real chance or possibility that it will:

- **substantially modify and/or destroy an area of important habitat for a migratory species;**
- **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species; and/or**
- **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.**

The Project area is not considered to comprise *important habitat* for any of the identified migratory species listed above, and therefore the Project is not likely to substantially modify or destroy important migratory species habitat. Similarly, the Project will not seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species; or result in an invasive species that is harmful to migratory species becoming established within the Project area.

Conclusion

The Project is not likely to result in a significant impact on any migratory species listed under the EPBC Act or international conventions.

World Heritage Properties and National Heritage Places

Approval under the EPBC Act is required for any action occurring within or outside a declared World Heritage property or National Heritage place that has, will have, or is likely to have a significant impact on the values of the World Heritage property or National Heritage place.

A 'declared World Heritage property' is an area that has been included in the World Heritage list or declared by the minister to be a World Heritage property. World Heritage properties are places with natural or cultural heritage values which are recognised to have outstanding universal value.

National Heritage Places have been established to list places of outstanding heritage significance to Australia. It includes natural, historic and Indigenous places that are of outstanding national heritage value to the Australian nation.

The Greater Blue Mountains World Heritage and National Heritage Values

The Greater Blue Mountains was listed as a World Heritage property and a National Heritage place in 2000 and 2007 respectively, due to its outstanding examples that represent significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; and the presence of significant habitats for in situ conservation of biological diversity, including the eucalypts and eucalypt-dominated communities, taxa with Gondwanan affinities, and taxa of conservation significance. The values of the Greater Blue Mountains (DEWHA, 2008) include:

- primitive species with Gondwanan affinities that are of outstanding significance in terms of the evolution of plant life, including the Wollemi Pine (*Wollemia nobilis*) and the primitive gymnosperm *Microstrobis fitzgeraldii*;
- a centre of diversification of the eucalypts which provides an outstanding record of the products of evolutionary processes associated with the global climatic changes of the late Tertiary and the Quaternary;
- the highly unusual juxtaposition of diverse scleromorphic species with Gondwanan taxa;
- an exceptional representation of the major eucalypt groups and aspects of their evolution and radiation, including species in the following groups:
 - genera: *Eucalyptus* (including *Corymbia*) and *Angophora*; and
 - subgenera: *Eucalyptus*, *Corymbia* and *Symphyomyrtus*;
- examples of species divergence occurring in a relatively small area, including:
 - differentiation of eucalypt taxa in isolation in response to persistent habitat islands (e.g. those associated with sandstone plateaux isolated by deep valleys) and
 - mutually exclusive distributions of taxa in the series *Strictae* (the mallee ashes) and *Haemostomae* (the scribbly ashes) resulting from long-term isolation of breeding populations (allopatric speciation);
- eucalypt taxa demonstrating very high levels of hybridisation;

-
- representative examples of dynamic processes in eucalypt-dominated ecosystems, including the full range of interactions between eucalypts, understorey, environment and fire, extending from forests with rainforest boundaries to mallee communities with heath boundaries, demonstrating the exceptional ecological amplitude of the eucalypts;
 - outstanding levels of plant diversity expressed at different taxonomic levels (152 families, 484 genera, ca 1500 species) and for all three measures of species diversity (local species richness or 'alpha' diversity, species turnover across environmental gradients or 'beta' diversity, and regional species richness or 'gamma' diversity);
 - plant taxa with very high levels of species diversity, including the families – Fabaceae (149 species), Myrtaceae (150 species), Orchideae (77 species), Poaceae (57 species), Asteraceae (69 species), Proteaceae (77 species), Cyperaceae (43 species), and the genera - *Eucalyptus* (91 species) and *Acacia* (64 species);
 - exceptional diversity of habitats that contribute to the property being one of the three most diverse areas on earth for scleromorphic species and the only one of these areas that is dominated by trees and without a Mediterranean climate, including plateau tops, ridges, exposed rocks, cliffs, rocky slopes and sheltered gorges and valleys;
 - exceptional diversity of habitats providing outstanding representation of the Australian fauna within a single place, including 400 vertebrate taxa – 52 native mammals, 265 birds or 33 percent of the Australian total, 63 reptiles, more than 30 frogs, and examples of species of global significance such as the platypus (*Ornithorhynchus anatinus*) and the echidna (*Tachyglossus aculeatus aculeatus*), and invertebrate taxa - butterflies (120 species) and moths (estimated 4000 species);
 - very high diversity of scleromorphic taxa represented within 20 plant families including Myrtaceae, Proteaceae, Epacridaceae, Fabaceae (Faboideae and Mimosoideae), Dilleniaceae, Rutaceae, and Euphorbiaceae (Tribe Stenolobeae);
 - ancient, relict species with Gondwanan affinities that have survived past changes of climate within refugia, for example in recessed canyons and perpetually moist areas, including:
 - the Wollemi Pine (*Wollemia nobilis*); and
 - the primitive gymnosperm *Microstrobis fitzgeraldii*;
 - other primitive species with Gondwanan affinities, including:
 - Lomatia, Dracophyllum, and Podocarpus;
 - taxa in the family Lauraceae;
 - Atkinsonia, the most primitive extant root parasitic genus; and
 - taxa in the family Winteraceae, such as Tasmania;
 - taxa contributing to an exceptional diversity of eucalypts and eucalypt-dominated ecosystems, including:
 - 2 eucalypt genera (*Eucalyptus* including *Corymbia*, *Angophora*);
 - 3 eucalypt subgeneric groups (*Eucalyptus*, *Corymbia*, *Symphyomyrtus*);

-
- 91 eucalypt species (13 percent of the global total); and
 - highly diverse understoreys of flora and fauna species;
 - structural forms contributing to an exceptional diversity of eucalypts and eucalypt-dominated ecosystems, including:
 - tall open forest (towering, single-stemmed trees);
 - open forest;
 - woodland;
 - low, open woodland; and
 - mallee shrubland (small, multi-stemmed shrubs);
 - more than 70 plant communities, including 56 open forest and woodland communities contributing to an exceptional diversity of eucalypt-dominated ecosystems associated with:
 - wet environments (including the margins of rainforests);
 - dry environments (rapidly-draining, drought-prone sandstone plateaux);
 - low-nutrient environments (including sandstone-derived substrates);
 - fire-prone environments (including the sandstone plateaux); and
 - fertile environments (remnants of formerly widespread Tertiary basalts);
 - high levels of diversity of invertebrate fauna, including Lepidoptera (4000 moth species, 120 butterfly species), and cave invertebrates (67 taxa recorded at Jenolan Caves);
 - plant taxa of conservation significance and their habitats, including:
 - endemic species (114 plant species);
 - relict species;
 - species with a restricted range; and
 - rare or threatened species (127 species);
 - animal taxa of conservation significance and their habitats, including:
 - endemic species;
 - relict species;
 - species with a restricted range; and
 - rare or threatened species (40 vertebrate taxa - including 12 mammal species and 15 bird species – and 12 invertebrate taxa).

Greater Blue Mountains World Heritage Property

An action is likely to have a significant impact on the World Heritage values of a declared World Heritage property if there is a real chance or possibility that it will cause:

- ***one or more of the World Heritage values to be lost;***
- ***one or more of the World Heritage values to be degraded or damaged; or***
- ***one or more of the World Heritage values to be notably altered, modified, obscured or diminished.***

The Project will not result in direct impacts to the Greater Blue Mountains World Heritage property and none of the values identified above will be lost, degraded or damaged as a result of the Project. The Project includes substantial impact mitigation and management measures that have been designed to ensure that there are no off-site impacts resulting from the Project, including as a result of changes to groundwater and surface water regimes; erosion and sedimentation; weeds and feral animals; uncontrolled access to the adjacent World Heritage property; and the Project is not expected to adversely affect the diversity of flora and fauna species or any other biological process outside the Project area.

The Project is not expected to result in the loss; degradation or damage; notable alteration, modification, obscure or diminish the identified values of the greater Blue Mountains World Heritage property.

Greater Blue Mountains National Heritage Place

Approval under the EPBC Act is required for any action occurring within, or outside, a National Heritage place that has, will have, or is likely to have a significant impact on the National Heritage values of the National Heritage place. The National Heritage List contains places or groups of places with outstanding heritage value to Australia – whether natural, Indigenous or historic or a combination of these.

An action is likely to have a significant impact on the National Heritage values of a declared National Heritage place if there is a real chance or possibility that it will cause:

- ***one or more of the National Heritage values to be lost;***
- ***one or more of the National Heritage values to be degraded or damaged; or***
- ***one or more of the National Heritage values to be notably altered, modified, obscured or diminished.***

The Project will not result in direct impacts to the Greater Blue Mountains National Heritage Place and none of the values identified above will be lost, degraded or damaged as a result of the Project. The Project includes substantial impact mitigation and management measures that have been designed to ensure that there are no off-site impacts resulting from the Project, including as a result of changes to groundwater and surface water regimes; erosion and sedimentation; weeds and feral animals; uncontrolled access to the adjacent National Heritage place; and the Project is not expected to adversely affect the diversity of flora and fauna species or any other biological process outside the Project area.

The Project is not expected to result in the loss; degradation or damage; notable alteration, modification, obscure or diminish the identified values of the greater Blue Mountains World Heritage property.



APPENDIX F

Tinda Creek Quarry Koala Plan of
Management



Aus-10 Rhyolite Pty Ltd

KOALA PLAN OF MANAGEMENT

Proposed Expansion of Tinda Creek Sand Quarry

June 2014

Aus-10 Rhyolite Pty Ltd

KOALA PLAN OF MANAGEMENT

Proposed Expansion of Tinda Creek Sand
Quarry

June 2014

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Aus-10 Rhyolite Pty Ltd

Project Director: **Peter Jamieson**
Report No. **1731/R20/FINAL**
Date: **June 2014**



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TABLE OF CONTENTS

1.0	Introduction	1
1.1	Objectives	1
1.2	Legislative Requirements	2
1.2.1	SEPP 44 – Koala Habitat Protection	2
1.2.2	<i>NSW Threatened Species Conservation Act 1995</i>	4
1.2.3	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i>	4
2.0	Ecology of Koalas	5
2.1	General Information	5
2.2	Habitat Quality	5
2.3	Preferred Koala Feed Tree Species	6
3.0	Regional and Local Koala Habitat and Populations	8
3.1	Koala Habitat.....	8
3.1.1	Regional Koala Habitat	8
3.1.2	Local Koala Habitat	8
3.1.3	Availability of Alternative Koala Habitat and Corridor Function.....	10
3.2	Koala Populations	11
3.2.1	Regional Population	11
3.2.2	Local Population.....	11
4.0	Potential Impacts from Proposed Project	12
4.1	Increased Traffic, Operational Impacts and Human Interaction.....	12
4.2	Noise and Vibration.....	13
4.3	Water Management.....	13
4.4	Clearance of Vegetation/Loss of Habitat.....	13
4.5	Fragmentation of Potential Koala Habitat	13
4.6	Increased Competition for Resources	13
5.0	Threatening Processes	14
6.0	Management Strategies	15
6.1	Impact Amelioration and Management Measures	15
6.2	Tree Felling Procedure.....	15
6.3	Increased Traffic, Operational Impacts and Human Interaction.....	15
6.4	Biodiversity Offset Strategy	16
6.5	Rehabilitation.....	16
6.6	Protection of Surrounding Areas of Core Habitat	16
7.0	Monitoring, Review and Reporting	17

7.1	Monitoring Program	17
7.1.1	Criteria	17
7.2	Reporting	17
7.3	Review	17
8.0	Conclusions	18
9.0	References	19

FIGURES

1.1	Locality Map	1
1.2	Project Area	1
3.1	SEPP 44 Habitat Assessment Sites	8
3.2	Vegetation Communities Providing Potential Koala Habitat	9
3.3	Fauna Survey Sites	12
3.4	Koala Records in the Project Area and Locality	12

1.0 Introduction

Aus-10 Rhyolite Pty Ltd t/a Hy-Tec Concrete and Aggregates (Hy-Tec) operates Tinda Creek, a sand quarry located approximately 67 km north of Windsor along Putty Road, NSW (**Figure 1.1**). Hy-Tec is seeking approval to increase production levels from Tinda Creek Quarry from approximately 125,000 tonnes per annum (tpa) up to 300,000 tpa and to increase the area subject to sand extraction to include additional identified resource domains. The quarry is currently located within Lot 2 DP 628806.

The quarry expansion is proposed to be undertaken on the site as shown in **Figure 1.2**, within parcels of land described in cadastral terms as Lot 1, Lot 2 and Lot 3 in DP 628806, on Putty Road, approximately 23 km north of Colo Heights, NSW. Lot 1, Lot 2, and Lot 3 are 86 ha, 86.67 ha and 86 ha respectively, with a total site area of 258.67 ha. The Project area is bounded on the north, east and south by Yengo National Park and on the west by Putty Road, several agricultural land holdings and Wollemi National Park (**Figure 1.2**).

An Environmental Impact Statement (EIS) that includes a detailed Ecological Assessment has been prepared (Umwelt (Australia) Pty Ltd (Umwelt)) on behalf of Hy-Tec, in accordance with the Director-General's Requirements for the proposed Project issued by the NSW Department of Planning and Infrastructure (DP&I), now known as the Department of Planning and Environment (DP&E). The Ecological Assessment includes a SEPP 44 Koala Habitat Protection (SEPP 44) Assessment that found that the Project area potentially comprised core koala habitat, as defined by the presence of dispersing young male koala which indicated breeding within or adjacent to the Project area.

For the purposes of this Koala Plan of Management (KPoM), the definition of core koala habitat from SEPP 44 is adopted, this being:

An area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

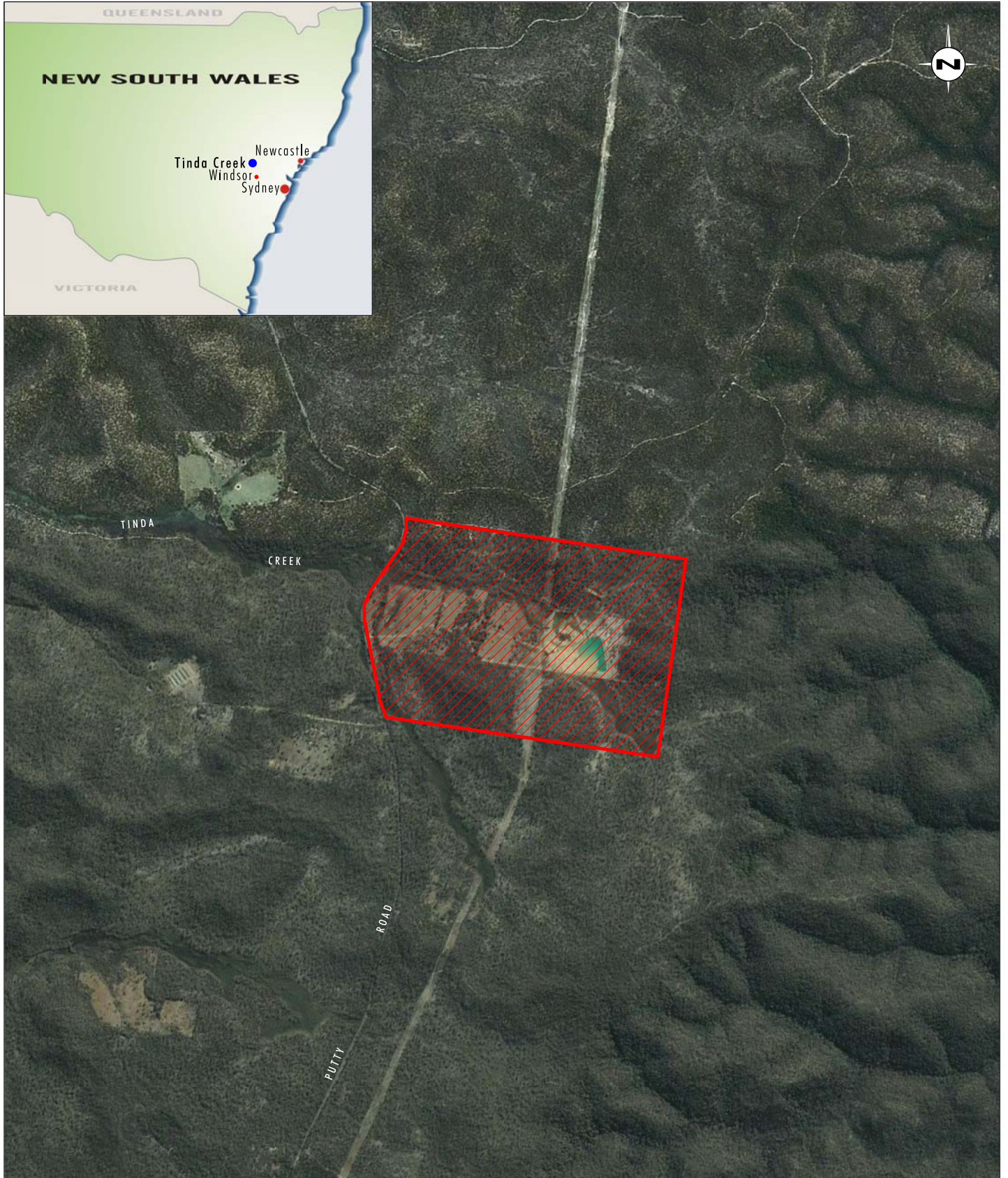
It is noted that a breeding female was not observed however the identification of the koala within the Project area triggered the requirement to determine whether or not the Project area provided 'core koala habitat'. The presence of a young male koala during February (a time during in which young koalas are typically still within their mothers home range) indicated that the mother's home range was either likely to be within or near the Project area, thus indicating that the Project area most likely forms or was in proximity to 'core koala habitat'.

This KPoM has been prepared in recognition of the presence of core koala habitat on or within the vicinity of the site and in accordance with the requirements of SEPP 44, as well as the accompanying SEPP 44 Circular No. B35 (DUAP, 1995).

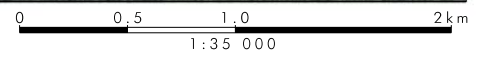
1.1 Objectives

The objectives of this KPoM are to:

- identify the location and characteristics of the core koala habitat identified within the Project area;
- identify the potential impacts of the Project to core koala habitat identified within the Project area; and



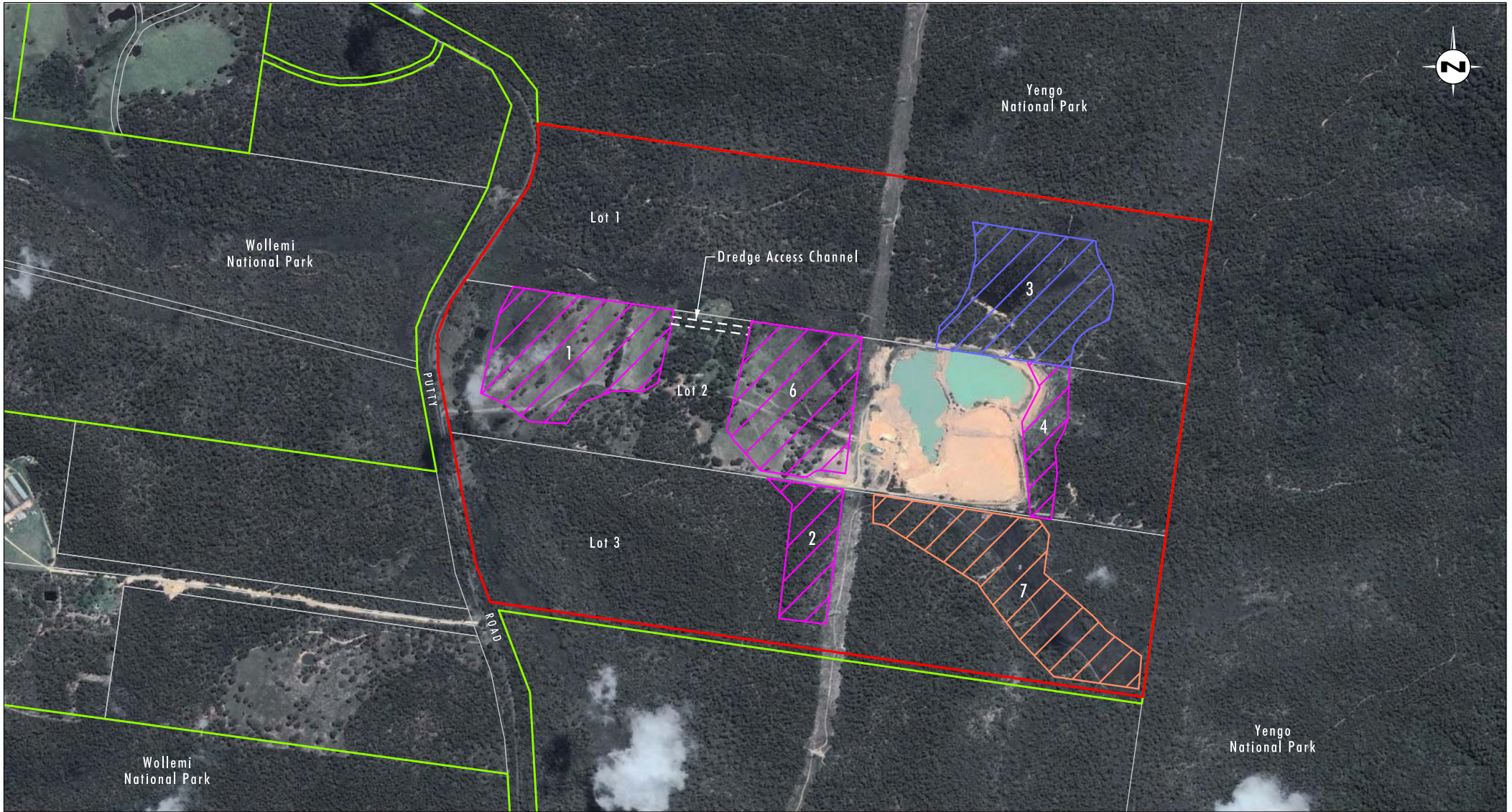
Source: Google Earth (2002)



Legend

 Project Area

FIGURE 1.1
Locality Map



Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary

FIGURE 1.2
Project Area

-
- provide management measures to minimise the potential impacts on core koala habitat associated with the Project.

1.2 Legislative Requirements

The *Environmental Planning and Assessment Act 1979* (EP&A Act) makes provision for a range of environmental planning instruments, which additionally provide for protection of koala habitat, including State Environmental Planning Policies and Local Environmental Plans. The main provisions of the state and local planning instruments are provided below.

1.2.1 SEPP 44 – Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection is a policy made under EP&A Act.

SEPP 44 aims to encourage the appropriate conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline. Any development application in an identified local government area, affecting land of one hectare or greater, including adjoining lands on the same holding, must be assessed under SEPP 44.

The proposed Project is subject to assessment under SEPP 44 as it lies in the Hawkesbury local government area which is listed in Schedule 1 of the Policy.

Assessment under SEPP 44 is based on an initial determination of whether the subject land constitutes potential koala habitat. This is determined by assessing whether the eucalypt species listed in Schedule 2 constitute 15% or more of the total number of trees in the upper or lower strata of the tree component of the subject land. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat. This is primarily determined by completing field surveys and literature searches to determine if a population of koala is present within the subject land.

A SEPP 44 assessment was conducted as part of the Ecological Assessment for the EIS (undertaken by Umwelt in spring 2010 and summer 2011). Two SEPP 44 tree species, grey gum (*Eucalyptus punctata*) and forest red gum (*E. tereticornis*) were recorded within the Project area but neither comprised 15% or more of the total number of trees in the upper or lower strata of the tree component so on this basis alone the Project area does not constitute core koala habitat.

The Project area was identified as koala habitat by the identification of two koalas during spotlighting surveys. A single koala was heard calling to the east of the south-western domain during spotlighting on 17 November 2011 (see **Figure 1.2**). Despite attempts to find the koala during spotlighting, it could not be located. A second koala was identified in a hard-leaved scribbly gum (*Eucalyptus sclerophylla*) during spotlighting on 8 February 2011. The second koala was a young male estimated to be between 4 and 6 kg in weight.

The identification of koalas within the Project area triggered the requirement to determine whether or not the Project area provides 'core koala habitat'. Core koala habitat is determined by the assessing the presence of a breeding population, particularly the presence of breeding females with back young.

Only the November 2010 survey period occurred during the typical period of July to December where koala mothers are carrying their young on their backs. The single koala heard and that could not be located was likely a male as females rarely bellow. The second

koala identified during the February 2011 survey was an approximate 4 to 6 kg, young male koala. Following a period of being on their mothers' backs, young koalas are forced to begin a stage of independence around the months of December and January. During this period young koalas typically remain within their mother's home range area and often in trees close to their mother. During the first half of the subsequent calendar year young koalas will typically disperse out of their mother's home range area in search of a home range area of their own. It is most likely that the young male koala identified during February was still within or nearby to his mother's home range area, although he may have already started the dispersal process.

The presence of a young male koala during February and the resulting likely presence of his mother's home range area within the Project area or nearby indicate that the woodland areas within or adjacent to the Project area are likely to form 'core koala habitat' as defined under SEPP 44.

The identification of core koala habitat under SEPP 44 triggers the requirement to prepare a KPoM for the Project.

This KPoM was prepared in response to this likely presence of 'core koala habitat' and in accordance with Circular B35, a companion document to SEPP 44 which guides the preparation of individual KPoMs (DUAP, 1995). The requirements detailed in the circular, as well as the specific sections of this document where each requirement is addressed, are outlined in **Table 1.1**.

Table 1.1 – Requirements of Circular B35

Guidelines Relating to the Preparation of a KPoM	Section
1. An estimate of population size;	3.3
2. Identification of preferred feed tree species for the locality and extent of resource available;	3.1
3. An assessment of the regional distribution of koalas and the extent of alternative habitat available to compensate for that to be affected by the actions;	3.2
4. Identification of linkages of core koala habitat to other adjacent areas of habitat and movement of koalas between areas of habitat. Provisions of strategies to enhance and manage these corridors;	3.2
5. Identification of major threatening processes such as disease, clearance of habitat, road kill and dog attack which impact on the population. Provision of methods for reducing these impacts;	5.0
6. Provision of detailed proposals for amelioration of impacts on koala populations from any anticipated development within zones of core koala habitat;	4.0 6.0
7. Identification of any opportunities to increase size or improve condition of existing core habitat, this should include lands adjacent to areas of identified core koala habitat;	6.2 6.3
8. The plan should state clearly what it aims to achieve (for example, maintaining or expanding the current population size or habitat area);	1.3
9. The plan should state criteria against which achievement of these objectives is to be measured (for example, a specified population size in a specific time frame or the abatement of threats to the population);	7.1
10. The plan should also have provisions for the continuing monitoring, review and reporting. This should include an identification of who will undertake further work and how it will be funded.	7.0

Under Part 1 (5) of the Policy (Land to which this Policy Applies), it is stated that the policy does not apply to land dedicated or reserved under the *National Parks and Wildlife Act 1974*,

which includes Yengo National Park and Wollemi National Park. As such, this KPoM applies only to those areas of identified core koala habitat that fall on privately owned land within the Project area.

1.2.2 NSW Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides protection for threatened plants and animals native to NSW, excluding fish and marine vegetation. Species listed under Schedules 1 and 2 of the TSC Act are considered to be threatened in NSW. Those in Schedule 1 are endangered, whilst those in Schedule 2 are Vulnerable. The koala (*Phascolarctos cinereus*) is listed as a vulnerable species within Schedule 2 of the TSC Act. The koala has additionally been listed as an endangered population in Pittwater LGA and the Hawks Nest/Tea Gardens LGA, which are not relevant to this KPoM.

Protection of the koala (including its habitat) is provided by integrating the conservation of the species into the development control process under the EP&A Act (which includes SEPP 44).

1.2.2.1 Approved Recovery Plan – Recovery Plan for the Koala (*Phascolarctos cinereus*) – (DECC, 2008)

The TSC Act requires that the Director-General of OEH prepare a recovery plan for all species, endangered populations and endangered ecological communities listed as Endangered or Vulnerable under the Schedules of the TSC Act (other than species presumed extinct). A Recovery Plan for the Koala has been prepared by OEH (DECC, 2008).

This recovery plan is the formal recovery plan for the koala in NSW and considers the conservation requirements of the species across its known range in NSW. It identifies the actions needed and parties responsible for undertaking the identified actions. It also provides a framework for localised recovery efforts throughout NSW, including the management issues relevant to the koala.

Although this document is primarily aimed at actions to be undertaken by government authorities many of the issues presented are still applicable, and the recovery objectives and proposed recovery actions have been considered in the development of this KPoM.

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

The EPBC Act provides the legislation to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places (also known as matters of national environmental significance).

The combined populations of the koala in Queensland, New South Wales and the Australian Capital Territory were listed as vulnerable under the EPBC Act in May of 2012. The koala was listed as vulnerable due to a substantial decline over three generations (TSSC, 2012).

A recovery plan for the koala was recommended as part of the listing advice and is due to be prepared following the expiration of the *National Koala Conservation and Management Strategy 2009 – 2014*.

1.2.3.1 National Koala Conservation and Management Strategy 2009 – 2014

This Management Strategy was prepared by the Natural Resource Management Ministerial Council (NRMMC, 2009) to provide a national coordinating framework for the numerous koala plans and actions that have been developed and are being undertaken by various state

and local governments across Australia. Being a policy document, this Management Strategy does not provide any legislative powers or obligations. Importantly, the Management Strategy provides overarching policies and directions for action for the integration of national and state koala policies in order to work towards the goal of conserving koalas and their habitat. This Management Strategy has been considered in the development of this KPoM.

2.0 Ecology of Koalas

2.1 General Information

The koala (*Phascolarctos cinereus*) is an arboreal marsupial with fur ranging from grey to brown above, and is generally white below. It has large furry ears, a prominent black nose and no tail. It spends most of its time in trees and has long, sharp claws, adapted for climbing. Adult males weigh 6 – 12 kg and adult females weigh 5 – 8 kg. During breeding, males advertise with loud snarling coughing and bellowing (OEH, 2013).

This species has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. It was briefly historically abundant in the 1890s in the Bega District on the south coast of NSW, although not elsewhere, and it now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands (OEH, 2013). Under the IUCN red list of threatened species the koala is listed as being in the category of *least concern*.

Koalas inhabit eucalypt woodlands and forests, and feed on the foliage of at least 70 known eucalypt species and 30 non-eucalypt species, selecting preferred browse species in various regions. This species is generally inactive for most of the day, feeding and moving mostly at night. Koalas spend most of their time in trees, but will descend and traverse open ground to move between trees, when required. Home range size varies with quality of habitat, ranging from less than two hectares to several hundred hectares in size. This species is generally solitary, however has complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Females breed at two years of age and produce one young per year (OEH, 2013).

The breeding season for koalas peak between September and February and animals are most active during this period (DECC, 2008). The gestation period for the koala is 35 days. Following birth, the young remains in the pouch for approximately 6 months, and on leaving the pouch, remains dependent on its mother and is carried on her back. Young reach independence at about 12 months old, although they can remain in the mother's home range for a further two to three years (Mitchell and Martin, 1990). After this time, young animals of both sexes disperse to establish their own home range areas (Ramsay, 1999). Dispersal distances range from one to 11 km although movements in excess of 50 km have been recorded (DECC, 2008).

2.2 Habitat Quality

The quality of forest and woodland communities as habitat for koalas is influenced by a range of factors, including:

- **species and size of trees present:** the most important factor influencing koala occurrences is the suite of tree species available. Koalas rely exclusively on regionally

specific primary and/or secondary food tree species (DECC, 2008). Adequate floristic diversity is also important. The quality of habitat is also influenced by the presence of suitable shelter trees;

- **structural diversity of the vegetation:** it has been found that koala activity is greater in structurally diverse forest with the majority of trees 50–80 cm DBH (DECC, 2008). Some groundcover vegetation and other features, such as hollow logs, are useful in providing shelter while on the ground and refuge in extreme weather conditions;
- **soil nutrients:** in general, vegetation on more fertile soils provides the most suitable habitat for koalas due to the greater availability of nutrients within leaves (Cork et al., 1990);
- **climate and rainfall:** koalas rely primarily on the moisture within their food to meet their water requirements; and
- **size and disturbance history of the habitat patch:** small, fragmented or highly disturbed habitats are less likely to be able to support koalas in the long term due to edge effects, limited resource availability and increased predation (DECC, 2008). Vegetation corridors are important to support continued koala movements where dispersal and recruitment are impeded by barriers such as large areas of open ground and roads.

2.3 Preferred Koala Feed Tree Species

Koalas feed on the foliage of eucalypt tree species and in some areas exhibit extremely strong preferences for particular eucalypt species. SEPP 44 lists preferred koala feed trees in Schedule 2 of the SEPP. These species are listed in **Table 2.1** below.

Table 2.1 – Preferred Koala Feed Trees listed in Schedule 2 of SEPP 44

Scientific Name	Common Name
<i>Eucalyptus tereticornis</i>	forest red gum
<i>Eucalyptus microcorys</i>	tallowwood
<i>Eucalyptus punctata</i>	grey gum
<i>Eucalyptus viminalis</i>	ribbon or manna gum
<i>Eucalyptus camaldulensis</i>	river red gum
<i>Eucalyptus haemastoma</i>	broad leaved scribbly gum
<i>Eucalyptus signata</i>	scribbly gum
<i>Eucalyptus albens</i>	white box
<i>Eucalyptus populnea</i>	bimble box or poplar box
<i>Eucalyptus robusta</i>	swamp mahogany

The Recovery Plan for the Koala (DECC, 2008) documents the preferred feed trees in each of seven management areas identified in the Recovery Plan. The Project area occurs within the Central Coast Management Area, and **Table 2.2** outlines the primary, secondary and supplementary species that have been identified in that Management Area.

Table 2.2 – Preferred Feed Trees in the Central Coast Management Area

Primary Feed Trees	Secondary Feed Trees	Stringybarks/Supplementary Feed Trees
Parramatta red gum (<i>Eucalyptus parramattensis</i>)	Broad-leaved sally (<i>Eucalyptus camphora</i>)	Blue-leaved stringybark (<i>Eucalyptus agglomerata</i>)
Swamp mahogany (<i>Eucalyptus robusta</i>)	Swamp gum (<i>Eucalyptus ovata</i>)	<i>Eucalyptus oblonga</i>
Forest red gum (<i>Eucalyptus tereticornis</i>)	Fuzzy box (<i>Eucalyptus conica</i>)	Thin-leaved stringybark (<i>Eucalyptus eugenioides</i>)
Tallowwood (<i>Eucalyptus microcorys</i>)	Brittle gum (<i>Eucalyptus praecox</i>)	<i>Eucalyptus ralla</i>
Ribbon gum (<i>Eucalyptus viminalis</i>)	Yertchuk (<i>Eucalyptus consideriana</i>)	White stringybark (<i>Eucalyptus globoidea</i>)
Cabbage gum (<i>Eucalyptus amplifolia</i>)	White-topped box (<i>Eucalyptus quadrangulata</i>)	<i>Eucalyptus tenella</i>
	Dwyer's red gum (<i>Eucalyptus dwyeri</i>)	Yellow stringybark (<i>Eucalyptus muelleriana</i>)
	Red mahogany (<i>Eucalyptus resinifera</i>)	Privet-leaved stringybark (<i>Eucalyptus ligustrina</i>)
	Slaty red gum (<i>Eucalyptus glaucina</i>)	Red stringybark (<i>Eucalyptus cannonii</i>)
	Rudder's box (<i>Eucalyptus rudderi</i>)	Brown stringybark <i>Eucalyptus capitellata</i>
	Bundy (<i>Eucalyptus goniocalyx</i>)	<i>Eucalyptus prominula</i>
	Large-fruited red mahogany (<i>Eucalyptus scias</i>)	Heart-leaved stringybark (<i>Eucalyptus camfieldii</i>)
	Craven grey box (<i>Eucalyptus largeana</i>)	Narrow-leaved stringybark (<i>Eucalyptus sparsifolia</i>)
	Grey gum (<i>Eucalyptus punctata</i>)	<i>Eucalyptus bensonii</i>
	Maiden's gum (<i>Eucalyptus maidenii</i>)	<i>Eucalyptus imitans</i>
	Monkey gum (<i>Eucalyptus cypellocarpa</i>)	<i>Eucalyptus blaxlandii</i>
	Brittle gum (<i>Eucalyptus michaeliana</i>)	
	Woollybutt (<i>Eucalyptus longifolia</i>)	
	Western grey box (<i>Eucalyptus macrocarpa</i>)	
	Blue box (<i>Eucalyptus baueriana</i>)	
	Grey box (<i>Eucalyptus moluccana</i>)	
	Coast grey box (<i>Eucalyptus bosistoana</i>)	
	<i>Eucalyptus notabilis</i>	

3.0 Regional and Local Koala Habitat and Populations

3.1 Koala Habitat

3.1.1 Regional Koala Habitat

Hawkesbury City Council (HCC) has not prepared a Comprehensive KPoM; as such there are no regional assessments of koala habitat.

3.1.2 Local Koala Habitat

Flora surveys for the proposed Project were undertaken in 2010, 2011 and 2012. As part of these surveys a total of 25 systematic vegetation quadrats (20 x 20 m dimensions) were sampled within the Project area as per the required methodologies for SEPP 44.

In each of these quadrats, an assessment of the presence of Schedule 2 feed trees (see **Table 2.1**) was undertaken. All Schedule 2 feed trees were recorded, along with an estimate of the percentage of the total Schedule 2 feed trees within each quadrat. This allowed an assessment as to whether koala feed trees comprised greater than 15% of canopy species in any of the vegetation communities recorded in the Project area. The location of each of these quadrats is provided in **Figure 3.1**.

Vegetation communities identified in the Project area have been mapped and described in the Ecology Assessment (Umwelt, 2014). This vegetation mapping provides the most recent local vegetation mapping, and as such has been used within the KPoM as the key resource for determining the potential availability and extent of koala habitat within the Project area as well as the broader area. **Table 3.1** identifies the vegetation communities with the potential to provide potential koala habitat. It is considered that the koala is more likely to occur in communities that contain primary, rather than secondary or supplementary feed trees.

Table 3.1 – Potential Koala Habitat within the Project Area

Vegetation Community	SEPP 44 Schedule 2 Feed Tree Species	Central Coast Primary Feed Tree	Central Coast Secondary Feed Tree	Central Coast Supplementary Feed Tree
Mellong Sandmass Dry Woodland	Forest red gum (<i>Eucalyptus tereticornis</i>)	Drooping red gum (<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>).		
Mellong Sandmass Swamp Woodland	Forest red gum (<i>Eucalyptus tereticornis</i>)	Drooping red gum (<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>).		
Stringybark – Ironbark Forest				Narrow-leaved stringybark (<i>Eucalyptus sparsifolia</i>)

Table 3.1 – Potential Koala Habitat within the Project Area (cont)

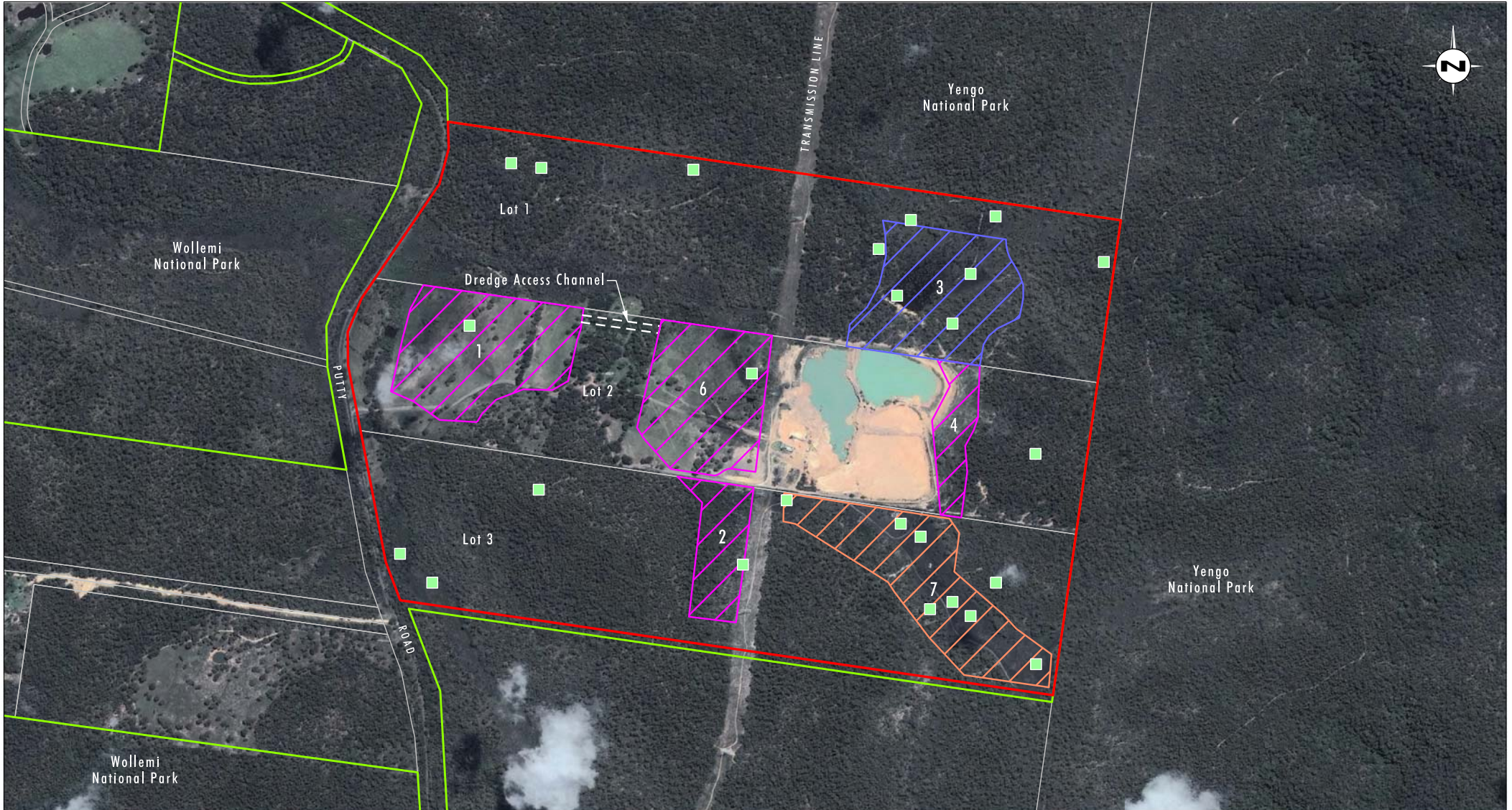
Vegetation Community	SEPP 44 Schedule 2 Feed Tree Species	Central Coast Primary Feed Tree	Central Coast Secondary Feed Tree	Central Coast Supplementary Feed Tree
Mellong Sandmass Sedgeland		Drooping red gum (<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>).		
Red Gum Riparian Forest		Drooping red gum (<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>).		
Hawkesbury Hornsby Plateau Exposed Woodland	Grey gum (<i>Eucalyptus punctata</i>)		Grey gum (<i>Eucalyptus punctata</i>)	Narrow-leaved stringybark (<i>Eucalyptus sparsifolia</i>)

The extent of each of these communities is provided in **Figure 3.2**. This figure identifies only those communities (or variants) considered likely to comprise potential koala habitat.

The assessment of the extent of potential koala habitat occurring in the Project area determined that approximately 199 ha of woodland and forest habitat (refer to **Figure 3.2**) occur within the Project area. Hawkesbury Hornsby Plateau Exposed Woodland, Mellong Sandmass Dry Woodland and Mellong Sandmass Swamp Woodland are considered to provide high quality potential koala habitat, with moderate quality habitat present in Red Gum Riparian Forest and Stringy Bark – Ironbark Forest. Sporadic occurrences of drooping red gum (*Eucalyptus parramattensis* subsp. *parramattensis*) are also known to occur along the edge of Mellong Sandmass Sedgeland, however this area of potential habitat has not been determined due to the scattered nature of the drooping red gum trees. Of the approximately 199 ha of potential koala habitat identified in the Project area, approximately 23 to 24 ha occurs within the proposed disturbance area, as shown in **Table 3.2**.

Table 3.2 – Extent of Potential Koala Habitat Identified in the Project Area and Proposed Disturbance Area (PDA)

Formation	Vegetation Community	Area of Potential Koala Habitat in the Project Area (ha)	Area of Potential Koala Habitat in the Domain 7 PDA (ha)	Area of Potential Koala Habitat in the Domain 3 PDA (ha)
Forest	Stringybark – Ironbark Forest	19.6	0.4	2.1
Woodland	Hawkesbury Hornsby Plateau Exposed Woodland	57.8	1.6	1.6
	Mellong Sandmass Dry Woodland	92.2	15.4	19.4
	Mellong Sandmass Swamp Woodland	29.5	6.3	4.8
Total		199.1	23.7	27.9



Source: Google Earth (2012), LPI NSW (2007)

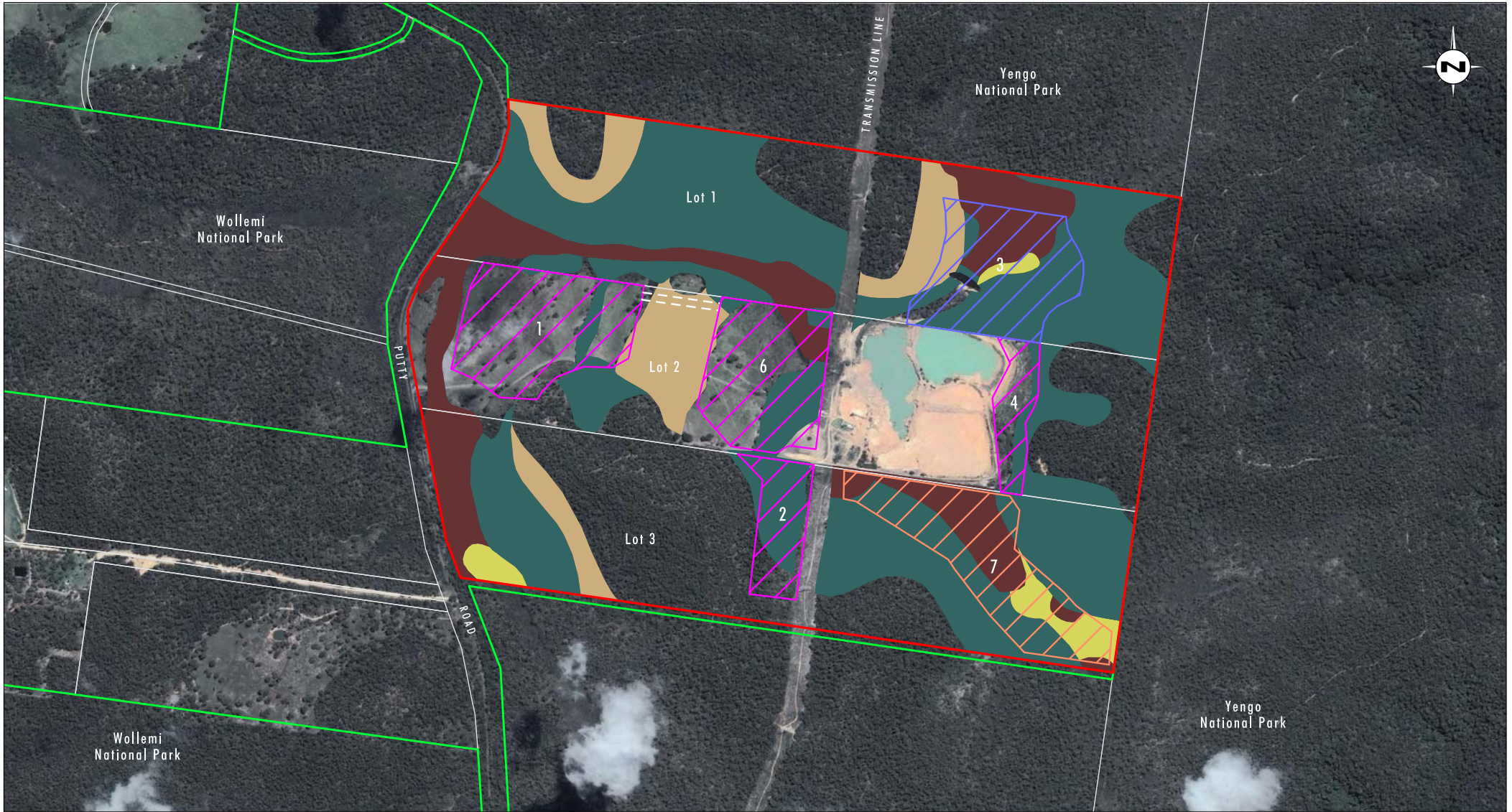
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Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Flora Quadrat with SEPP 44 Habitat Assessment

FIGURE 3.1

SEPP 44 Habitat Assessment Sites



Source: Google Earth (2012), LMPA (2009)

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Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Mellong Sandmass Dry Woodland
- Mellong Sandmass Sedgeland
- Mellong Sandmass Swamp Woodland
- Stringybark - Ironbark Forest

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FIGURE 3.2

Vegetation Communities Providing Potential Koala Habitat

Forest red gum (*Eucalyptus tereticornis*) is listed as a preferred koala feed tree under Schedule 2 of SEPP 4 and as a primary feed tree in the Central Coast Management Area (DECC, 2008). This species was recorded as a minor canopy species, making up less than 15% cover within Mellong Sandmass Dry Woodland and Mellong Sandmass Swamp Woodland.

Drooping red gum (*Eucalyptus parramattensis* subsp. *parramattensis*) is not listed as a preferred koala feed tree under Schedule 2 of SEPP 44; however is listed as a primary feed tree in the Central Coast Management Area (DECC, 2008). This species was recorded as a minor canopy species, making up less than 15% cover within Mellong Sandmass Dry Woodland, Mellong Sandmass Swamp Woodland and Red Gum Riparian Forest communities and as scattered individuals surrounding the Mellong Sandmass Sedgeland.

Grey gum (*Eucalyptus punctata*) is listed as a preferred koala feed tree species under Schedule 2 of SEPP; however as a secondary feed tree in the Central Coast Management Area (DECC, 2008). This species was recorded as a minor canopy species, making up less than 15% cover in Hawkesbury Hornsby Plateau Exposed Woodland.

Red mahogany (*Eucalyptus resinifera*) is not listed as a preferred feed species under SEPP 44; however is listed as a secondary feed tree under the Central Coast Management Area (DECC, 2008). This was recorded as a minor canopy species, making up less than 15% cover.

Narrow-leaved stringybark (*Eucalyptus sparsifolia*) is not listed as a preferred SEPP 44 tree species, however is listed as a supplementary feed tree under the Central Coast Management Area (DECC, 2008). This was recorded as a minor canopy species, making up less than 15% cover in Hawkesbury Hornsby Plateau Exposed Woodland and Stringybark – Ironbark Forest.

3.1.3 Availability of Alternative Koala Habitat and Corridor Function

Figure 3.2 identifies the vegetation communities likely to comprise potential koala habitat within the Project area. This potential koala habitat has been determined by identifying which of the communities mapped during the Ecological Assessment feature one of the Schedule 2 feed tree species or species nominated as feed trees within the Central Coast Management Unit (DECC, 2008) as a canopy dominant (refer to **Section 3.1.2**).

The majority of this habitat occurs in large, relatively continuous patches in the northern and southern parts of the Project area (**Figure 3.1**). Review and analysis of regional vegetation mapping data indicates that those communities that were recorded during vegetation surveys within the Project area occur extensively in the local area and region. Both Wollemi and Yengo National Parks are expected to include substantial areas of potential koala habitat on the basis of suitable vegetation communities.

Generally, the Wollemi and Yengo National Parks are heavily vegetated, with high degrees of vegetated connectivity extending from the Project area and covering in excess of 600 000 ha. While it is not known if these areas of vegetation all contain suitable foraging habitat for the koala, they do provide some degree of protective vegetated corridor which would allow for the movement of this species.

3.2 Koala Populations

3.2.1 Regional Population

The Project area falls within Koala Management Area 2: Central Coast (DECC, 2008). The population information available for this Koala Management Area is as follows:

On the Central Coast, koalas are known to occur within Brisbane Water National Park and around Gosford and Woy Woy (O'Brien 1995). In the north-eastern Blue Mountains, koalas occur in Wollemi National Park (N. Stone, National Parks and Wildlife Service (NPWS), pers. comm.) and in the Colo River area, in and around Yengo National Park (Curtin et al. 2002). Koalas are also present in the Canyonleigh area, approximately 25 km west of Moss Vale (C. Allen, Australian Koala Foundation, pers. comm., unpublished data). Scattered records also occur in the Hunter Valley. Two individual koalas were recorded in the lower Blue Mountains at Glenbrook in 1998 and 1999, but radio-tracking studies of one individual failed to locate evidence of any other animals (D. Wotherspoon, Blue Mountains Wilderness Trust, pers. comm.). A detailed community and field-based survey in 2000 failed to locate any direct evidence of koalas in the lower Blue Mountains, despite the presence of some areas of potential habitat (Close et al. 2000). The results obtained are not consistent with other surveys of low-density koala populations nearby and suggest that the two animals were dispersing from populations in the northern Blue Mountains (Close et al. 2000). There is likely to be a population of koalas centred around the catchment of Little Cattai Creek (west of the Old Northern Road), and potentially a population along the lower sections of Cattai Creek (perhaps into O'Haras Creek). There has been a population of koalas along South Creek and adjoining bushland, north of the Great Western Highway, at least up until relatively recently, and surviving remnants of this population may still be present. There are certainly pockets of good habitat left, although this population would certainly also face ongoing challenges if it exists (J. Sanders, DECC, pers. comm.) (DECC 2008).

The Koala Recovery Plan (DECC, 2008) has identified the Pittwater Local Government Area as a core area of koala activity, with records in that area comprising an important endangered koala population. This area is the closest regionally important population of the koala, occurring approximately 75 km to the south east of the Project area. This distance does not fall within the dispersal distance range for this species (being from one to 11 km – although movements in excess of 50 km have been recorded) (DECC, 2008), it is unlikely that the records within the Project area would substantially interact with this population.

3.2.2 Local Population

The local population size and extent was estimated through a literature review and fauna field survey completed as part of the Project.

3.2.2.1 Literature Review

The Draft Recovery Plan for the Koala (NPWS, 2003) refers to the koala population in the Sydney Basin as generally occupying secondary quality habitat. DEC (2005a) indicates that the koala in Wollemi National Park occurs in very low densities in the northern escarpments of the park as well as in the east near Howes Valley in areas adjoining Yengo National Park. In Wollemi National Park the key habitat areas are considered to be those dominated by grey gum (*Eucalyptus punctata*), white box (*Eucalyptus albens*), grey box (*Eucalyptus moluccana*) or red gums (*Eucalyptus tereticornis*) or Blakely's red gum (*Eucalyptus blakelyi*) (DEC, 2005a).

DEC (2005b) indicates that the koala occurs in Yengo National Park in very low densities in the northern escarpment, with the higher levels of activity recorded in the vicinity of Yengo Track near Werong Creek approximately 50 km to the north-east of the Project area. Koala records in Yengo National Park tend to occur in areas dominated by grey gum (*Eucalyptus punctata*) in forest with higher fertility soils, particularly in areas enriched by shale lenses in sandstone bedrock (DEC, 2005b).

A total of 18 koala records occur within a 10 km radius of the centre of the Project area recorded between the years of 1992 and 2007, as per the Atlas of NSW Wildlife (OEH, 2014). There were also koala records within the Project area during surveys undertaken by Umwelt in 2010 and 2011.

3.2.2.2 Field Survey

Four fauna surveys were completed within the Project area, during spring 2010, summer 2011, winter 2011 and spring 2012. **Figure 3.3** provides the locations of all fauna-based field surveys completed within the Project area. Fauna searches that directly related to the koala included spotlight searching, signs of presence searching and nocturnal call playback. All other methods, such as bird surveys and trap checking, contributed to opportunistic surveys for the koala.

As part of the fauna surveys completed koalas were recorded at two locations (refer to **Figure 3.4**).

4.0 Potential Impacts from Proposed Project

Approximately 199 ha of potential koala habitat was identified in the Project area, however, only 23 to 24 ha of this will be impacted by the Project. Due to the records of likely juvenile male koalas, dispersing from their mothers' home ranges it is considered likely that the Project area provides core koala habitat as described by SEPP 44. The potential impacts of the Project are discussed below.

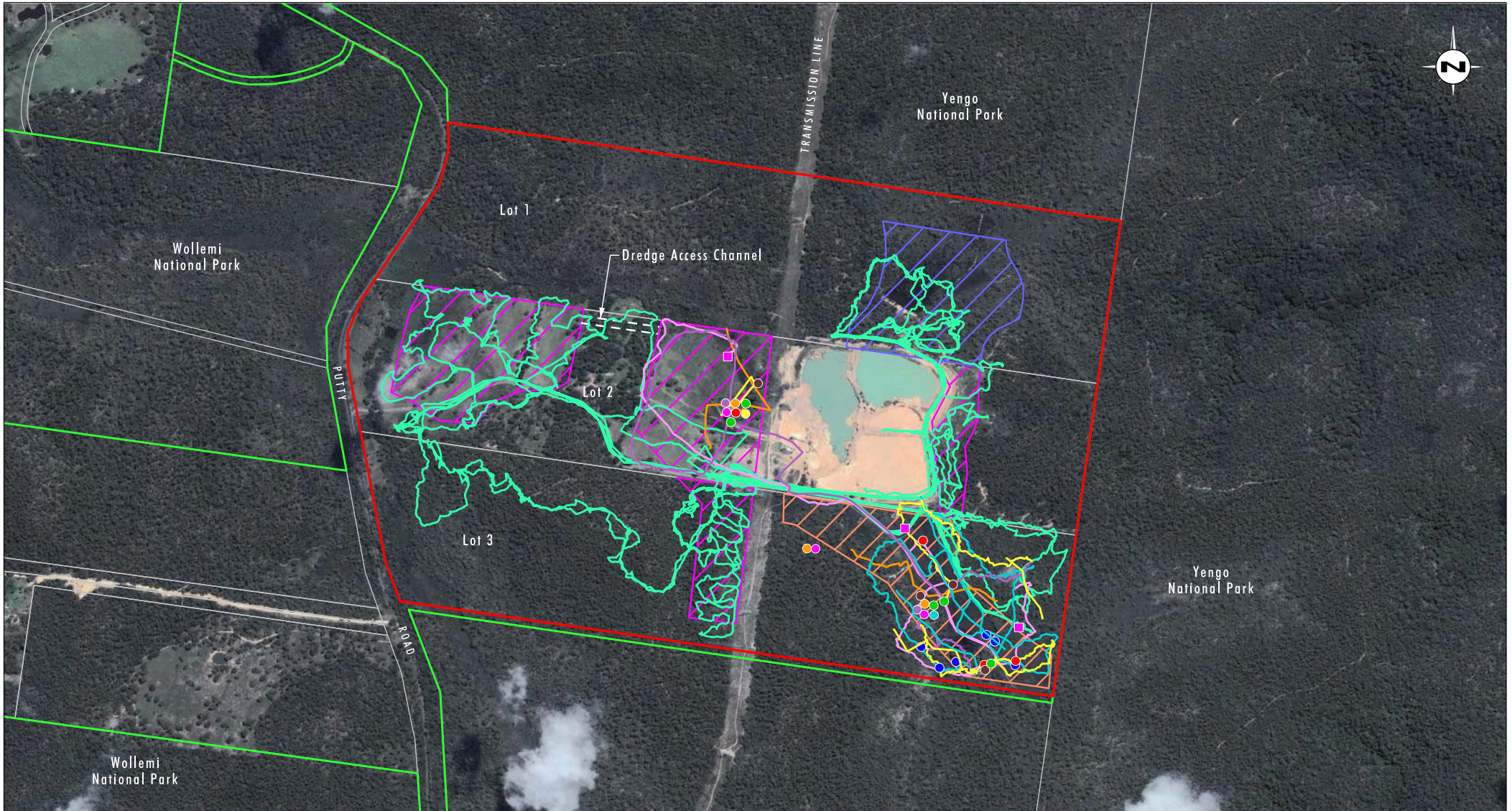
4.1 Increased Traffic, Operational Impacts and Human Interaction

The Project will result in an increase in local traffic flows to and from the quarry site as a result of increased production from up to 125,000 t per year to up to 300,000 t per year. This will be primarily due to increased heavy vehicle movements associated with haulage of extracted materials. Increased vehicular movements may increase localised koala deaths and injuries as a result of vehicle collisions.

Operational impacts that may impact upon the normal behaviour patterns of the koala include lighting and dust. These disturbances may cause areas of habitat to become suboptimal, and cause the koala to vacate such areas.

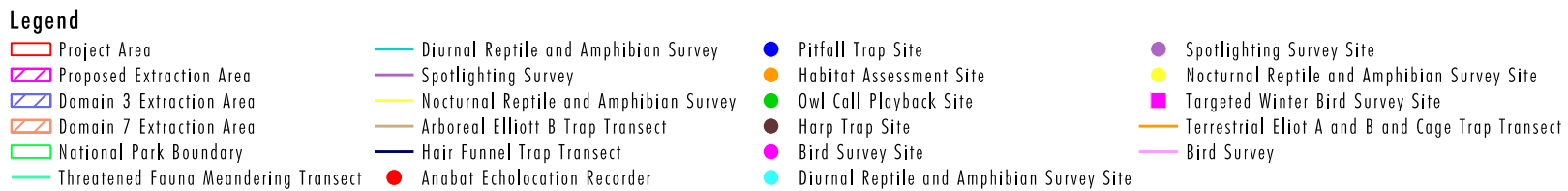
The proposed Project will not require any changes to the existing workforce of 6 to 8. Consequently there are unlikely to be increased levels of human interaction or alterations to normal behaviour patterns due to human presence as a result of this project.

Impacts from these elements as a result of the Project are expected to be minor and the koala is expected to continue to occupy the Project area in co-existence with the expanded quarry. Increased traffic, operational impacts and human interactions are not expected to adversely affect the continued occupation of the Project area by the koala.



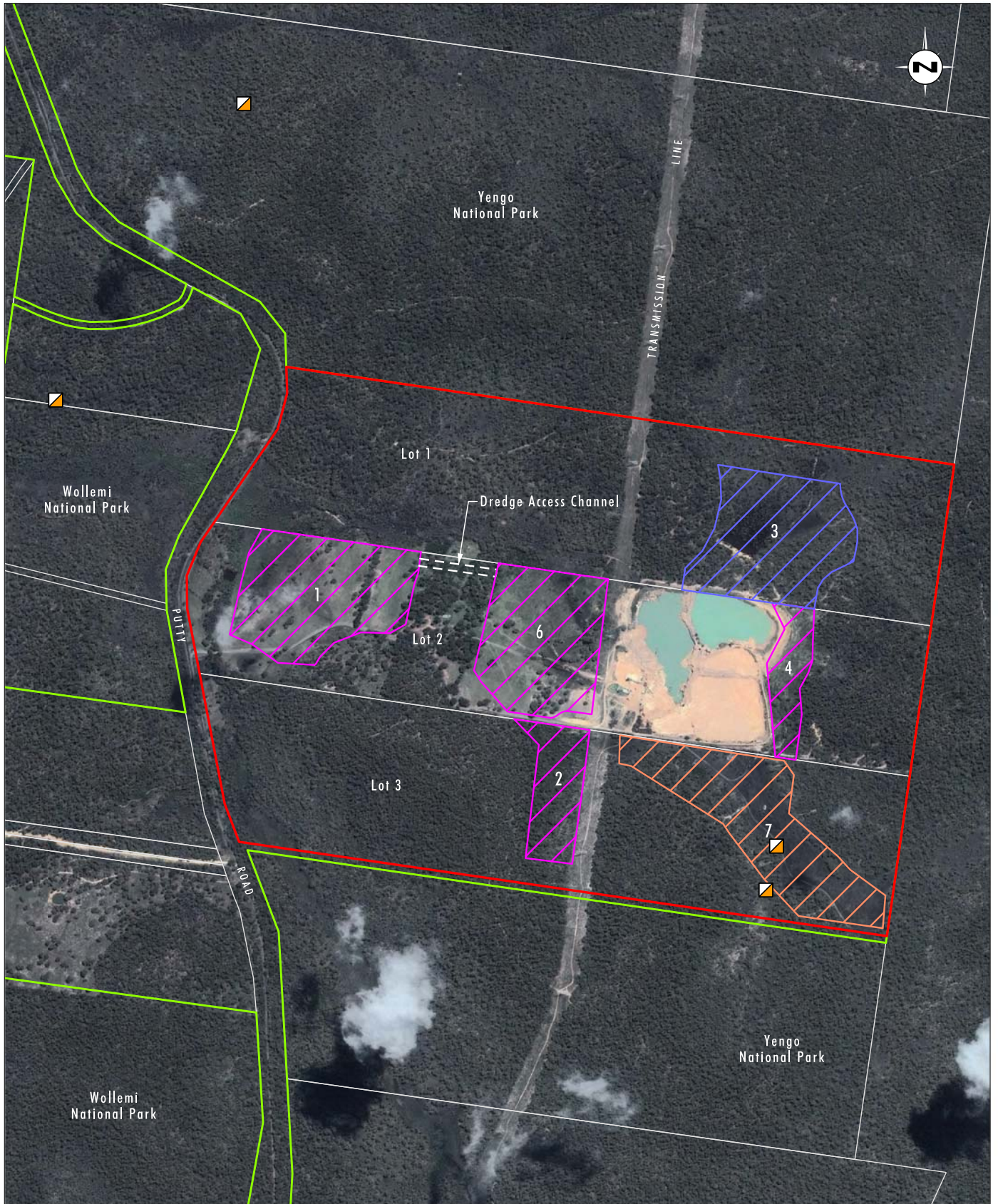
Source: Google Earth (2012), LPI NSW (2007)

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FIGURE 3.3
Fauna Survey Sites



Source: Google Earth (2012), LPI NSW (2007)

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Legend

- ▭ Project Area
- ▨ Proposed Extraction Area
- ▨ Domain 3 Extraction Area
- ▨ Domain 7 Extraction Area
- ▭ National Park Boundary
- ▣ Koala

FIGURE 3.4

Koala Records in the Project Area and Locality

4.2 Noise and Vibration

There are not proposed to be any vibration generating components as a consequence of this Project and noise impacts are not expected to vary significantly from the baseline conditions that have existed at the site during the 25 year operation of the existing quarry.

4.3 Water Management

The proposed surface water management for the Project will be in accordance with current practices and is not expected to substantially impact locally occurring populations of the koala.

As discussed in the main text of the EIS, the Project is not expected to result in adverse impacts to local groundwater aquifers and groundwater dependent ecosystems that are known to provide potential koala habitat will not be adversely impacted as a result of the Project.

4.4 Clearance of Vegetation/Loss of Habitat

The clearing of native vegetation (particularly of koala feed trees) is a major threat facing the koala across its range and the clearing of vegetation will reduce the extent of potential koala habitat by approximately 23 to 24 ha, which represents approximately 13% of the extent of potential koala habitat in the Project area.

4.5 Fragmentation of Potential Koala Habitat

The clearing of vegetation within the Project area will result in a minor increase in the levels of fragmentation of the local area, which is largely contiguous with the adjacent Wollemi and Yengo National Parks. This scale of fragmentation is unlikely to adversely affect the mobility of any koalas occurring within the project area or dispersing from or through the Project area.

4.6 Increased Competition for Resources

The removal of approximately 23 to 24 ha of potential koala habitat will reduce the potential area of occupancy of the koala in the Project area, with a 13% reduction in the area of potential koala habitat predicted. A 13% reduction is not considered likely to adversely affect locally occurring koala individuals through increased competition for resources, including consideration of the ongoing availability of suitable territories and home ranges, mates and other habitat features such as specific feed species and foraging resources within the Project area.

Increased resource competition is not expected to have any significant impacts on any locally occurring populations of the koala due to the very small area of potential habitat that will be removed as a result of the Project.

5.0 Threatening Processes

Koalas are known to be susceptible to a number of identified threatening processes. These are recognised within the Koala Recovery Plan (DECC, 2008) as being (in order of general importance):

- habitat loss and fragmentation;
- habitat degradation;
- road kills;
- dog attacks;
- fire;
- logging;
- disease;
- severe weather conditions;
- swimming pools; and
- overbrowsing.

There are currently 37 key threatening processes listed under the TSC Act. Of these, the following have the koala specifically listed as being potentially affected:

- forest eucalypt dieback associated with over-abundant psyllids and bell miners;
- clearing of native vegetation;
- invasion, establishment and spread of *Lantana camara*;
- predation and hybridisation of feral dogs (*Canis lupus familiaris*);
- anthropogenic climate change;
- high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition;
- infection of native plants by *Phytophthora cinnamomi*;
- predation by the European red fox (*Vulpes vulpes*);
- predation by the feral cat (*Felis catus*); and
- removal of dead wood and dead trees.

The Project is expected to have a minor impact on the exposure of the koala to the key threatening process of *clearing of native vegetation*. It is not expected that the Project will exacerbate any of the other three key threatening processes that are known to adversely affect the koala.

The proposed Project is not likely to increase the current exposure of the koala in the Project area to the above key threatening processes.

6.0 Management Strategies

6.1 Impact Amelioration and Management Measures

Hy-Tec has sought to avoid and minimise potential impacts on the ecological values of the Project area throughout the project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities and fauna habitats. These avoidance measures are described in detail in **Section 5.1** of the Ecological Assessment.

Hy-Tec has committed to the design and implementation of a comprehensive strategy to mitigate the adverse impacts of the Project on the koala. Further to this, a comprehensive biodiversity offset strategy has been developed, which includes the protection and enhancement of native vegetation and threatened species habitat, to develop a positive long-term outcome for the threatened species and key ecological features affected by the Project, including the koala. The proposed biodiversity offset strategy is documented in **Section 7.0** of the Ecological Assessment.

6.2 Tree Felling Procedure

A robust tree felling procedure will be implemented at Tinda Creek Quarry to minimise the potential for impacts on koalas as a result of the clearing of habitat trees. The procedure includes a visual canopy inspection of all trees to be removed by suitably experienced and licensed ecologist on the day of felling to ensure that the koala is not present in the canopy and that koalas are not injured during vegetation clearing.

It is expected that the tree felling procedure for the koala would be undertaken in conjunction with the tree felling procedure detailed in Section 6.2 of the Ecological Assessment which relates to hollow-dependent fauna in addition to the koala.

All personnel who will capture/handle/house and/or transport native fauna species (injured or uninjured) will be appropriately licensed under the requirements of the NSW Animal Ethics Committee.

6.3 Increased Traffic, Operational Impacts and Human Interaction

To reduce potential impacts as a result of operational activities, increased traffic levels and human interaction it is recommended that 'Koala Warning' signs and 'Injured Native Wildlife' signs be installed in appropriate locations as a reminder to take care when driving on site. This should also be enhanced by an enforced on-site speed limit of 20 km/h to ensure adequate reaction time for drivers of vehicles in the event that a koala is encountered.

A minimum 40 m wide undisturbed buffer between the quarry and adjacent properties will also be maintained to ensure the prevention of impacts on surrounding National Parks and consequently surrounding koala habitat.

All staff members in the Project area will need to be educated about the presence of koalas as well as what they should do in the event of encountering an injured koala. This will include the need for readily available contact numbers for any koala carers or animal care groups.

6.4 Biodiversity Offset Strategy

A biodiversity offset strategy has been developed in consultation with DP&E, OEH, Department of the Environment and other relevant stakeholders. The development of this offset area will ensure that land bordering Yengo National Park is preserved in perpetuity and consequently that koala habitat in the Project area is maintained in the long term.

6.5 Rehabilitation

The aim of the rehabilitation of the proposed disturbance area will be to re-establish those vegetation communities and fauna habitats currently recorded and connect, as far as practicable, the habitat areas to the north and south of the proposed disturbance area with a vegetated corridor. A range of criteria relating to biodiversity issues has been developed to direct the rehabilitation activities. Rehabilitation biodiversity objectives will be used in rehabilitation planning, and will:

- comprise a sustainable final landform and use that can co-exist with surrounding land uses;
- re-establish vegetation consistent with extant vegetation communities of the proposed disturbance area within the post-mining landform; and
- re-establish fauna habitats consistent with extant fauna habitats of the proposed disturbance area within the post-mining landform.

Rehabilitation will be conducted progressively over the life of the quarry, as an integral component of quarry operations. All rehabilitation works will be scheduled to commence as soon as practicable after disturbance and reformation of the landscape. This approach will minimise the disturbed area at any point in time and hence reduce the ecological impact of the Project.

The post-mining areas will be progressively rehabilitated to self-sustaining native vegetation communities, in accordance with a rehabilitation strategy. Consideration will be given to the re-establishment of known koala feed trees that occur as dominant and sub-dominant canopy species. Rehabilitation works will use local provenance endemic species (for native communities), where practicable, including consideration of seed availability.

6.6 Protection of Surrounding Areas of Core Habitat

A minimum 40 m buffer zone is proposed between Yengo National Park and proposed disturbed areas. The minimum 40 m buffer zone will not be fenced on the National Park side of the buffer to prevent the creation of an impediment to wildlife from moving into the quarry area.

7.0 Monitoring, Review and Reporting

7.1 Monitoring Program

A koala habitat monitoring program will be implemented by Hy-Tec to assess the ongoing implementation of the KPoM and the success of impact mitigation measures. The monitoring program will include one survey prior to quarrying (to provide baseline data), and a minimum of three post-quarrying surveys (at three months, and then at 12 months and 24 months post-quarrying). The objectives of the monitoring program will be to identify any potential adverse impacts (i.e. on potential koala habitat and on the presence of koalas) caused by the quarry.

The results of all monitoring programs will be reported to the relevant stakeholders as detailed in **Section 7.2**.

7.1.1 Criteria

A range of criteria have been established to determine whether the objectives of this KPoM have been met (refer to **Section 1.3**) and also to identify the effectiveness of the management strategies outlined in **Section 6**. The criteria include:

- no koalas will be harmed as a result of any tree-clearing practices that take place as a result of this Project; and
- potential quarry-induced impacts will not result in the alteration to the floristics, structure or condition of non-cleared areas of potential koala habitat.

An assessment of performance against these criteria will be reported to relevant stakeholders as detailed in **Section 7.2**.

7.2 Reporting

Results from the koala habitat monitoring program, including an assessment against the criteria outlined in **Section 7.1.1**, will be reported annually in the Hy-Tec Annual Environmental Management Report (AEMR). The AEMR will also include information on the effectiveness of any mitigation measures implemented during the reporting period.

7.3 Review

This KPoM is to be reviewed at least every five years or earlier as required. The review will be conducted in consultation with Hawkesbury City Council and NSW P&I and will reflect any identified changes to the core koala habitat or changes to the predicted impacts or mitigation measures identified in this KPoM.

8.0 Conclusions

The Project area contains approximately 199 ha of potential habitat for the koala, which has been identified as core koala habitat as defined under SEPP 44. This was identified as core koala habitat not because of the presence of identified SEPP 44 preferred koala feed trees but due to the presence of koalas in the Project area and adjacent national parks.

Approximately 23 to 24 ha of potential habitat for the koala will be removed as a result of the Project, however the Project is not expected to have an adverse impact on the local koala population and the mitigation measures identified in **Section 6.0** of this KPoM have been developed to reduce the level of impact on this species. A detailed koala habitat monitoring program has been established to measure whether the Project is having an adverse impact on the koala, and to determine whether the prediction of no adverse impact on the habitat of the koala in the Project area are realised.

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