APPENDIX E

Biodiversity Assessment Report

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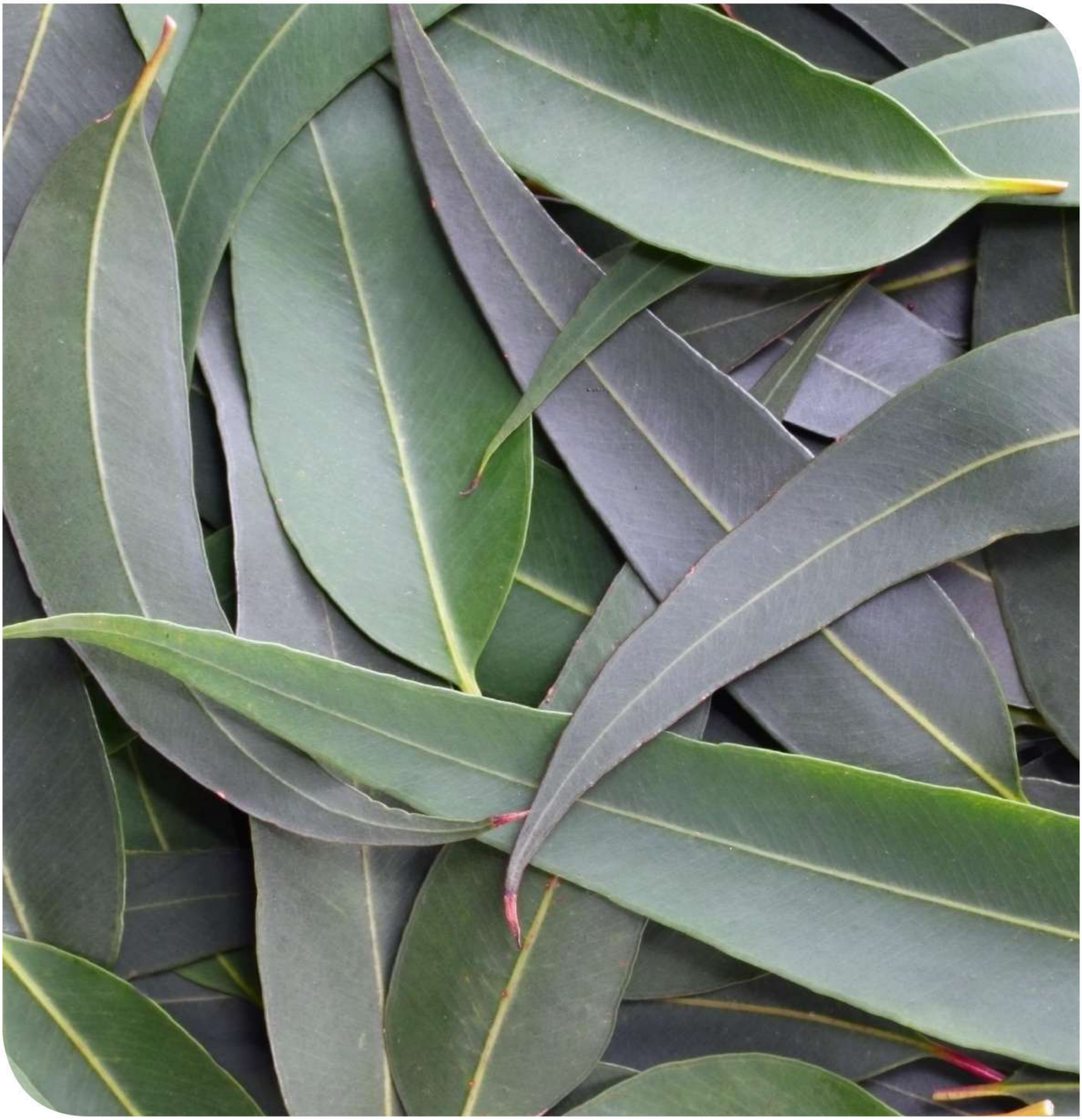
Tahmoor South Project

Biodiversity Assessment Report of the Amended Project

Prepared for SIMEC Mining - Tahmoor Coal Pty Ltd. | 12 February 2020



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Project number	Client	Project manager	LGA
5315	Tahmoor Coal Pty Ltd	Amanda Griffith	Wollondilly LGA

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Enquiries should be addressed to:

Sydney Head Office
Niche Environment and Heritage
02 9630 5658
info@niche-eh.com
PO Box 2443 North Parramatta
NSW 1750 Australia

Executive summary

Context

Tahmoor Coal is seeking development consent for the continuation of mining at Tahmoor Mine, extending underground operations and associated infrastructure south, within the Bargo area. The proposed development seeks to extend the life of underground mining at Tahmoor Mine for an additional 13 years until approximately 2035.

In accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act), an Environmental Impact Statement (EIS) was prepared to assess the potential environmental, economic and social impacts of the Project. The EIS for the Project was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) (formerly the Department of Planning and Environment (DPE)) from 23 January 2019 to 5 March 2019.

Key issues raised in submissions included concerns relating to the proposed extent of longwall mining, the magnitude of subsidence impacts and the extent of vegetation clearing required for the expansion of the reject emplacement area (REA). In response to these and other issues raised in Government agency, local Council, stakeholder and community submissions, and as a result of ongoing mine planning, several amendments have been made to the proposed development, so as to also further reduce the predicted environmental impacts of the Tahmoor South Project.

The key amendments to the Project since public exhibition of the EIS are:

- A revised mine plan, including:
    - an amended longwall panel layout and the removal of LW109;
    - a reduction in the height of extraction within the longwall panels from up to 2.85 metres (m) to up to 2.6 m; and
    - a reduction in the proposed longwall width, from up to 305 m to approximately 285 m.
- A reduction in the total amount of Run-of-Mine (ROM) coal to be extracted over the Project life, from approximately 48 million tonnes (Mt) to approximately 43 Mt of ROM coal, comprising;
    - 30 Mt of coking coal product (reduced from 35 Mt);
    - 2 Mt of thermal coal product (reduced from 3.5 Mt)
- A revised extended REA; including:
    - a reduction in the additional capacity required to accommodate the Project;
    - a reduction in the REA extension footprint, from 43 ha to 11.06 ha;
    - an increase in the final height of the REA (from RL 305 m to RL 310 m).
- Confirmation of the location and footprint of ancillary infrastructure associated with the ventilation shaft sites (e.g. the power connection easement for ventilation shaft site TSC1); and
- A continuation of the use of the existing upcast shaft (T2); although, operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

No amendments have been made to other key aspects of the Project as presented in the EIS for which approval is sought, such as the proposed annual coal extraction rate, mining method, traffic movements and employee numbers. A detailed description of the amended development is provided in the Amended Project Report (AECOM 2020).

In relation to biodiversity, the key change to the project is the reduction in area of the proposed extension of the REA. The project amendments have reduced the predicted impacts to biodiversity as follows:

- Shale Sandstone transition Forest: reduced clearing from 43.4 hectares to 23.57 hectares (approximate 46% reduction);
- *Persoonia bargoensis*: avoided removal of 96 to eight individuals;
- *Grevillea parviflora* subsp. *parviflora*: avoided removal of 2,324 to 491 individuals;
- *Pomaderris brunnea*: avoided removal of approximately 40 to 1 individual.

Given the changes in disturbance footprint and reduced impacts, an update of the Niche (2018) Tahmoor South Biodiversity Assessment Report has been prepared in this document. The biodiversity impacts associated with the Project have been assessed under the *Framework for Biodiversity Assessment - NSW Biodiversity Offsets Policy for Major Projects* (FBA) (OEH 2014), in accordance with the savings and transitional arrangements provided under the NSW *Biodiversity Conservation Act 2016* (BC Act).

This Biodiversity Assessment Report (BAR) uses the methodology provided in the FBA to describe and assess the ecological values within the Study Area and surrounds and determine how the Project is likely to impact on threatened biodiversity listed under the BC Act and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report addresses the Secretary's Environmental Assessment Requirements (SEARs) as well as submissions from NSW Office of Environment and Heritage, Wollondilly Shire Council, Wingecarribee Shire Council and the Independent Scientific Expert Committee on the publicly exhibited EIS, and identifies avoidance, mitigation and offsets for the Project. Revision of the Project footprint in response to submissions received has resulted in a reduction in impacts to native vegetation and threatened biodiversity.

The assessment has utilised the findings of other specialist studies including that of MSEC (2020) in regards to subsidence predictions associated with the Project.

Study Area

The Study Area is approximately 2,156 hectares (ha) in size and includes:

- The extent of the proposed surface infrastructure including two ventilation shaft sites, powerline and REA;
- The area within the predicted 20mm subsidence contour.

37.77 ha of native vegetation (including 14.2 ha of rehabilitated land) would be cleared for the surface infrastructure.

Subsidence impacts are predicted by MSEC (2020) to occur within the 20 mm subsidence contour, and as such, we have utilised this area and the details within the MSEC (2020) for our impact assessment.

Survey effort

The Study Area, and wider Project Area has been the subject of extensive targeted threatened biodiversity survey since 2012, with the most recent survey completed in September 2019. Survey effort has concentrated on areas directly impacted by clearing associated with the surface infrastructure, and natural features that may be susceptible to subsidence related impacts i.e. watercourses and cliff lines.

Native vegetation assessment

Validation of vegetation mapping (Tozer et al. 2006 and OEH 2013) was undertaken within areas to be cleared for the proposed for surface infrastructure and confirmed the presence of the following Plant Community Types (PCTs):

- PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (HN556);
- PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).

PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) corresponds to Shale Sandstone Transition Forest, which is listed as a Threatened Ecological Community (TEC) under both the BC Act and EPBC Act.

Threatened flora

Forty-seven threatened flora species have been recorded or have potential habitat within 10 km of the Study Area. Seven threatened flora were recorded in the Study Area and immediate surrounds. These were: *Acacia bynoeana* (recorded outside of Study Area)*, Epacris purpurascens* var. *purpurascens, Grevillea parviflora* subsp. *parviflora, Persoonia hirsuta, Persoonia glaucescens* var*. glaucescens, Persoonia bargoensis,* and *Pomaderris brunnea.* Three species (*Grevillea parviflora* subsp*. parviflora, Persoonia bargoensis* and *Pomaderris brunnea)* were recorded in the area proposed for surface infrastructure.

Threatened fauna

Seventy-four threatened fauna have been recorded or are predicted to occur within 10 km of the Study Area. Of those listed under the BC Act, 18 are regarded as 'species credit species' (noting 12 are 'dual credit' species) which unlike 'ecosystem credit species' cannot be predicted by habitat surrogates.

Twelve threatened fauna species listed on the BC Act and/or EPBC Acts were recorded within the Study Area or immediately adjacent. These included: Glossy Black Cockatoo, Little Eagle, Powerful Owl, Scarlet Robin, Sooty Owl, Varied Sittella, Eastern Bentwing Bat, Eastern Free-tail Bat, Large-footed Myotis, Eastern Cave Bat, Eastern False Pipistrelle and Red-crowned Toadlet.

Impacts - Vegetation

The main impact on biodiversity associated with the Project is clearing of native vegetation and removal of habitat for the surface infrastructure. A total of 37.77 ha of native vegetation made up of the following will be removed consisting of:

- 14.2 ha of rehabilitated land
- 23.57 ha of the TEC Shale Sandstone Transition Forest (PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)) including 17.26 hectares in good condition, and 6.31 ha in derived native grassland condition.

Subsidence has the potential to result in gas emissions along watercourses, and changes to hydrology, which could result in localised temporary impacts to native vegetation. However, based on subsidence predictions by MSEC (2020) and supported by previous events in the Southern Coalfield, the likelihood for such an event to occur and result in detrimental change to native vegetation is highly unlikely.

For the most part, the native vegetation of the Study Area consists of open woodland and forest habitat types, that are highly unlikely to be impacted by subsidence. Furthermore, no Coastal Upland Swamps or Groundwater Dependant Ecosystems were recorded within the Study Area.

An offset for the impact to the PCTs impacted by the vegetation clearing has been calculated in accordance with the FBA.

An Assessment of Significance under the EPBC Act has also been completed for the impact on Shale Sandstone Transition Forest, which concluded the Project is likely to significantly impact the TEC. As such, an offset for the Commonwealth listed Shale Sandstone Transition Forest is proposed.

Impacts – Threatened flora

The clearing of native vegetation for the surface infrastructure would result in an impact to the following threatened flora:

Threatened flora	No. impacted in Niche (2018) Tahmoor South Project (EIS)	No. impacted for the Amended Project
Persoonia bargoensis	96	8
Grevillea parviflora subsp. *parviflora*	2,324	491
Pomaderris brunena	40	1

Assessments of Significance under the EPBC Act were completed for these species. The assessments concluded that the Project is unlikely to result in a significant impact to *Persoonia bargoensis, Grevillea parviflora* subsp. *parviflora*, and *Pomaderris brunnea* given the relatively large size of the known populations within the locality that would not be impacted by the Project. Regardless of the conclusions, it should be noted that an offset in accordance with the FBA has been provided in this assessment for the impact to each of these threatened flora to satisfy the NSW offset requirement. It should be noted that the Niche (2018) Tahmoor South Project Biodiversity Assessment Report concluded that a significant impact to *Persoonia bargoensis* was likely given the removal of 96 individuals, which have now been largely avoided.

An additional three species (*Acacia bynoeana, Persoonia glaucescens* and *Persoonia hirsuta)* listed under the EPBC Act have been recorded in the Study Area. An Assessment of Significance concluded that impacts to these species were unlikely, as they were considered not to be present in the surface infrastructure area and unlikely to be impacted by subsidence.

Impacts – Threatened fauna

Thirty-four threatened and migratory fauna have been attributed a moderate or higher likelihood of occurrence within the Study Area. The majority of these species are highly mobile species (such as threatened birds and microbats) that are likely to use the Study Area on an intermittent basis and would not be solely dependent upon the habitat features within the area to be disturbed by the surface infrastructure works.

Of these species, five species credit fauna were recorded or identified with the potential to occur in the Study Area: Large-eared Pied Bat, Large-footed Myotis, Eastern Cave Bat, Koala and Eastern Pygmy-possum.

The Red-crowned Toadlet was recorded outside of the Study Area along Hornes Creek. The species has been attributed a low-moderate likelihood of occurrence within the Study Area based on potential habitat.

The Koala, Large-eared Pied Bat and Eastern Pygmy-possum were not recorded in the Study Area but have been assumed present based on the presence of suitable habitat and records within the locality. The

Project was considered likely to impact on potential habitat for these species and offsets for the removal of 17.26 ha of potential foraging and nesting habitat within the surface infrastructure have been provided.

Large-footed Myotis was recorded within the surface infrastructure area. Impacts to 17.26 ha of habitat as a result of the Project has been proposed for this species.

In relation to EPBC Act listed threatened fauna, the Project was determined to potentially impact habitat associated with the following species: Fork-tailed Swift, Great Egret, Cattle Egret and Rainbow Bee-eater, Satin Flycatcher, Swift Parrot, Large-eared Pied Bat, Grey-headed Flying Fox, Koala, and Greater Glider. An EPBC Act Assessment of Significance for each of these species has been completed and concluded that a significant impact to any EPBC Act listed threatened fauna is unlikely.

Avoidance and minimisation

Site selection for the Project has been dictated by the existing REA and supporting infrastructure within the development consent boundary. A detailed assessment of avoidance, and Project justification has been provided in section 7, which in summary, concludes the follow key avoidance/minimisation measures in project design and implementation, as described in the biodiversity assessment prepared for the EIS Niche (2018):

- The longwalls in the north of the Study Area have been designed to stand back from the Bargo River and Nepean River. This design maximises the protection of the natural features within these rivers and reduces any potential for the Project to impact the biodiversity values associated with those two rivers.
- The longwalls in the south of the Study Area have been re-designed to stand back from the Nepean State Conservation Area and avoid impacts to Cow Creek. This avoids impacts to the Giant Burrowing Frog which was recorded during field surveys along Cow Creek.
- The longwalls originally proposed in what was called the 'Eastern Domain' have been removed from the Project.

In addition to the above measures, further avoidance and mitigation measures have been incorporated into the Project, resulting in the amended project design. These measures include the following:

- The REA was redesigned to minimise the potential impacts on Shale Sandstone Transition Forest TEC. The proposed additional disturbance associated with the REA has been reduced from 43 ha to 11 ha, primarily through increasing the height of the REA. The overall amount of Shale Sandstone Transition Forest to be cleared has been reduced by 43.5 hectares to 23.57 hectares (approximate 46% reduction);
- The redesign of the REA has avoided a significant impact under the EPBC Act for *Persoonia bargoensis*, by avoiding the removal of approximately 96 individuals of a known population; and
- A core population *of Grevillea parviflora* subsp. *parviflora* and *Pomaderris brunnea* has largely been avoided.

Mitigation and management

The Project will reduce impacts to biodiversity through:

- Implementation of a Biodiversity and Subsidence Management Plan with active monitoring;
- All surface infrastructure areas would be progressively rehabilitated in accordance with the SLR (2020) Rehabilitation and Closure Strategy, to create a stable landform that does not result in sediment laden runoff or fugitive dust emissions, blends well with the adjacent natural landscapes and re-establishes a native bushland;
- Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing;

- Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with threatened species - e.g. speed limits along access roads to reduce potential for fauna vehicle strikes;
- Update of the existing Tahmoor Coal Bushfire Management Plan;
- Dust suppression;
- Procedures for the management of spills throughout the Study Area including the requirements for vehicles to carry spill kits;
- Management and removal of all rubbish from the Study Area.

Credit calculations

Using the process specified in the FBA, the offset liability was determined in terms of 'ecosystem' credits and 'species credits'. We have concluded that the Project would require the following credit offset liability:

Threatened species	Area/ No. impacted	Credits required
Shale Sandstone Transition Forest /PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	23.57	1,084
Native mine rehabilitation/ PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).	14.20	398
Persoonia bargoensis	8	616
Grevillea parviflora subsp. *parviflora*	491	6,874
Pomaderris brunnea	1	15
Large-footed Myotis	17.26 ha	380
Koala	17.26 ha	449
Large-eared Pied Bat	17.26 ha	224
Eastern Cave Bat	17.26 ha	224
Eastern Pygmy Possum	17.26 ha	345

Offsets required for MNES significantly impacted by the Project include Shale Sandstone Transition Forest TEC. No other threatened biodiversity listed under the EPBC Act are likely to be significantly impacted by the Project.

Offset Strategy

Tahmoor Coal propose a three-stage offset approach spanning over a 4+ year period, as not all the surface infrastructure would be cleared in the first year.

Following Project approval, the following tasks would be completed by Tahmoor Coal:

1. Formal establishment of the proposed Stewardship Sites (this includes detailed surveys, reporting management plan etc. as per the requirements of the BAM).
2. Retirement of the required credits generated from the Stewardship Sites.
3. Purchase and retire credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) which are available on the public register. Note that the credits purchased to satisfy the Shale Sandstone Transition Forest requirement would meet the EPBC listing criteria.

4. Payment into the BCT Fund for outstanding PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).
5. Purchase/establish Stewardship Sites within landholdings that contain PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556).

Glossary and list of abbreviations

Term or abbreviation	Definition
Cumulative impacts	Combination of individual effects of the same kind due to multiple actions from various sources over time.
Direct impacts	Those that directly affect habitat and individuals of a species, population or ecological community. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. In the context of the Project, direct impacts will result in the direct removal of 37.77 hectares of native vegetation.
Habitat critical to survival (EPBC Act)	'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community. Such habitat may be but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.
Indirect impacts	Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas.
Local population:	The population that occurs in the Study Area. The assessment of the local population may be extended to include individuals beyond the Study Area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the Study Area, according to the following definitions. The local population of a threatened plant species comprises those individuals occurring in the Study Area or the cluster of individuals that extend into habitat adjoining and contiguous with the Study Area that could reasonably be expected to be cross-pollinating with those in the Study Area. The local population of resident fauna comprises those individuals known or likely to occur in the Study Area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the Study Area. The local population of migratory or nomadic fauna comprises those individuals that are likely to occur in the Study Area from time to time.
Study Area	The area contained within the 20 mm predicted subsidence zone, and all proposed surface infrastructure. It encompasses the area of direct and indirect impact.
Subject site:	Means the area directly affected by the Tahmoor South Project.
Threatened ecological community (TEC)	An ecological community identified by the NSW *Biodiversity Conservation Act 2016* (BC Act) or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as critically endangered, endangered or vulnerable.

Acronym	Term/Definition
BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BBCC	BioBanking Credit Calculator
BC Act	Biodiversity Conservation Act
BMP	Biodiversity Management Plan
CAMBA	China-Australia Migratory Bird Agreement
CMA	Catchment Management Authority
CEEC	Critically Endangered Ecological Community
Dbh	Diameter at breast height
DoEE	Commonwealth Department of Environment and Energy
DPIE	Department of Planning, Industry and Environment
FBA	Framework for Biodiversity Assessment
EEC	Endangered Ecological Community
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
FBA	Framework for Biodiversity Assessment
Ha	Hectare/s
IBRA	Interim Biogeographic Regionalisation for Australia
JAMBA	Japan-Australia Migratory Bird Agreement
Km	Kilometre
KTP	Key Threatening Process
LGA	Local Government Area
Mm	Millimetre
MNES	Matters of National Environmental Significance (from the Commonwealth Environment Protection and Biodiversity Conservation Act 1999).
NPWS	National Parks and Wildlife Service
OEH	Office of Environment and Heritage (formerly DECCW, DECC, DEC)
PCT	Plant Community Type
REF	Review of Environmental Factors
RoKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 44	State Environmental Planning Policy 44 – Koala Habitat Protection
SSTF	Shale Sandstone Transition Forest
TEC	Threatened Ecological Community

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1. Introduction

1.1 Overview

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an underground coal mine between the townships of Tahmoor and Bargo, approximately 80 km south-west of Sydney in the Southern Coalfields of NSW. Tahmoor Mine produces up to 3 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal (Figure 1).

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- A revised mine plan, including:
    - an amended longwall panel layout and the removal of LW109;
    - a reduction in the height of extraction within the longwall panels from up to 2.85 metres (m) to up to 2.6 m; and
    - a reduction in the proposed longwall width, from up to 305 m to approximately 285 m.
- A reduction in the total amount of Run-of-Mine (ROM) coal to be extracted over the Project life, from approximately 48 million tonnes (Mt) to approximately 43 Mt of ROM coal, comprising;
    - 30 Mt of coking coal product (reduced from 35 Mt);
    - 2 Mt of thermal coal product (reduced from 3.5 Mt)
- A revised extended REA; including:
    - a reduction in the additional capacity required to accommodate the Project;
    - a reduction in the REA extension footprint, from 43 ha to 11.06 ha;
    - an increase in the final height of the REA (from RL 305 m to RL 310 m).
- Confirmation of the location and footprint of ancillary infrastructure associated with the ventilation shaft sites (e.g. the power connection easement for ventilation shaft site TSC1); and
- A continuation of the use of the existing upcast shaft (T2); although, operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

No amendments have been made to other key aspects of the Project as presented in the EIS for which approval is sought, such as the proposed annual coal extraction rate, mining method, traffic movements and employee numbers. A detailed description of the amended development is provided in the Amended Project Report (AECOM 2020).

In relation to biodiversity, the key change to the project is the reduction in area of the proposed extension of the REA. The project amendments have reduced the predicted impacts to biodiversity as follows:

- Shale Sandstone transition Forest: reduced clearing from 43.4 hectares to 23.57 hectares (approximate 46% reduction);
- *Persoonia bargoensis*: avoided removal of 96 to eight individuals;
- *Grevillea parviflora* subsp. *parviflora*: avoided removal of 2,324 to 491 individuals;
- *Pomaderris brunnea*: avoided removal of approximately 40 to 1 individual.

1.2 Purpose of this report

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Tahmoor Coal to assess the ecological values and impacts associated with the Tahmoor South Project and provide a Biodiversity Assessment Report. This Biodiversity Assessment Report has been prepared to assess the impacts of the amended Project on biodiversity (the Project). The assessment considers and outlines the differences in impacts compared to the original project as presented in the EIS. In this way, it serves as an update to the Biodiversity Assessment Report (Niche 2018) submitted to the DPIE on the 23 January 2019.

This Biodiversity Assessment Report has been completed according to the requirements of the *Framework for Biodiversity Assessment - NSW Biodiversity Offsets Policy for Major Projects* (FBA) (OEH 2014) in accordance with the transitional arrangements provided under the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (BC Regulation). Further detail on recent changes to NSW environmental legislation and the applicable transitional arrangements that relate to the approval and assessment process for this Project are provided in section 2.1. This report also addresses the Secretary's Environmental Assessment Requirements (SEARs), and identifies avoidance, mitigation and offsets for the Project.

1.3 The Project

The amended development (The Project) would use longwall mining to extract coal from the Bulli seam within the bounds of CCL716 and CCL747. Coal extraction of up to four (4) million tonnes of ROM coal per annum is proposed as part of the development with extraction of up to 43 Mt of ROM coal over the life of the Project. The project would produce approximately:

- 30 Mt coking coal product;
- 2 Mt thermal coal product; and
- 12 Mt of rejects.

These approximate market mix volumes include moisture and are therefore an estimate only. Once the coal has been extracted and brought to the surface, it would be processed at Tahmoor Mine's existing CHPP and coal clearance facilities, and then transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla and Newcastle (from time to time) for Australian and international markets. Up to 200,000 tonnes per annum of either product coal or reject material is proposed to be transported to customers via road.

The amended development would use the existing surface infrastructure at the Tahmoor Mine surface facilities area. Some upgrades are proposed to facilitate the extension.

The amended development also incorporates the planning for rehabilitation and mine closure once mining ceases.

In summary, the key components of the amended development comprise:

- Longwall mining in the Central Domain;
- Mine development including underground development, vent shaft construction, pre-gas drainage and service connection;
- Upgrades to the existing surface facilities area including:
    - Upgrades to the CHPP;
    - Expansion of the existing REA;
    - Additions to the existing bathhouses and associated access ways; and
    - Upgrades to onsite and offsite service infrastructure, including electrical;
- Rail transport of product coal to Port Kembla and Newcastle (from time to time);
- Up to 200,000 tonnes per annum of either product coal or reject material is proposed to be transported to customers via road;
- Mine closure and rehabilitation; and
- Environmental management.

The components of the Project and Tahmoor South Project are listed above, and those relevant to the biodiversity assessment are shown on Figure 2 and Figure 3.

1.4 Proposed operations relevant to the terrestrial ecology impact assessment

1.4.1 Underground mining

Mining Area

Tahmoor Coal holds CCL 747 and CCL 716, within which coal will be mined from the Bulli seam as part of the Project.

The Project seeks to undertake longwall mining of the Bulli seam within the Central Domain, at a depth of between approximately 375 metres and 430 metres below ground level.

During the mine planning process, a constraints analysis, risk assessment and preliminary fieldwork were undertaken to identify sensitive natural surface features (such as waterways, cliffs, and Aboriginal heritage sites) and to develop RMZs. Subsequent to the risk assessment, the proposed longwall layout was modified to minimise significant subsidence impacts to these natural features.

As described above, following submission and public exhibition of the EIS, further amendments were made to the proposed longwall layout, including removing LW109 and reducing the longwalls width and cut height.

The amended proposed extent of longwall panels is shown on Figure 2, which defines the maximum extent of the footprint of the proposed longwall mining and consists of both first (roadways) and secondary (longwall) workings. The Subsidence Study Area encompasses the area of investigation of specialist studies as part of the Project. It has been provided on the figures for this Biodiversity Assessment to provide context.

The extent of longwalls provides for some flexibility for changes to mining development work and longwall layout during detailed design, subject to geological conditions. It is proposed that minor changes to the layout would be approved under the Extraction Plan (EP) approval process. The final detailed design of the longwall layouts would be subject to review and approval in consultation with the relevant authorities and to the satisfaction of the Secretary of the DPIE. Mining operations which are proposed to be undertaken within the area designated as the extent of longwalls include first workings; comprising main headings, gate roads and cut throughs, as well as the development of the longwall panels (secondary workings).

Mine Ventilation

The Project will utilise the existing mine's ventilation system, including the existing three ventilation shafts. Additionally, the Project will require the construction of two additional ventilation shafts to provide a reliable and adequate supply of ventilation air to personnel in the mine.

The Project would make use of three vent shafts currently being used for the operations at Tahmoor North, being one upcast (T2) and two downcast shafts (T1 and T3). The two additional vent shafts proposed for the Tahmoor South Project would be located in the Central Domain as follows:

- TSC1: an upcast ventilation shaft that would be located on Tahmoor Coal's Charlies Point Road property, and
- TSC2: a downcast ventilation shaft that would be located on Crown Land adjacent to Tahmoor Coal's Charlies Point Road property.

The proposed vent shafts are shown on Figure 3.

1.4.2 Upgrading the existing Tahmoor Mine surface facilities

The existing surface facilities and infrastructure at the Tahmoor Mine surface facilities area, operating within surface CCL 716 and Mining Lease 1642, will be utilised for the Project.

Rejects Management

The EIS identified that in order to accommodate the rejects generated by the Project, the existing REA at the mine would require expansion.

Changes to the longwall extent has resulted in a reduction in the estimated volume of rejects to be generated by the Project. In addition, it is proposed that the height of the REA expansion area be increased to RL 310 m to optimise the REA footprint. The rejects disposal method has been selected based on a review of a number of disposal options taking into consideration a number of project objectives, including:

- provide a safe solution, causing no hazards to mine operations and with low impact on mine stability;
- minimise the impact on the environment where possible, including dust emissions, visual impact, groundwater and sub-surface contamination, use of foreign reagents;
- provide an economic solution, with minimal capital and operating cost, returning a positive benefit to cost ratio, providing employment for the local community and minimising the impact on mine production;
- adopt a sound technical solution, utilising proven technology with high availability and reliability, versatility and flexibility;
- provide a solution that will enable the disposal of the total volume of rejects forecast for the Tahmoor South Project.

An investigation of reject disposal options was undertaken by Palaris (2020) (refer to Appendix of the Amended Project Report (AECOM 2020). The adopted expansion of the existing REA takes into consideration a balance of environmental impacts of dust, noise and visual impacts to surrounding properties as well as the impacts to biodiversity.

The preferred disposal strategy consists of an expanded area to the south, using a staged fill plan approach. The REA will be progressively rehabilitated over the life of the mine.

Infrastructure Services Upgrades

The proposed development will utilise a range of infrastructure services including existing offsite electrical, telecommunications and water reticulation infrastructure currently servicing the Tahmoor Mine. Some upgrade to the existing services may be required. In addition, the construction and commissioning of an extension to the existing 66kV overhead power line from the REA along Charlies Point Road to the vent shaft sites will be required.

1.4.3 Rehabilitation and Mine Closure

Rehabilitation of the proposed development will be undertaken using a staged approach comprising:

- progressive rehabilitation of the REA; and
- mine closure and rehabilitation of the surface facilities area and ventilation shafts.

Areas of the REA will be progressively rehabilitated over the life of the Project. This process will involve capping the reject material with topsoil and establishing vegetation. Annual monitoring will be undertaken to determine the success of revegetation and to inform ongoing management of the rehabilitated areas.

There are a number of post mining land use options that may be applicable to the Project including passive recreation, native bushland conservation or employment lands such as light industrial. Currently, it is considered that the likely final land use option for most of the surface areas will be native bushland. However, final land use options will be confirmed in a detailed closure planning process, which involves undertaking a final land use analysis. A detailed closure plan will be developed within five years of mine closure. In broad terms, rehabilitation of the surface facilities area and ventilation shafts will involve:

- removal of infrastructure and services;
- levelling, re-contouring and grading to achieve safely battered slopes and surfaces;
- applying topsoil for rehabilitation where required;
- establishing native bushland vegetation which would require minimal ongoing care and maintenance; and
- monitoring of rehabilitated areas to assess the success and inform the management of areas of re-established vegetation.

Infrastructure and facilities may be retained where compatible with the end land uses which will be identified in the detailed closure planning process

1.4.4 Summary of surface facilities development footprint

Development of the surface infrastructure for the Project will result in vegetation clearing and loss of flora and fauna habitat. Vegetation clearing footprints for the various Project elements are shown in Table 1. The Project will result in the removal of 37.77 ha of native vegetation and fauna habitat. It is also noted that the powerline for the ventilation shafts did not form part of the Project assessed in the EIS, with approval for this powerline proposed to be sought under Part 5 of the EP&A Act. At the time the EIS and associated biodiversity assessment report was completed prior to submission for public exhibition in January 2019, the detailed design of the powerline had not been completed and the exact route was not known.

This powerline has now been included as part of the project for which development consent is sought under Part 4 of the EP&A Act, and has therefore been included in the biodiversity assessment of the amended project.

Table 1. Development footprint for the surface infrastructure applicable to biodiversity

Project element	Native vegetation disturbance (ha)	Native Rehabilitated Vegetation (ha)	Non-native / cleared land (ha)	Total development footprint (ha)
REA	11.06	14.20	41.90	67.16
TSC 1 Ventilation shaft site	6.05	0.00	3.58	9.63
TSC 2 Ventilation shaft site	3.47	0.00	0.01	3.47
Powerline	2.99	0.00	0.85	3.84
Total	**23.57**	**14.20**	**46.34**	**84.10**

1.5 The Study Area

The Study Area for the Biodiversity Assessment Report includes:

- The predicted 20mm Subsidence Area;
- The extent of the proposed REA extension;
- The proposed surface infrastructure including ventilation shaft sites and proposed powerline.

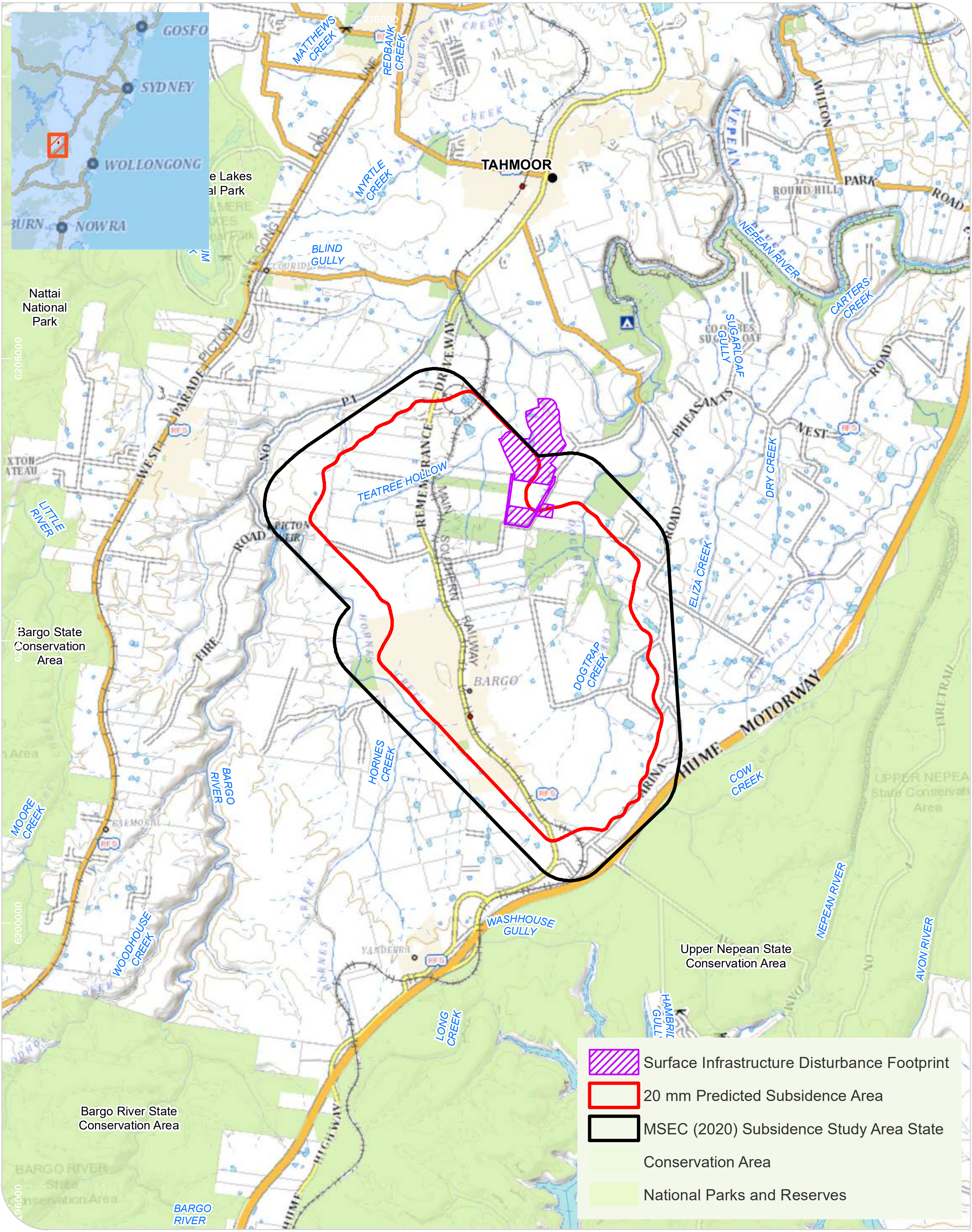
The Study Area is approximately 2,156 ha in size and is shown on Figure 2.

The subject site is defined as the area that will be subject to direct impacts from the Project. A total of 37.77 hectares of native vegetation, which includes 14.20 ha of native mine rehabilitation, occurs in the subject site and would be cleared for the surface infrastructure.

It should be noted that the Study Area for this biodiversity impact assessment does not include the '*Subsidence Study Area'* as shown on Figure 2 and defined in MSEC (2020). The '*Subsidence Study Area*' is the boundary encompassing a minimum of 600 m from the nearest edge of longwalls within the proposed Extent of Longwalls, as recommended in the independent inquiry report titled "Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield – Strategic Review" (NSW Department of Planning, (DoP), 2008). Subsidence impacts are predicted by MSEC (2020) to occur within the 20 mm Subsidence Area, not within the '*Subsidence Study Area*', and as such, we have not utilised the '*Subsidence Study Area*' in this assessment for impact calculations.

Furthermore, it should be noted that the study area does not include areas along Carters Creek, Eliza Creek, Cow Creek and Thirlmere Lakes where baseline water modelling has detected negligible changes in hydrology and surface water flow. Such changes are predicted to be so minor, that is highly unlikely to have any impact on biodiversity. This is discussed further in sections 8.5.5, 8.7 and 8.8 of this assessment.

The locality for the terrestrial ecology assessment incorporates a 10 km radius around the Study Area detailed above. The locality represents the area within which database searches (detailed in section 3) are extended.



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Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Locality overview
Tahmoor South Project

Figure 1

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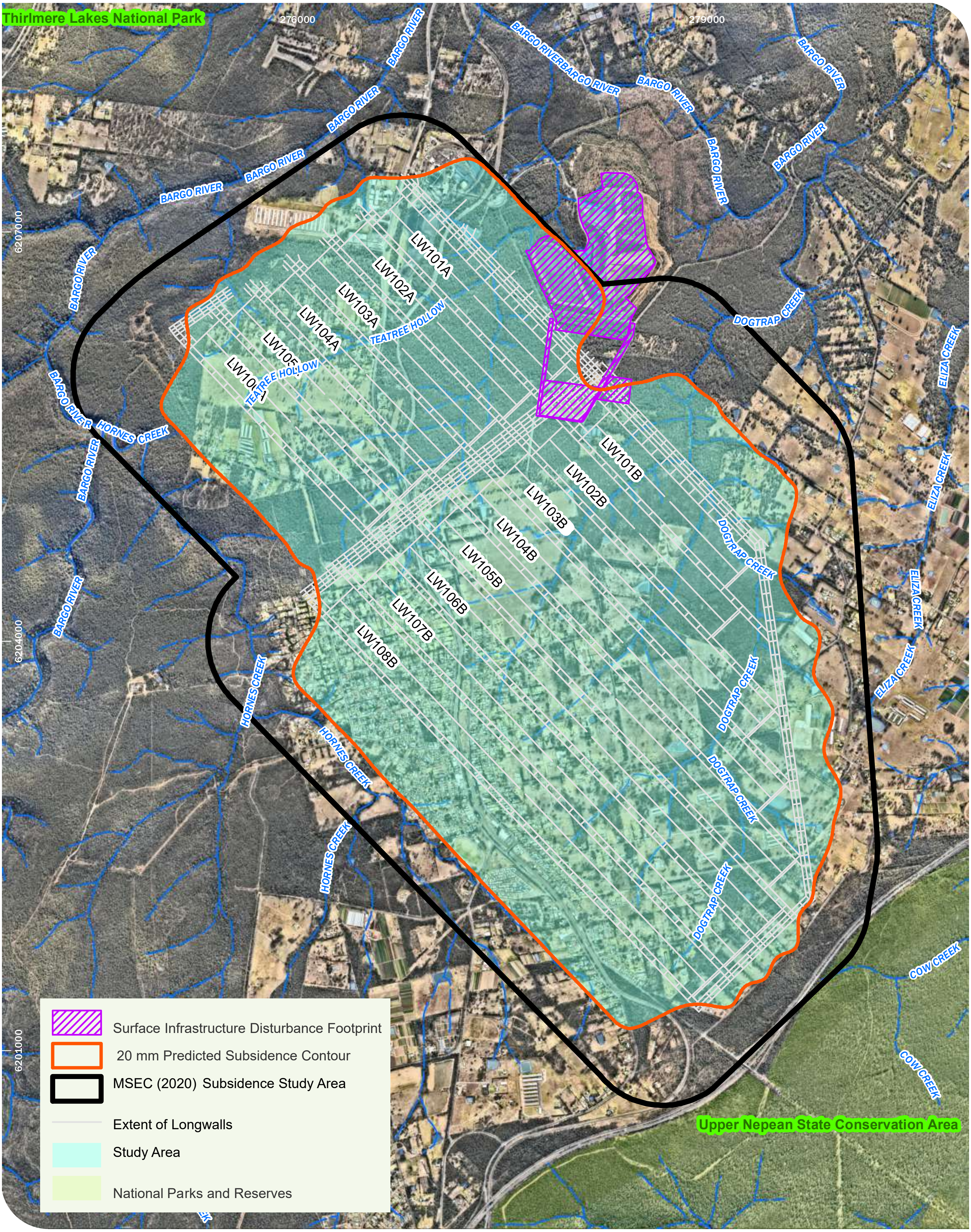

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Study Area

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 2

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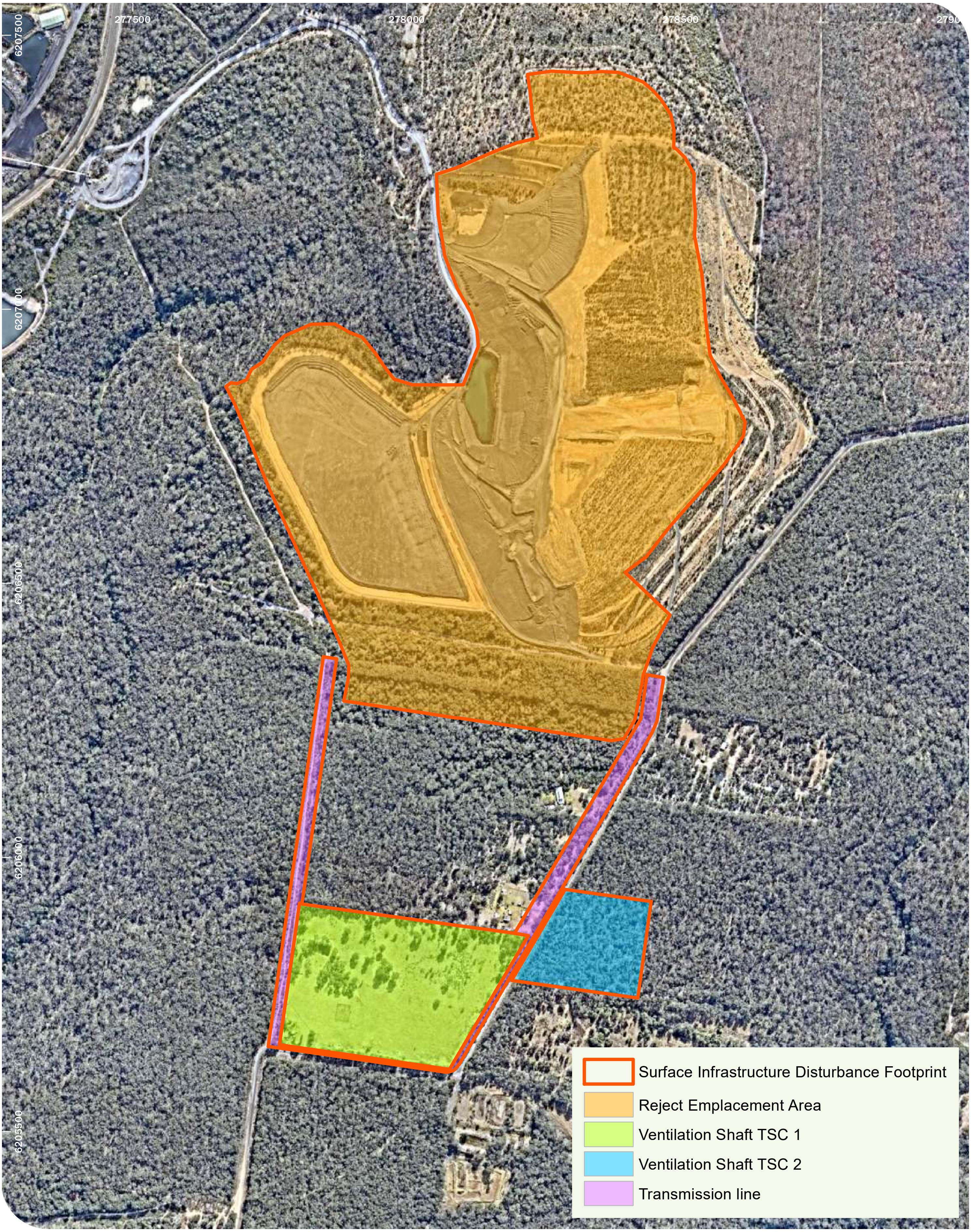

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Surface infrastructure

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 3

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2. Approach to the Project

2.1 Approval process

2.1.1 Application of the FBA

This Biodiversity Assessment Report has applied the FBA, according to the transitional arrangements provided under the BC Act, to describe and assess the ecological values within the Study Area, and determine how the Project is likely to have an impact on threatened biodiversity listed under the BC Act and the EPBC Act.

On 25 August 2017, the NSW *Threatened Species Conservation Act 1995* (TSC Act) was repealed and replaced with the NSW BC Act. The BC Act provides a new process for assessing impacts to biodiversity based on the Biodiversity Assessment Method (BAM), where impacts and offsets are measured in biodiversity 'credits', as determined by the BAM Calculator. Major Projects (State Significant Development and State Significant Infrastructure) are now subject to assessment under the Biodiversity Offset Scheme (BOS). However, savings and transitional arrangements specified within the BC Regulation allow for assessment/consideration under the former FBA under the following circumstances:

- Mining projects that had submitted a conceptual project development plan to the Division of Resources & Geoscience before 25 August 2017 will have until 25 August 2019 to submit a development application under the previous legislation. The Secretary of the Department of Planning and Environment must identify these projects in writing by 25 November 2017.
- Substantial environmental assessment was undertaken before 25 August 2017 (as determined in writing by the Secretary of the Department of Planning and Environment) and the application is made within 18 months of the Secretary's determination, or
- Environmental assessment requirements were issued before 25 August 2017 and the application is made before 25 February 2019. If the environmental assessment requirements are reissued, the application must instead be made within 18 months of the reissue, but no later than 25 August 2020.

As such, this assessment has been completed using the BioBanking Credit Calculator (BBCC) Version 4.0. The Major Project module has been used for all development calculations.

2.1.2 Commonwealth requirements

A Referral to the Commonwealth was submitted for the Project in November 2017. The Referral addressed impacts to biodiversity, specifically Matters of National Environmental Significance (MNES). However, the Project footprint at that time was different to the current footprint as assessed in the current report. It included a larger footprint and associated impact area to threatened flora and TECs. Based on the then footprint design, the Department of Environment and Energy (DoEE) declared the Project a controlled action, detailing their response in DoEE (2018) *Referral Decision and Designated Proponent – controlled action EPBC 2017/8084 Tahmoor South Project - dated 12th January 2018*.

The Project at the time was regarded by DoEE to have likely significant impacts on the MNES shown in Table 2. Impacts to each of these entities from the Project are detailed in this report; the relevant section being identified in Table 2.

The amended footprint was developed in response to submissions from various Government agencies on the BAR (as described in section 1.1). It resulted in the following reduction of impacts to MNES:

- Shale Sandstone transition Forest: from 43.5 hectares to 23.57 hectares (approximate 46% reduction);
- *Persoonia bargoensis*: from 96 to eight individuals;

- *Grevillea parviflora* subsp. *parviflora*: from 2,324 to 491 individuals;
- *Pomaderris brunnea*: from about 40 to 1 individual.

It is also stated in the Referral Decision that the 'NSW Government has advised the Department that the Project will be assessed under the assessment bilateral agreement'. As such, the impact assessment has applied the FBA to determine a suitable offset for the Project.

MNES that may be subject to significant impacts include Shale Sandstone Transition Forest, which will be offset in accordance with the Bilateral Agreement (section 12).

Table 2. DoEE Controlled Action decision

MNES	Section addressed in report
The DoEE has regarded the Project to have a significant impact upon the following species:	
Shale Sandstone Transition Forest (SSTF) (Critically Endangered)	Impacts to Shale Sandstone Transition Forest are detailed in section 8.3. An Assessment of Significance for the TEC has been provided in Appendix 8. The Assessment concluded a significant impact was likely. An offset strategy has been provided in section 12.
Bargo Geebung (*Persoonia bargoensis*, Vulnerable)	Impacts to *Persoonia bargoensis* are detailed in section 9.3.1. An Assessment of Significance for the species has been provided in Appendix 8. The assessment concluded a significant impact was unlikely.
Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*, Vulnerable)	Impacts to *Grevillea parviflora* subsp. *parviflora* are detailed in section 8.4. An Assessment of Significance for the species has been provided in Appendix 8. The assessment concluded a significant impact was unlikely.
Rufous Pomaderris (*Pomaderris brunnea*, Vulnerable)	Impacts to *Pomaderris brunnea* are detailed in section 8.4. An Assessment of Significance for the species has been provided in Appendix 8. The assessment concluded a significant impact was unlikely.
DoEE also noted that the following ecological community and threatened species could potentially be impacted by the Project:	
Turpentine-Ironbark Forest of the Sydney Basin Bioregion (Critically Endangered)	Turpentine-Ironbark Forest of the Sydney Basin Bioregion does not occur in the Study Area (section 5.2 and 5.3). No impacts to the community are likely (section 5.3).
Leucopogon exolasius (Woronora Beard-heath, Vulnerable)	*Leucopogon exolasius* does not occur within the Study Area (section 6.1). An Assessment of Significance for the species has been provided in Appendix 8. The Assessment concluded a significant impact was unlikely.
Phascolarctos cinereus (Koala, Vulnerable)	The Koala was not recorded despite targeted survey (section 8.5.1) An impact assessment for the Koala is provided in section 8.5.1. An Assessment of Significance for the species has been provided in Appendix 8. The Assessment concluded a significant impact was unlikely. Regardless, potential impacts to the Koala have been offset as detailed in section 12.
Macquaria australasica (Macquarie Perch, Endangered)	An aquatic ecology impact assessment under the *Fisheries Management Act 1994* has been completed by Niche (2020) for the Macquarie Perch. The assessment concludes that the study area does not contain habitat for the species, and the Macquaire Perch would not be impacted by the Project.
Petauroides volans (Greater Glider, Vulnerable).	The Greater Glider was not recorded despite targeted survey (section 6.3) An Assessment of Significance for the species has been provided in Appendix 8. The Assessment concluded a significant impact was unlikely.

2.1.3 Secretary's Environmental Assessment Requirements (SEARs)

In preparing this Terrestrial Ecology Impact Assessment, the SEARs issued for the Tahmoor South Project (SSD 17-8445) on 9 June 2017, and the Supplementary SEARs received on 14 February 2018 have been addressed. The key matters raised by the Secretary that are applicable to this Terrestrial Ecology Impact Assessment, and the section within this report which addresses each of the SEARs, is outlined in Table 3. The SEARs that relate specifically to aquatic ecology, are assessed in Niche (2020).

Table 3. Secretary's Environmental Assessment Requirements applicable to Terrestrial Ecology

Study Requirements		**Section Addressed**
Secretary's Environmental Assessment Requirements		
Biodiversity	An assessment of the likely biodiversity impacts of the development, including impacts to terrestrial and aquatic species and habitats, in accordance with the Framework for Biodiversity Assessment, by a person accredited in accordance with 5142(8)(1)(c) of the Threatened Species Conservation Act 1995, and having regard to OEH's requirements (Attachment 2); and	This document
	a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects	Offset strategy proposed in section 12
Key Agency Requirements		
The NSW Office of Environment and Heritage		
Biodiversity	Biodiversity impacts related to the proposed development are to be assessed and documented in accordance with the Framework for Biodiversity Assessment including the Addendum to the NSW Biodiversity Offsets Policy for Major Projects (Upland Swamps impacted by longwall mine subsidence (December 2016) as relevant, unless otherwise agreed by OEH, by a person accredited in accordance with 5142(8)(1)(c) of the Threatened Species Conservation Act 1995.	This document
	The project team's attention is drawn to the Addendum to NSW Biodiversity Offsets Policy for Major Projects (Upland swamps impacted by longwall mining subsidence), particularly in relation to any swamp communities which may be impacted by the proposal. We also recommend for impacts upon upland swamps and 3rd order or above streams that a full justification, including reasons for drainage, alternative and suggested remediation and offsets for any such damage, be presented. Any monitoring data undertaken as required during the EIS process should also be supplied to assist in our assessment.	No Upland swamps occur in Study Area – Appendix 2. Impacts to riparian areas discussed in section 8.2. Impacts associated with riparian vegetation discussed in section 8.3.2.
Attachment B	Impacts on the following species will require further consideration and provision of the information specified in s9.2 of the Framework for Biodiversity Assessment: • River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (EEC) • Shale Sandstone Transition Forest in the Sydney Basin Bioregion (CEEC) • Southern Highlands Shale Woodlands (CEEC) • Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC) • *Persoonia bargoensis* (Bargo Geebung) • *Persoonia glaucescens* (Mittagong Geebung) • *Persoonia hirsuta* (Hairy Geebung) • *Haplocephalus bungaroides* (Broad-headed Snake)	Section 9 and Section 9
Wollondilly Shire Council		

<table>
<tr><th colspan="2">Study Requirements</th><th>Section Addressed</th></tr>
<tr><td>Protection of Koala habitat</td><td>The undertaking of detailed Koala surveys that takes into account the following activities to determine the presence of Koala habitat (as requested by Council's submission in regards to the review of SEPP 44:
• The analysis of historical records to determine the previous presence of Koalas and the behavioural patterns of Koalas on the site.
• The undertaking of comprehensive surveys to determine the presence of Koalas consistent with best practice across all vegetation communities present on a site proposed for development.
• An analysis of the observed and identified potential behavioural usage of the site by Koalas across all vegetation types within the site based on a detailed assessment, (which is not restricted to the habitat species listed in the revised SEPP 44)
• The role of the site in a landscape context in allowing for the movement of Koala based on a detailed assessment and analysis of existing records.
Intended measures to protect Koala habitat consistent with Guidelines in the updated SEPP 44 which must be development in consultation with OEH and Council</td><td>No Koalas present within the area to be disturbed.
Comprehensive surveys including spotlighting, SAT analysis have been completed (section 6.2.2).
Koala discussed in section 6.2 and section 9.</td></tr>
<tr><td>Protection of threatened species</td><td>Impacts to threatened species associated with Tahmoor South be assessed and consistent with requirements contained in its current Development Control Plan.</td><td>Impact assessments have been completed as part of this report in accordance with the requirements of the FBA.</td></tr>
<tr><th colspan="3">NSW Department Planning and Environment – Supplementary SEARs (dated 14 February 2018)</th></tr>
<tr><td></td><td>The EIS must include an assessment of the relevant impacts of the action on threatened species and communities and water resources; including:
• A description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short-term and long-term relevant impacts;
• A statement whether any relevant impacts are likely to be known, unpredictable or irreversible';
• Analysis of the significance of the relevant impacts;
• Any technical data and other information used or needed to make a detailed assessment of the relevant impacts.</td><td>This assessment has utilised the specialist reports completed as part of the Project to determine impacts toward biodiversity.
Direct and indirect impact in relation to biodiversity are discussed in section 8.</td></tr>
<tr><td></td><td>For each of the relevant matters protected that are likely to be significantly impacted by the development, the EIS must provide information on proposed avoidance and mitigation measures to deal with the relevant impacts of the action, including:
• a description and an assessment of the expected or predicted effectiveness of the mitigation measures;
• Any statutory policy basis for the mitigation measures;
• The cost of the mitigation measures;
• An outline of an environmental management plan that sets of the framework for continuing management mitigation and monitoring programs for the relevant impacts of the action, including any provision for independent environmental auditing; and
• The name of the agency responsible for endorsing or approving each mitigation measures of monitoring program.</td><td>Mitigation measures are detailed in section 10.
The cost of mitigation measures are provided in the Economic Impact Assessment for the Project (Cadence Economics 2018) (section 10).
The main body of the EIS document outlines the Tahmoor</td></tr>
</table>

Study Requirements		Section Addressed
		Environmental Management System (EMS), which includes a series of Environmental Management Plans (EMPs) (section 10.2).
	Where a significant residual adverse impact to a relevant protected threatened species or community is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	Offset strategy provided in section 12
	For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any: • Conservation advice or recovery plan for the species or community • Relevant threat abatement plan for a process that threatens the species or community • Wildlife conservation plan for the species; and • Any strategic assessment.	Relevant Commonwealth guidelines and policy statements referred to in Appendix 8
	The EIS must identify each EPBC Act listed threatened species and communities likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impact. For species and communities potentially located in the Study Area or in the vicinity that are not likely to be impacted, provide evidence why that are not likely to be impacted.	Appendix 1 – likelihood of occurrence Impacts are discussed in Section 8.
	For each of the EPBC Act listed threatened species and communities likely to be impacted by the action the EIS must provide a separate: • Description of habitat (including identified and mapping of suitable breeding habitat, suitable foraging habitat, important population and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statement including listing advice conservation advice and recovery plans: • Details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements; • Description of the relevant impacts of the action having regards to the full national extent of the species or communities range; and • Description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action; • Identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account; • Description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established • Details of how the current published FBA has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; • Details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the FBA and/or mapping and description of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites	Impacts are discussed in Section 8. Separate assessments for EPBC Act listed biodiversity are provided in Appendix 8. Survey effort is provided in sections 6.1.1 and 6.2.2 Impacts are assessed in section 8 and EPBC Act Assessment of Significance provided in Appendix 8. Mitigation measures provided in section 10. Biodiversity offset strategy provided in section 12.

Study Requirements		Section Addressed
	The EIS should provide a description of the location, extent and ecological characteristics and values the identified water resource potentially affected by the project. The assessment of impacts should include information on: The habitat or lifecycle of native species, including invertebrate fauna and fish species, depend upon the water resource bring seriously affected.	Impacts to aquatic ecology assessed in Niche (2020).
	Based on the information in the referral documentation, the location of the action, species records and likely habitat present in the area, there are likely to be significant impacts to: • Shale Sandstone Transition Forest in the Sydney Basin Bioregion (CEEC) • *Persoonia bargoensis* (Bargo Geebung) • *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) • *Pomaderris brunnea* (Rufus Pomaderris) There is some risk that there may be significant impacts on the following matters and levels of impact should be further investigated: • Turpentine Ironbark Forest of the Sydney Basin Bioregion (CEEC) • *Leucopogon exolasius* (Woronora Beard-heath • Koala (*Phascolarctos cinereus*) • Macquarie Perch (*Macquaire australasica*) • Greater Glider (*Petauroides volans*)	Impacts to each of these entities are discussed in section 8.

2.1.4 Response to submissions

This report includes assessment of Project amendments made in response to submissions on the EIS from the following organisations:

- NSW Office of Environment and Heritage (now part of the DPIE)
- Wollondilly Shire Council
- Wingecarribee Shire Council
- Independent Expert Scientific Committee (IESC).

Niche's response to the submissions relevant to biodiversity (including OEH, DPIE and Wollondilly Shire Council) are provided throughout this report, and specifically addressed in a are included in a separation submission document prepared by AECOM and Tahmoor Coal. The key comments in relation to biodiversity, and how they have been addressed in this assessment are provided in Table 4.

Table 4. Key comments from OEH (14 March 2019) and how comments have been addressed in this report.

Key comments from OEH	How it has been addressed in this report.
The proponent did not thoroughly demonstrate how the 'avoid' principle of biodiversity assessment policy, guidelines and SEARs were met in regards to the sites biodiversity constraints.	The justification and avoidance on biodiversity values is detailed in section 7. In summary the amended Project has avoided impacts by the following: • The REA was redesigned to minimise the potential impacts on Shale Sandstone Transition Forest TEC by 43.5 hectares to 23.57 hectares (approximate 46% reduction); • The redesign of the REA has avoided a significant impact under the EPBC Act for *Persoonia bargoensis*, by reducing the removal of approximately 96 individuals of a known population, to 8 individuals;

Key comments from OEH	How it has been addressed in this report.
	• A core population of *Grevillea parviflora* subsp. *parviflora* and *Pomaderris brunnea* has largely been avoided.
Consideration should be given to reducing the quantum of clearing and resulting impacts upon threatened entities, with offsetting limited to residual impacts only. The proponent should undertaken hollow-bearing tree survey to quantify impacts to potential hollow dependent threatened species, and to determine high habitat value site constraints so impacts to these areas can be avoided/minimised.	As discussed above, the justification and avoidance on biodiversity values is detailed in section 7. Hollow-bearing tree assessment was completed and is discussed in section 6.3. A total of 14 hollow-bearing trees were recorded in the Study Area. Hollow dependent threatened species are discussed in 6.2 and section 8.5.
Impacts for Further Consideration for *Persoonia bargoensis* in accordance with section 9.2 of the FBA need to further demonstrate that the local population will not be put at risk of extinction or have its viability significantly reduced as a result of the development. In the absence of further survey, the eastern pygmy possum should be assumed present and offset.	The Impact for Further Consideration for *Persoonia bargoensis*, has been updated based on the amended Project. The redesign of the REA has avoided a significant impact under the EPBC Act for Persoonia bargoensis, by reducing the removal of approximately 96 individuals of a known population, to 8 individuals; The Eastern Pygmy Possum has been assumed presence, and offset accordingly.
Further development of the Biodiversity Offset Strategy is required to demonstrate that required offsetting, after all avoidance measures have been applied, can be achieved. Further clarification regarding some species credits not identified in the offset as described in attachment A must also be addressed.	The Biodiversity offset Strategy has been detailed in section 12. Offsets have been proposed for all threatened species impacted by the Project as per the requirements of the FBA, and for those threatened entities that may have a significant impact under the EPBC Act (Shale Sandstone Transition Forest).

Key Project amendments include a revised surface disturbance area and subsequent reduction (approximately 50%) in clearance of native vegetation (from 49.2 ha to 37.77 ha – noting that 14.20 ha is native mine rehabilitation in the form of tubestock) and impacts to the following key threatened flora:

- *Persoonia bargoensis*: from 96 to eight (8) individuals
- *Grevillea parviflora* subsp. *parviflora*: from 2,324 to 491 individuals
- *Pomaderris brunnea:* from 40 to 1 individual.

2.2 Assessment resources and assessor qualifications

This BAR has been prepared by the following accredited assessors:

- Simon Tweed (Senior Ecologist and Accredited BioBanking Assessor): fauna field survey, data management, data entry, review of credit calculations, report preparation.
- Luke Baker (Senior Botanist and Accredited BioBanking Assessor): field survey, data management, data entry, credit calculations, report preparation.
- Sian Griffiths (Senior Botanist and Accredited BioBanking Assessor): report preparation, review of report.

Other specialist staff involved in preparing the assessment include:

- Matthew Richardson (Director): field survey, report review, quality assurance.
- Dr Amanda Griffith (Senior Ecologist): reporting.
- Dr Ross Jenkins (Team Leader GIS and Systems Analyst): mapping.
- Dr Cairo Forrest (Ecologist): field surveys, reporting.
- Dr Frank Lemckert: (Team Leader Ecology): fauna field survey, expert amphibian assessment.
- Anna Senior (Ecologist): field survey, data management, data entry.
- Greg Tobin (GIS Analyst): mapping.
- Matthew Stanton (Research Ecologist): field survey, Anabat analysis.

3. Background review

In completing this BAR, a number of threatened species databases and previous documents relevant to the Project have been reviewed as detailed in this section.

3.1 Database searches

Threatened species potentially impacted by the Project were identified through the database and literature review process detailed below. The list of potentially impacted species was determined by considering the likelihood of occurrence and the likelihood of impacts for each species.

Five categories for 'likelihood of occurrence' (Table 5) were attributed to the list of threatened species after consideration of criteria such as known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further were those in the 'Known' to 'Moderate' categories and where impacts for the species could reasonably occur from the Project.

Table 5. Likelihood of occurrence criteria

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the Study Area.	The species was observed within the Study Area.
High	It is likely that a species inhabits or utilises habitat within the Study Area.	It is likely that a species inhabits or utilises habitat within the Study Area.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the Study Area.	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the Study Area.
Low	It is unlikely that the species inhabits the Study Area.	It is unlikely that the species inhabits the Study Area. If present at the site the species would likely be a transient visitor. The site contains only common habitat for this species which the species would not rely on for its on-going local existence such as limited breeding habitat resources.
None	The species has not been recorded within the Study Area and habitat within the Study Area is unsuitable for the species.	The species has not been recorded within the Study Area and habitat within the Study Area is unsuitable for the species.

3.1.1 BioBanking Credit Calculator

Threatened species predicted to occur within the CMA subregion (BioBanking Threatened Species Profile Database) were reviewed and included within the Threatened Species Likelihood of Occurrence Tables (Appendix 1). The list of species predicted to occur within the CMA Subregion was refined for the Study Area within the BioBanking Credit Calculator (BBCC). This involved refining the list on the basis of answering a series of 'Geographic and habitat feature' questions within the BBCC, which further filtered the threatened species that are likely to be relevant to the habitats present within the development footprint. The details of the inputs to generate the list are provided below.

Table 6 outlines the responses to geographic/habitat feature questions in the BBCC. The responses to the geographic and habitat questions in Table 7 generated the list of species credit predicted species for consideration in this assessment along with the suggested survey time detailed in Table 7.

Table 6. Project relevant geographic and habitat questions

Impact?	Common name	Scientific name	Feature
Yes	Rosenberg's Goanna	*Varanus rosenbergi*	Land within 250 m of termite mounds or rock outcrops
Yes	Red-crowned Toadlet	*Pseudophryne australis*	Heath or eucalypt forest on sandstone with a build-up of litter or other debris and containing, or within 40 m of ephemeral or intermittent drainage lines
Yes	Cumberland Plain Land Snail	*Meridolum corneovirens*	Land containing bark or leaf litter accumulation
Yes	Large-eared Pied Bat	*Chalinolobus dwyeri*	Land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels
Yes	Giant Burrowing Frog	*Heleioporus australiacus*	Land within 40 m of heath, woodland or forest
Yes	*Hibbertia superans*	*Hibbertia superans*	Ridgetops
Yes	Green and Golden Bell Frog	*Litoria aurea*	Land within 100 m of emergent aquatic or riparian vegetation
No	*Wahlenbergia multicaulis* (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	*Wahlenbergia multicaulis - endangered population*	Land situated in damp, disturbed sites
Yes	*Lasiopetalum joyceae*	*Lasiopetalum joyceae*	Lateritic to shaley ridgetops

Table 7. Species credit predicted species for consideration and survey time matrix

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acacia gordonii	*Acacia gordonii*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Allocasuarina glareicola	*Allocasuarina glareicola*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bargo Geebung	*Persoonia bargoensis*	Yes	Yes	Yes	Yes	Yes							Yes
Brown Pomaderris	*Pomaderris brunnea*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bynoe's Wattle	*Acacia bynoeana*	Yes	Yes	Yes						Yes	Yes	Yes	Yes
Cumberland Plain Land Snail	*Meridolum corneovirens*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Darwinia biflora	*Darwinia biflora*	Yes	Yes							Yes	Yes	Yes	Yes
Darwinia peduncularis	*Darwinia peduncularis*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deane's Paperbark	*Melaleuca deanei*	Yes	Yes										Yes
Dillwynia tenuifolia	*Dillwynia tenuifolia*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dillwynia tenuifolia (a shrub) population, Kemps Creek	*Dillwynia tenuifolia* - endangered population Kemps Creek	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Downy Wattle	*Acacia pubescens*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eastern Pygmy-possum	*Cercartetus nanus*												
Epacris purpurascens subsp. *purpurascens*	*Epacris purpurascens subsp. purpurascens*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eucalyptus sp. Cattai	*Eucalyptus sp. Cattai*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	*Callocephalon fimbriatum* population in the Hornsby and Ku-ring-gai Local Government Areas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Giant Burrowing Frog	*Heleioporus australiacus*	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes
Green and Golden Bell Frog	*Litoria aurea*	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes
Grevillea parviflora subsp. *supplicans*	*Grevillea parviflora subsp. supplicans*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gyrostemon thesioides	*Gyrostemon thesioides*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hairy Geebung	*Persoonia hirsuta*	Yes	Yes	Yes	Yes	Yes							Yes
Haloragodendron lucasii	*Haloragodendron lucasii*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hibbertia superans	*Hibbertia superans*							Yes	Yes	Yes	Yes	Yes	Yes
Koala	*Phascolarctos cinereus*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Large-eared Pied Bat	*Chalinolobus dwyeri*	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes
Lasiopetalum joyceae	*Lasiopetalum joyceae*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Leucopogon fletcheri subsp. *fletcheri*	*Leucopogon fletcheri subsp. fletcheri*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marsdenia viridiflora subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora subsp. viridiflora -* endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Matted Bush-pea	*Pultenaea pedunculata*									Yes	Yes	Yes	
Mittagong Geebung	*Persoonia glaucescens*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nodding Geebung	*Persoonia nutans*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Persoonia mollis subsp. *maxima*	*Persoonia mollis subsp. maxima*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pimelea curviflora subsp. *curviflora*	*Pimelea curviflora subsp. curviflora*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Red-crowned Toadlet	*Pseudophryne australis*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regent Honeyeater	*Anthochaera phrygia*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rosenberg's Goanna	*Varanus rosenbergi*	Yes	Yes									Yes	Yes
Small-flower Grevillea	*Grevillea parviflora subsp. parviflora*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squirrel Glider	*Petaurus norfolcensis*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sydney Plains Greenhood	*Pterostylis saxicola*									Yes	Yes	Yes	
Tetratheca glandulosa	*Tetratheca glandulosa*							Yes	Yes	Yes	Yes	Yes	

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	*Wahlenbergia multicaulis* - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Woronora Beard-heath	*Leucopogon exolasius*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zieria involucrata	*Zieria involucrata*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

3.1.2 BioNet Atlas of NSW Wildlife Database

A review of spatial records of threatened flora and fauna within the locality and wider region was undertaken using data obtained from the BioNet Atlas of NSW Wildlife. Records were obtained prior to field survey and searches of the BioNet Atlas were updated in September 2019 (OEH 2019a). Results from the database searches have been incorporated into the Threatened Species Likelihood of Occurrence Table provided in Appendix 1.

3.1.3 EPBC Act Protected Matters Search

An EPBC Protected Matters Search was carried out for a 10 km area around the Study Area. Results from the database search has been incorporated into the Threatened Species Likelihood of Occurrence Table provided in Appendix 1.

3.2 Review of relevant studies

Literature and data sources reviewed as part of this assessment include the following:

- AECOM (2012) Tahmoor South Project Preliminary Environmental Assessment, prepared for Tahmoor Coal August 2012
- HEC (2020a) Tahmoor South Project – Surface Water Impact Assessment - baseline
- HEC (2020b) Tahmoor South Project – Surface Water Impact Assessment
- EMM Consulting (2020) Tahmoor South Project – Noise and Vibration Assessment
- Fluvial Systems (2013) Tahmoor South Project – Environmental Impacts Statement Technical Specialists Report –Geomorphology – Final Report
- GeoTerra (2014) Tahmoor South Project – Shallow Groundwater Baseline Monitoring
- DEC (2004a) The Native Vegetation of the Nattai and Bargo Reserves. Unpublished Report. Department of Environment and Conservation, Hurstville
- DEC (2004b) “The Vertebrate Fauna of the Nattai and Bargo Reserves.” Unpublished report funded by the Central Directorate Parks and Wildlife Division Biodiversity Survey Priorities Program by NSW Department of Environment and Conservation, Conservation Assessment and Data Unit Conservation Programs and Planning Branch; Metropolitan, Environment Protection and Regulation Division
- Niche (2013) Tahmoor South Terrestrial Monitoring Project Year 2012-2013
- Niche (2012) Tahmoor South Pilot Study, Prepared for Tahmoor Coal
- Niche (2010a) Bargo Exploration Program Surveys 1 Review of Environmental Factors
- Niche (2010b) Bargo Exploration Program Surveys 2 Review of Environmental Factors
- Niche (2010c) Bargo Exploration Program Surveys 3 Review of Environmental Factors
- Niche (2010d) Bargo Exploration Program Surveys 4 Review of Environmental Factors
- Niche (2011a) Tahmoor Coal Ventilation Shaft Fenceline Clearing Assessment
- Niche (2011b) Bargo Project Offsetting Strategy
- Niche (2011c) Tahmoor South Project Pilot Study
- Niche (2011d) Bargo Exploration Program Surveys 6 Review of Environmental Factors
- Niche (2011e) Bargo Exploration Program Surveys 7 Review of Environmental Factors
- Niche (2011f) Bargo Exploration Program Surveys 8 Review of Environmental Factors
- Niche (2011g) Bargo Exploration Program Surveys 9 Review of Environmental Factors
- Niche (2011h) Bargo Exploration Program Surveys 10 Review of Environmental Factors
- NPWS (2003) Native Vegetation of the Woronora, O’Hares and Metropolitan Catchments
- NPWS (2002) The native vegetation of the Cumberland Plain, Western Sydney
- Tozer et al. (2006) Native vegetation of south east NSW.
- OEH (2013) Remnant Vegetation of the western Cumberland subregion, 2013 Update.
- MSEC (2020) Tahmoor South Project – Amendment Report for Longwalls 101A to 108B.

- MSEC (2018) Subsidence Constraints Assessment: Assessment of potential constraints on the proposed Tahmoor South Project due to surface subsidence impacts resulting from the proposed longwall mining.

4. Landscape assessment

4.1 Landscape features of the Study Area

The key landscape features of the Study Area are concentrated around the watercourses, namely Teatree Hollow Creek, and Dogtrap Creek (Figure 4).

As the watercourses occur within the lowest part of the landscape, the gullies are typically occupied by steep slopes (defined by MSEC (2020) as an area of land having a gradient greater than 1 in 3 (33% or 18.3)).

According to MSEC (2020), a total of 24 cliffs are located within the '*Subsidence Study Area*', however, of these cliffs, 23 will not be directly mined beneath. These include the cliffs along the Bargo River and Hornes Creek, which are all located outside the extents of the proposed longwalls. All cliffs, with the exception of one cliff along Dogtrap Creek, will not be directly mined beneath by the Project. Further discussion on cliffs within the Study Area is provided in 8.2.

4.1.1 Landscape Assessment in the BBCC

As detailed in section 4 of the FBA, a Landscape Assessment is required to be entered into the BBCC. Landscape Value is an assessment of the spatial configuration of vegetation, including percent native vegetation cover, adjacent remnant area and connectivity. For each, there is one assessment of the current state of the landscape around the entire Project, and one assessment of the state of the landscape if the Project were to proceed using spatial configuration of Assessment Circles.

4.1.2 Assessment circles

Two Assessment Circles were placed over the Study Area as per the FBA (shown on Figure 5). The largest Assessment circle combination (10,000 hectares for outer circle, and 1,000 hectares for inner circle) was centred over the entire area of greatest disturbance.

4.1.3 Landscape setting

The Study Area occurs within the Sydney Basin IBRA region, and incorporates the following three IBRA subregions: Cumberland, Burragorang, and Sydney Cataract (Figure 5). The Cumberland IBRA subregion occupies the majority of the Study Area, and has therefore been entered into the BBCC.

The following Mitchell landscapes occurs across the Study Area: Picton – Razorback Hills, Woronora Plataea, Nattai Plateau, Hawkesbury Nepean and Upper Nepean Gorges (Figure 5). The Picton – Razorback Hills occupies the majority of the Study Area and has therefore been entered into the BBCC.

4.1.4 Native vegetation cover

GIS interrogation was used to determine the vegetation cover percentage as provided in Figure 5.

Table 8. Native vegetation cover – assessment circles

Native vegetation cover class (%)			
Before development		After development	
10,000 ha	1,000 ha	10,000 ha	1,000 ha
51-55%	81-85%	51-55%	76-80%

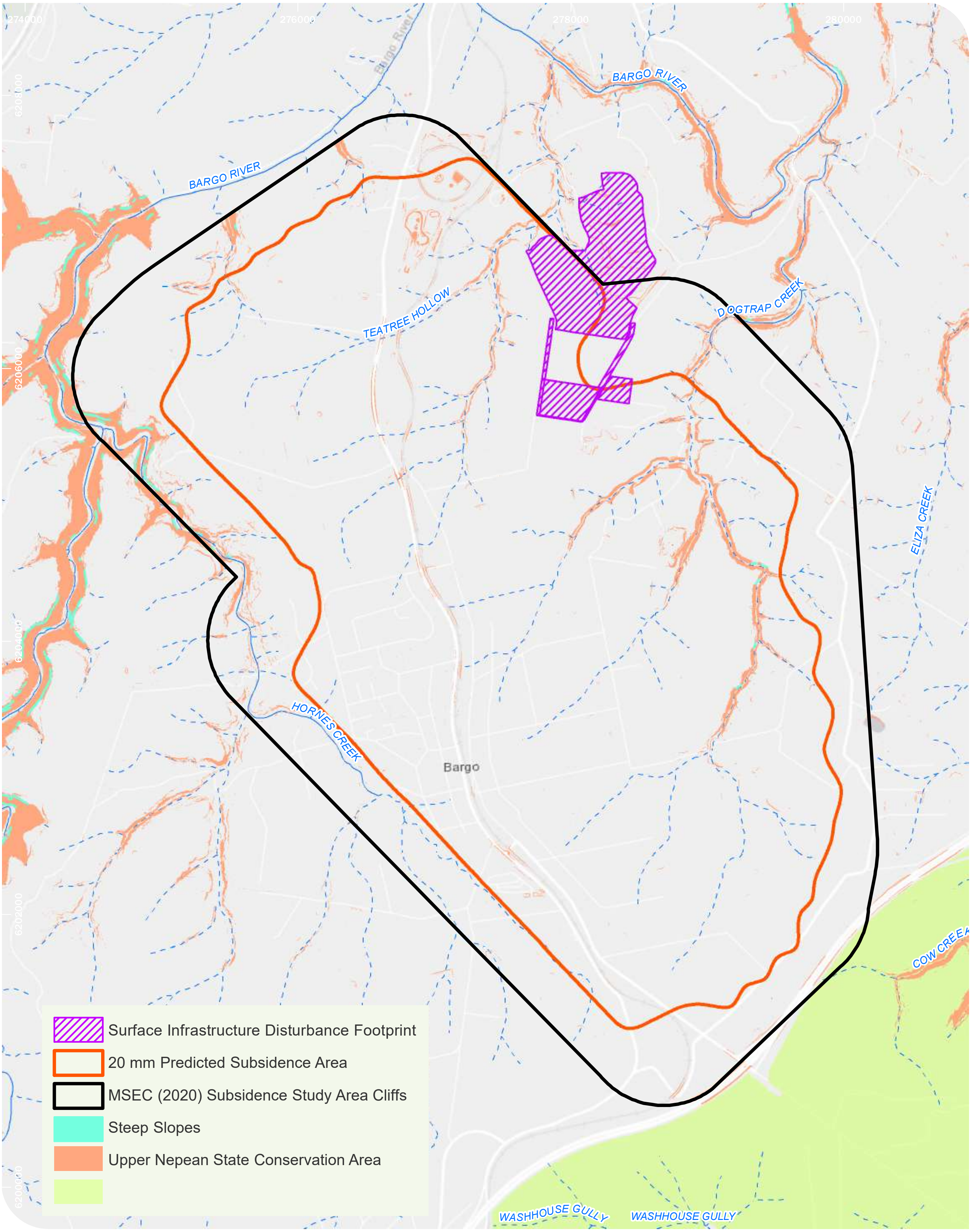
4.1.5 Connectivity value

The Study Area does not occur within a strategic location[1], given the study area does not contain riparian buffers that are of a 4th order or higher Strahler level (Figure 6). As such, the 'connectivity width' (as defined in the FBA) is 100 to 500 m which occurs between the REA expansion area and the ventilation shaft TSC2 has been added to the BBCC. This connectivity width would not change after the development.

4.1.6 Landscape score calculation

The information presented in the above section was entered into the BBCC, resulting in a landscape score calculation of 12.0 for the development.

[1] Land that is: part of a state significant biodiversity link and in a plan approved by the Chief Executive OEH; a regionally significant biodiversity link and in a plan approved by the Chief Executive OEH; or in the riparian buffer area of a 4th order stream or higher, an important wetland or an estuarine area.



niche
Environment and Heritage

0 600
m
GDA 1994 MGA Zone 56

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Landscape features
Tahmoor South Project

Figure 4

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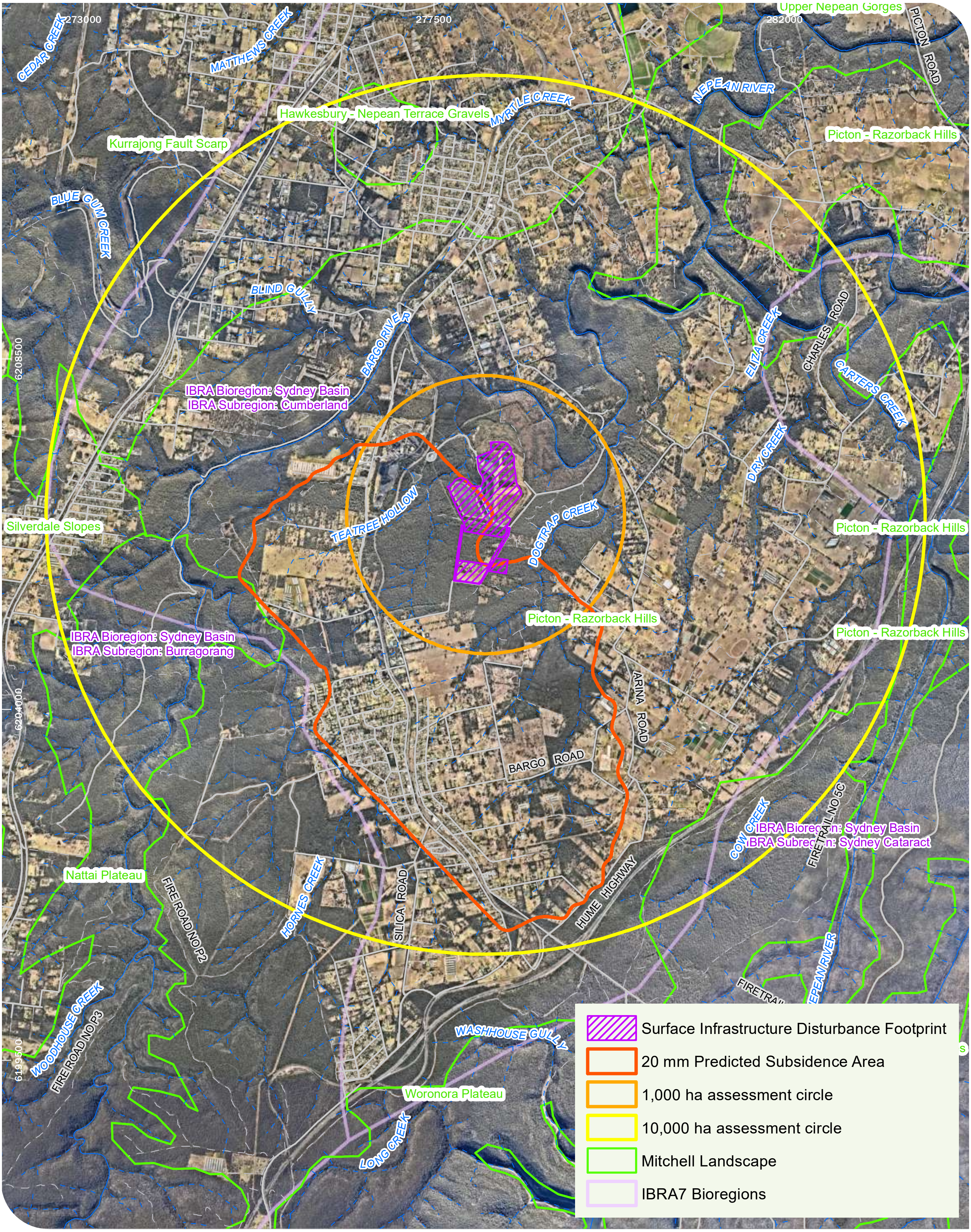
World Light Gray Reference: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community/ World Light Gray Canvas Base: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community



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0 1,500 m

GDA 1994 MGA Zone 56

Landscape assessment location map

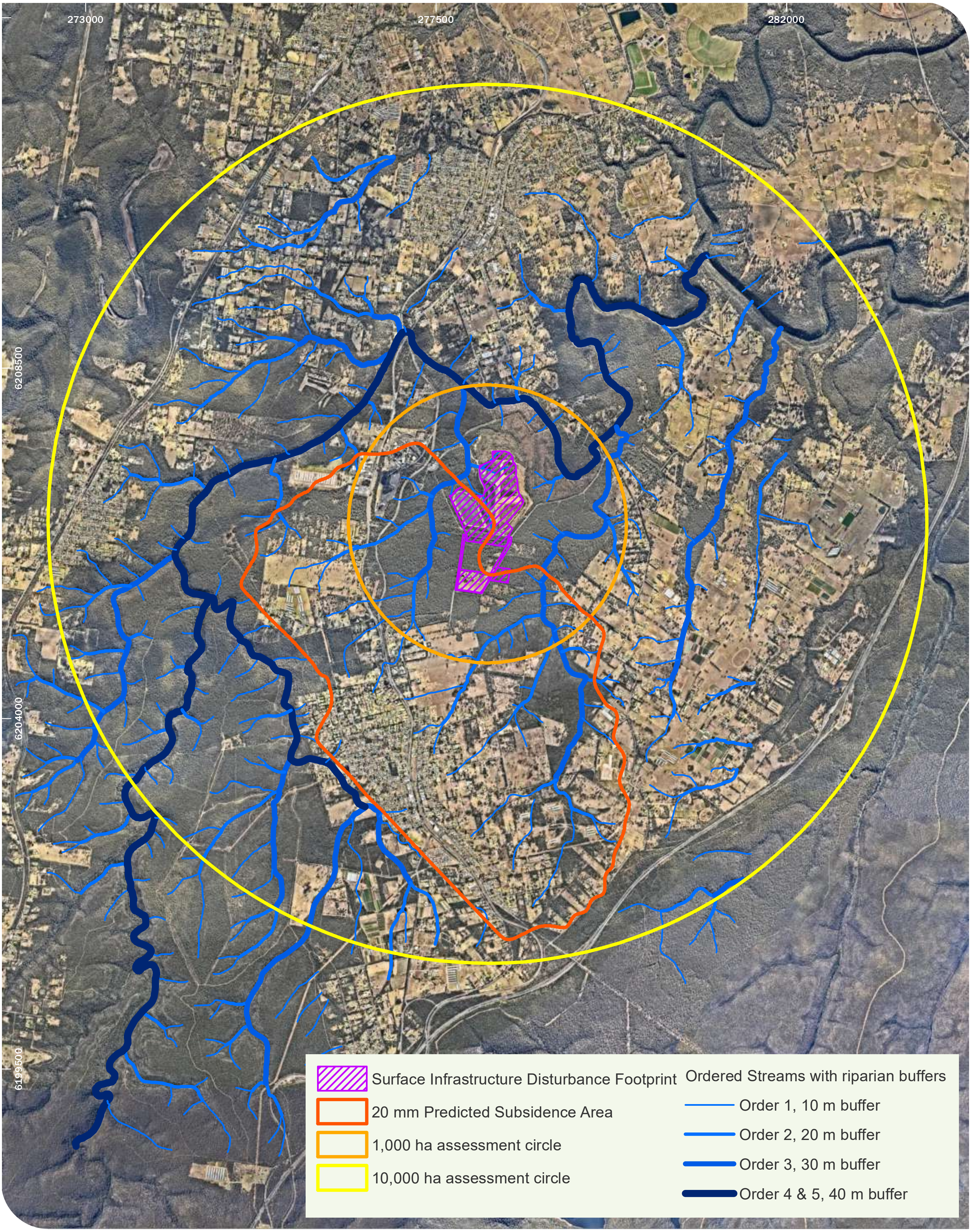
Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 5

public_NSW_Imagery:

v2.0



niche Environment and Heritage

0 1,500
m
GDA 1994 MGA Zone 56

Landscape assessment - site map of surface infrastructure

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 6

public_NSW_Imagery:

v2.0

5. Assessing native vegetation

5.1 Vegetation verification

The Study Area has had a history of extensive vegetation survey completed by Niche since 2012, with the most recent field survey completed in September 2019. An overview of the survey effort history relevant to vegetation verification has been provided in Table 9 with additional detail provided in Appendix 3.

In summary, the vegetation validation survey concentrated on areas within the Study Area that would be directly impacted by infrastructure, or potentially impacted by subsidence (eg. riparian zones). For areas not directly impacted, the existing vegetation mapping completed by Tozer et al. (2006) and OEH (2013) was used.

The required number of BioBanking plots as stipulated by the FBA for PCTs impacted by the Project were completed. The number of BioBanking plots undertaken within each of the vegetation communities throughout the Study Area is detailed in Table 10. The location of the 12 plots completed in September 2019 within the area to be directly cleared as a result of surface infrastructure area is shown in Figure 9 and the plot data is provided in Appendix 5.

Additional information (abundance, structure etc.) was recorded on the basis of current best practice flora survey guidelines for assessment of a large site, particularly OEH's Working Draft Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities (DEC 2004) and OEH (2016) NSW Guide to Surveying Threatened Plants.

BioBanking plots/transects were completed to collect the following attributes:

- native species richness (20 x 20 m)
- native over-storey cover (Projective foliage cover at 5 m intervals along 50 m transect)
- native mid-storey cover (Projective foliage cover at 5 m intervals along 50 m transect)
- native ground cover (grasses) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (shrubs) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (other) (frequency tally at 1 m intervals along 50 m transect)
- exotic cover (as for native over-storey, mid-storey and groundcover)
- over-storey regeneration (proportion of overstorey dominants present as immature recruitment)
- number of trees with hollows (within 50 x 20 m plot)
- total length of fallen logs (within 50 x 20 m plot).

In addition to the prescribed BioBanking plot methodology above, within each 20 x 20 m plot all vascular plant species were identified (to species level where sufficient plant material was available) and assigned a cover abundance score.

Random meanders for threatened flora and their habitats were conducted between BioBanking plots, RDP locations, and fauna survey points.

Table 9. Vegetation and threatened flora survey effort

Survey	Survey details
Pilot study (2011-2012)	A terrestrial ecology pilot study was conducted over four days from the 5th to the 8th of December 2011, and on the 11th and 16th of April 2012 to determine ecological values that would require consideration during the Environmental Impact Statement (EIS) for the Project. The survey associated with the Pilot Study involved a rapid based vegetation validation assessment using Tozer et al. (2006) as a base. The assessment also included a habitat based assessment for threatened flora to determine which threatened flora may need to be considered further in targeted surveys as part of the EIS for the Project.
Riparian monitoring (2012-2013)	A riparian monitoring project was completed for two monitoring years. The purpose of the riparian monitoring project was to gain baseline floristic data at 42 permanent monitoring sites along riparian areas within the Study Area, and within a number of Control sites. BioBanking plots were completed at each monitoring site. The data would be used in a Before-After-Control Impact Assessment (BACI) for the Project. The first year of riparian vegetation monitoring was conducted by two botanists from 18 to 27 June 2012, and again from 5 to 13 December 2012. The second year of riparian vegetation monitoring was conducted between the 3 of June and the 15 of June 2013. Two different survey periods were aimed at targeting any potential seasonal differences in species presence.
REA detailed survey (2013) – Now removed from the Project.	The proposed REA expansion area and vegetation immediately surrounding the REA was investigated by four ecologists from November 2012 to January 2013. The assessment included detailed vegetation mapping and threatened flora survey. The survey resulted in the collection of over 43 BioBanking plot/transects, rapid survey points, and targeted threatened flora survey and population counts for *Grevillea parviflora* subsp. *parviflora, Persoonia bargoensis*, and *Pomaderris brunnea*.
Ventilation shafts, haul road and powerline (2013) – Now removed from the Project.	The original location of the ventilation shaft sites, haul road and powerline were investigated by two ecologists over five days in June 2013 and one day in September 2013. The assessment included detailed vegetation mapping and threatened flora survey. The survey of these areas involved a habitat assessment and BioBanking plots and random meanders.
Detailed survey within and adjacent to the Study Area (2017)	Survey assessments were completed by two ecologists on 13th September 2017 to the 17th of September 2017. The purpose was to inspect the condition of the vegetation, re-count flora populations, and gain additional floristic plot data. During the assessment an additional four BioBanking plots/transects were completed to accompany the four plots/transects completed during the 2013 survey. Targeted threatened flora surveys were undertaken across the disturbance areas, along with a population count for *Grevillea parviflora* subsp. *parviflora*.
Ventilation shaft sites and Hornes Creek (2018).	Survey assessments were completed by two ecologists on 12th September 2018 to the 19th of September 2017. The purpose was to validate the vegetation mapping within the ventilation shaft sites, and to complete threatened flora survey and counts within these areas. During the assessment an additional seven BioBanking plots/transects were completed. Targeted threatened flora surveys were undertaken across the proposed disturbance areas, along with a population count for *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis*.
Revised surface infrastructure disturbance footprint (September 2019)	The Project footprint was revised following public exhibition of the BAR. The following surveys were undertaken (by two ecologists in September 2019) within previously un-surveyed areas within the revised Project footprint: • Validation of vegetation mapping within the REA, Ventilation shaft sites TSC 1 and TSC 2 and powerline

Survey	Survey details
	• 12 BioBanking plots (including seven within the REA and five within Ventilation shaft sites TSC 1 and TSC 2) • Hollow-bearing tree survey within the revised surface infrastructure disturbance footprint • Targeted threatened flora searches within the powerline corridor.

Table 10. Vegetation validation survey effort plot requirement

Niche vegetation mapping	Plant Community Type (PCT) best fit	Condition	Total (ha)	Plots required	Plots completed (Riparian Monitoring Program 2013)	Plots completed (2013 survey)	Plots completed (2017 and 2018 survey)	Plot completed outside the Study Area since 2013	Plots completed (2019 survey)
	Plots relevant to current Project footprint								
Cumberland Shale Sandstone Transition Forest	PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (HN556	Moderate/ Good	17.26	3	0	5	3	13	6
		Moderate/ Good_ derived	6.31	3	0	0	3	3	3
Plantings	Mine Rehabilitation – best fit is PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).	Other	14.2	3	0	0	1	0	3
Non-native	-	-	46.34	0	-	-	-	-	-
Riparian vegetation within the Study Area	Combination of both: HN586 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin, and HN564 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin.	Moderate/ Good	[2]16.0 (approx.)	4	15	0	0	0	0

[2] Determined by placing a 10 metre buffer along each riparian course in the Study Area.

5.2 Vegetation validated mapping

The vegetation validation concentrated on the areas of native vegetation impacted by the surface infrastructure disturbance, whilst the OEH (2013) mapping has been relied upon for the remaining portions of the Study Area.

The validated vegetation mapping with the surface infrastructure has been provided in Figure 10 and a breakdown of the vegetation within the Study Area has been provided in Table 11.

The field survey confirmed that the area proposed for the surface infrastructure consists of the following PCTs:

- PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (HN556), occurring within the area proposed for surface infrastructure. Two condition classes of PCT1395 were recorded ('Good condition', and a derived grassland condition).
- Mine rehabilitation which is regarded as 'native vegetation' under the FBA. The 'best fit' PCT associated with the mine rehabilitation is PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).

Descriptions for those vegetation communities that would be impacted by surface infrastructure, along with details regarding condition, are provided in Appendix 5.

Table 11. Vegetation communities mapped within the Study Area

Plant Community Type (PCT)[4]	Formation	Class	Condition	Surface infrastructure (hectares)					Subsidence area (ha) (OEH 2013)
				REA	Powerline	TSC 1 Ventilation	TSC 2 Ventilation	Total	
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (HN556)	Dry Sclerophyll Forests (Shrub/grass subformation)	Cumberland Dry Sclerophyll Forests	PCT 1395_Good	11.06	2.06	0.67	3.47	**17.26**	**258.47**
			PCT 1395_Derived	0	0.93	5.38	0	**6.31**	**Not Mapped**
No best fit – have used PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).	No best fit - Dry Sclerophyll Forests (Shrubby subformation)	No best fit - Sydney Hinterland Dry Sclerophyll Forests	Mine rehabilitation	14.20	0	0	0	**14.20**	**389.34**
PCT849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (HN528)	Grassy Woodlands	Coastal Valley Grassy Woodland	Moderate/Good	0	0	0	0	**0**	**9.05**
PCT1181 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564)	Dry Sclerophyll Forests (Shrubby subformation)	Sydney Hinterland Dry Sclerophyll Forests	Moderate/ Good	0	0	0	0	**0**	**332.10**
Non-native/ Infrastructure/ cleared/ not mapped	N/A	N/A	N/A	41.90	0.85	3.58	0.01	**46.34**	**855.15**
Total				**67.16**	**3.84**	**9.63**	**3.47**	**84.11**	**1844.11**

[4] Niche validated mapping within the area proposed for surface infrastructure, and OEH (2013) mapping for the remainder of the Study Area.

5.3 Threatened Ecological Communities

A list of Threatened Ecological Communities (TECs) occurring or potentially occurring within the locality as generated from the database searches detailed in section 3, is provided in Appendix 2. The database searches identified 27 TECs that have been identified as potentially occurring within the locality. However, based on the results of the detailed vegetation validation, an analysis of existing vegetation mapping by OEH (2013), and review of the Conservation Advice of the TECs, two TECs are considered to occur within the Study Area:

- (PCT 1395) Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (HN556) which aligns to Shale Sandstone Transition Forest, a Critically Endangered Ecological Community (CEEC) under both the BC Act and EPBC Act. The validated vegetation mapping confirmed the presence of Shale Sandstone Transition Forest within the disturbance areas as shown in Figure 11. Two condition classes were attributed to the TEC within the Study Area based on the structure and occurrence of weeds (see Appendix 5 for details): good condition (17.26 hectares) and a derived grassland form of the community (6.31 hectares) The extent of this TEC has been mapped in Figure 11.
- PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion which aligns to Cumberland Plain Woodland (HN528) is listed as CEEC under both the BC Act and EPBC Act. This unit has been mapped by OEH (2013) as occurring in the Study Area (Figure 8). Given the expanse of the Study Area within private property, survey was limited to accessible areas. As such, it is possible that Cumberland Plain Woodland may occur as small patches within some private properties throughout the Study Area. Regardless, this limitation is relatively minor given Cumberland Plain Woodland occurs away from riparian areas that may be subject to impacts from subsidence, and similarly is not specifically ground-water dependant. Therefore, should any surface soil cracking within the TEC occur, the TEC is unlikely to be subject to significant floristic or structural change (section 8.2). This community would not be directly impacted by surface infrastructure.

Turpentine Ironbark Forest in the Sydney Bioregion was identified by DoEE (2018) as a TEC that could potentially be impacted by the Project (Section 2.1.2). However, this TEC was not recorded during the field survey, nor has it previously been mapped as occurring within the Study Area by Tozer et al (2006) or OEH (2013). The Study Area also occurs predominately within the Wollondilly LGA which is not an LGA listed in the Scientific Determination for the Sydney Turpentine Ironbark Forest. However, it is noted in OEH (2013) that a similar form of Sydney Turpentine Ironbark Forest occurs more widely in the Wollondilly and Hawkesbury areas. Based on the results of the field survey, and existing vegetation mapping, no similar communities to Sydney Turpentine Ironbark Forest occur within the Study Area. As such, it is highly unlikely that Sydney Turpentine Ironbark Forest occurs within the Study Area, and thus is not likely to be impacted by the Project.

5.4 Site Values scoring

The Site Value score used in the BBCC are obtained from the collection of transects and plots completed for each of the PCTs and condition classes within the Study Area. The Site Value scores are used to determine the present condition of the PCT to be impacted.

5.4.1 Flora

Twelve BioBanking plots were undertaken within the surface infrastructure footprint during the September 2019 field survey, whilst further plots were undertaken outside of the surface infrastructure footprint during previous survey campaigns (Figure 9; Table 10). The results of the plot and transect data recorded during the field assessment is provided in Appendix 5.

During the field survey over 265 flora species were recorded across the Study Area. This included a total of 75 introduced species.

5.4.2 Site Values

The Site Value assessment was carried out by entering the data obtained from transects and plots into the BBCC. The data provides quantitative measures of 10 site attributes (section 5.1) for each vegetation zone impacted by surface infrastructure. The BBCC compares the benchmark for the vegetation type or class to provide the Site Value score. This score represents the overall condition of the vegetation compared against the benchmark.

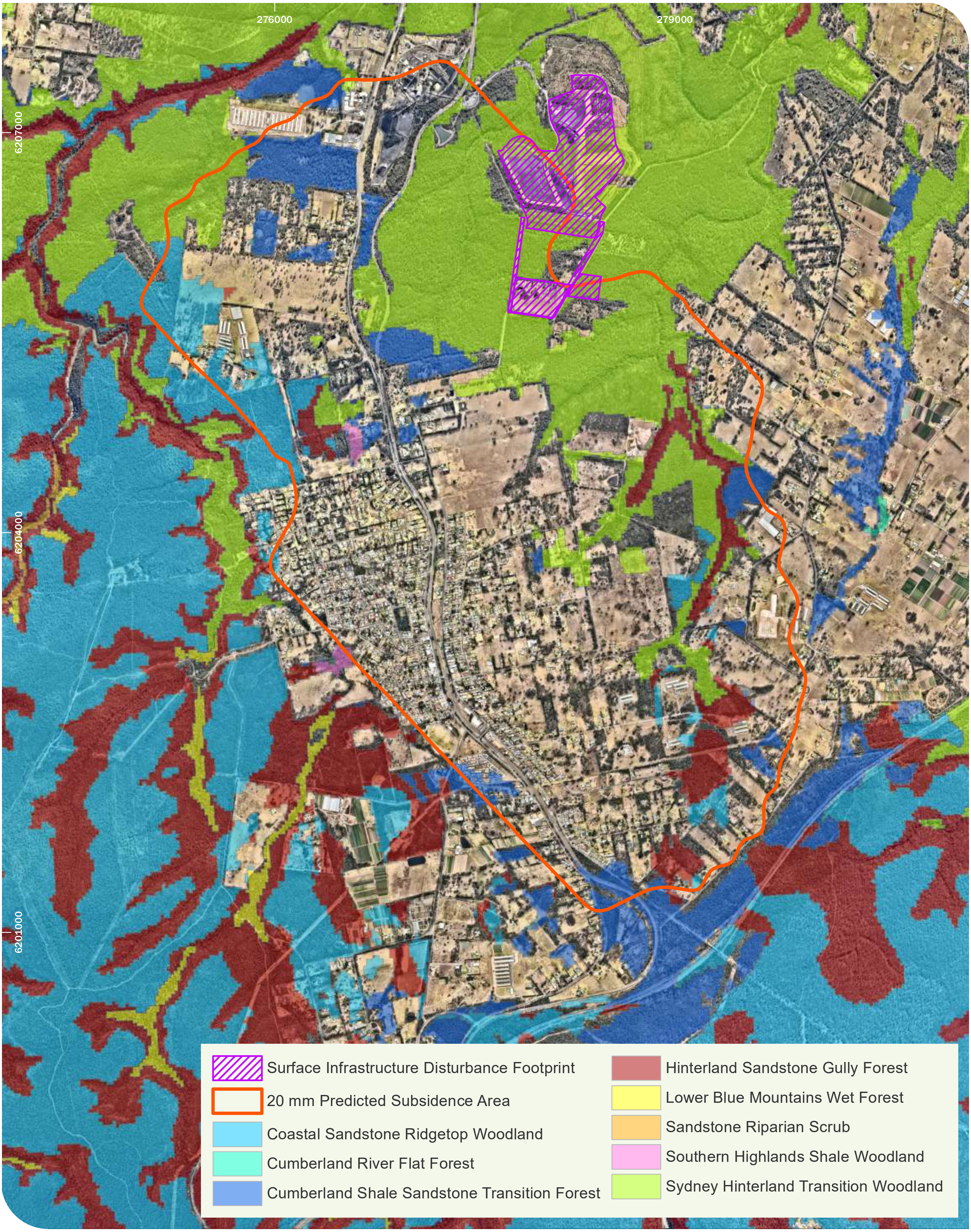
Vegetation that would be cleared for surface infrastructure, was then assigned a future Site Value score of zero given the biodiversity values in these areas would be lost.

The score from these inputs, coupled with other data in the following section of this report, is used to determine the number of ecosystem credits that are required to offset the biodiversity impacts associated with the Project.

5.5 Limitations

Vegetation to be directly disturbed for surface infrastructure was surveyed in accordance with the FBA. However, due to the size of the Study Area, and location across a significant number of private landholdings, not all vegetation within the Study Area could be inspected. As such, the OEH (2013) vegetation mapping has been used for areas that were unable to be inspected. We see this as a minor limitation given vegetation outside of the area proposed for surface infrastructure are unlikely to be impacted by subsidence (section 8.2)

While some plant species are cryptic and detection can be difficult, given the surveys were completed across numerous years during different months, this has provided a suitable period to sufficiently detect the range of native and threatened flora species should they be present.



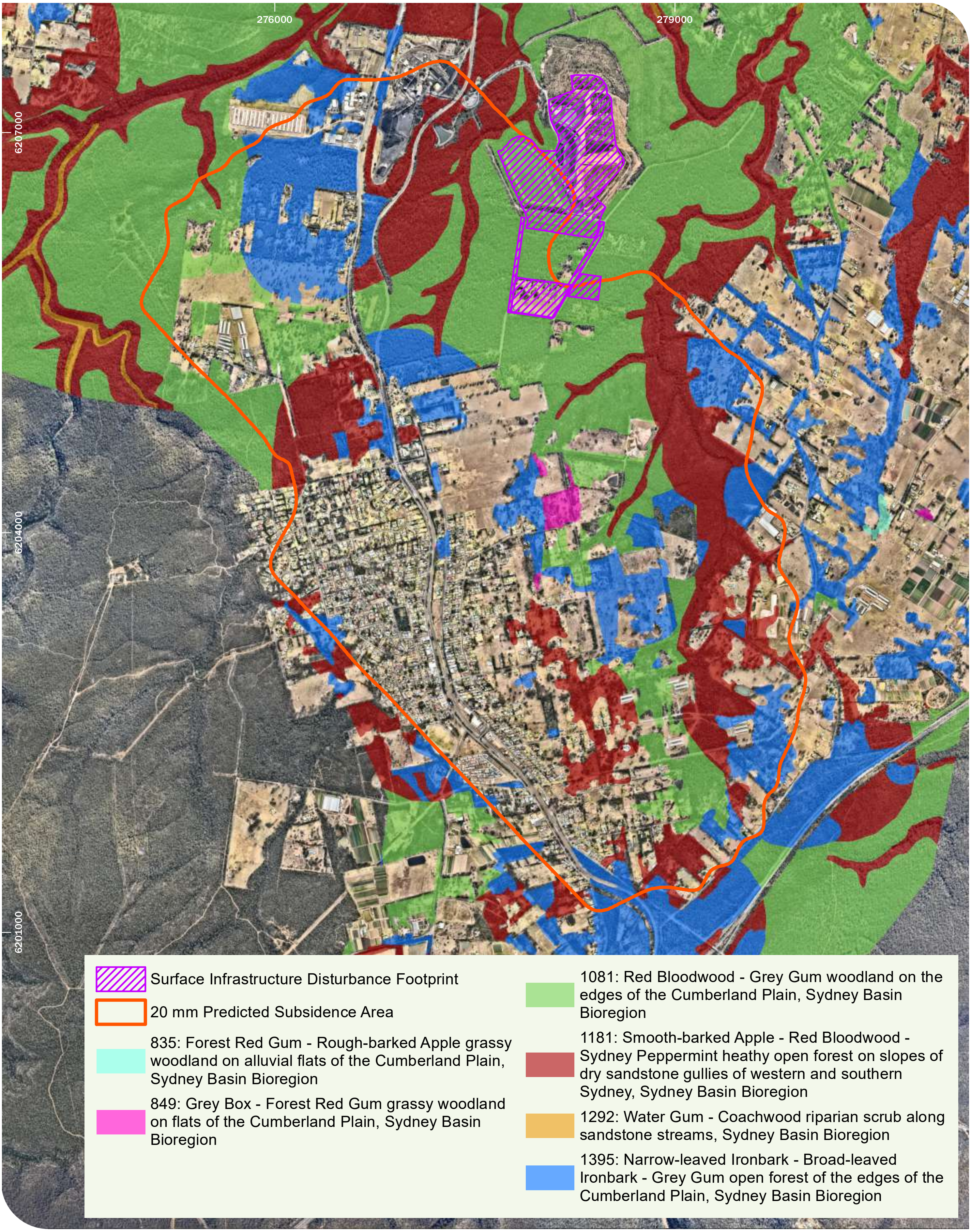
niche Environment and Heritage

Vegetation Mapping (Tozer et al. 2006)

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 7



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niche Environment and Heritage

0 750
m
GDA 1994 MGA Zone 56

Vegetation Mapping (OEH 2013)
Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 8

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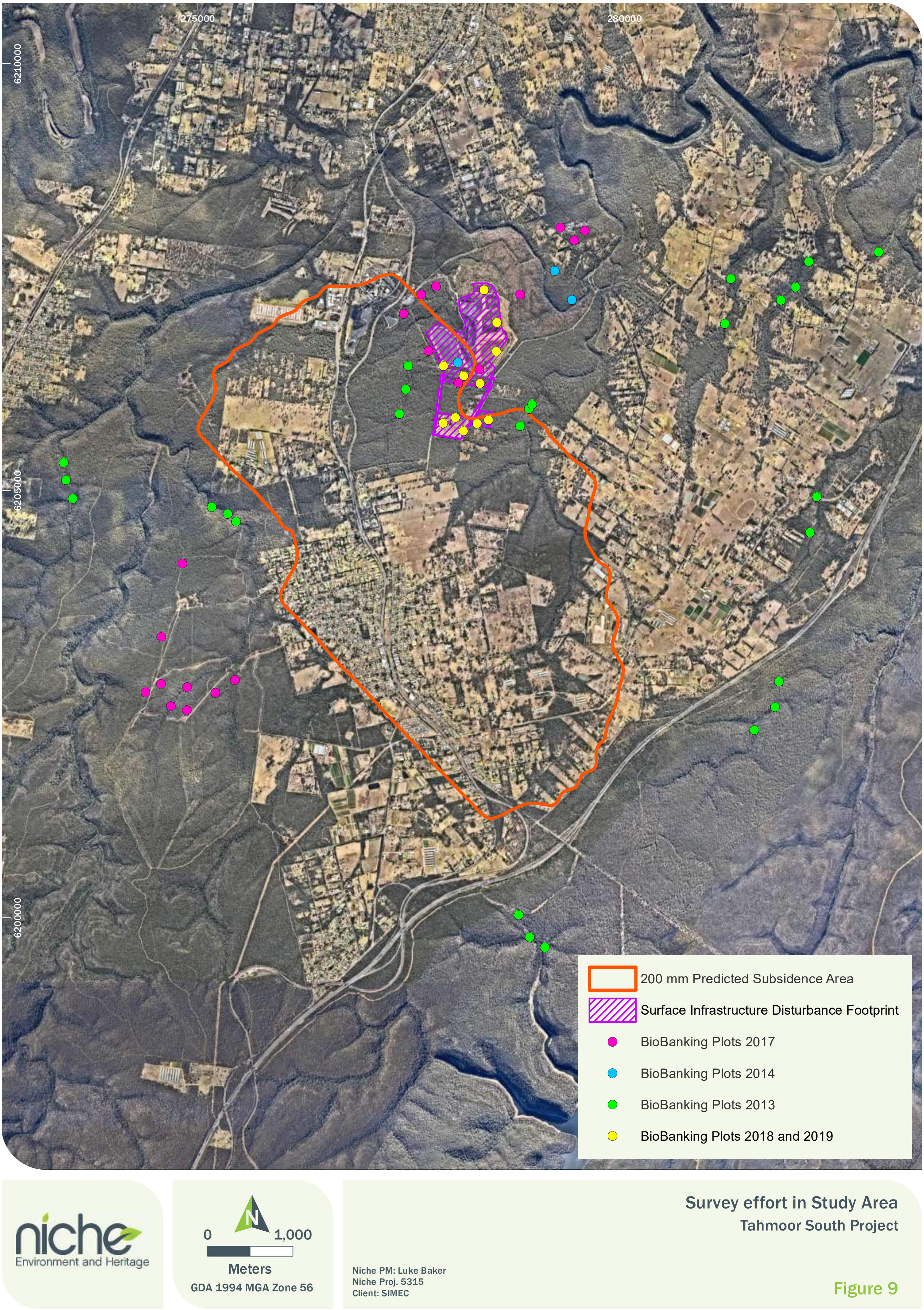

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Survey effort in Study Area

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. 5315
Client: SIMEC

Figure 9

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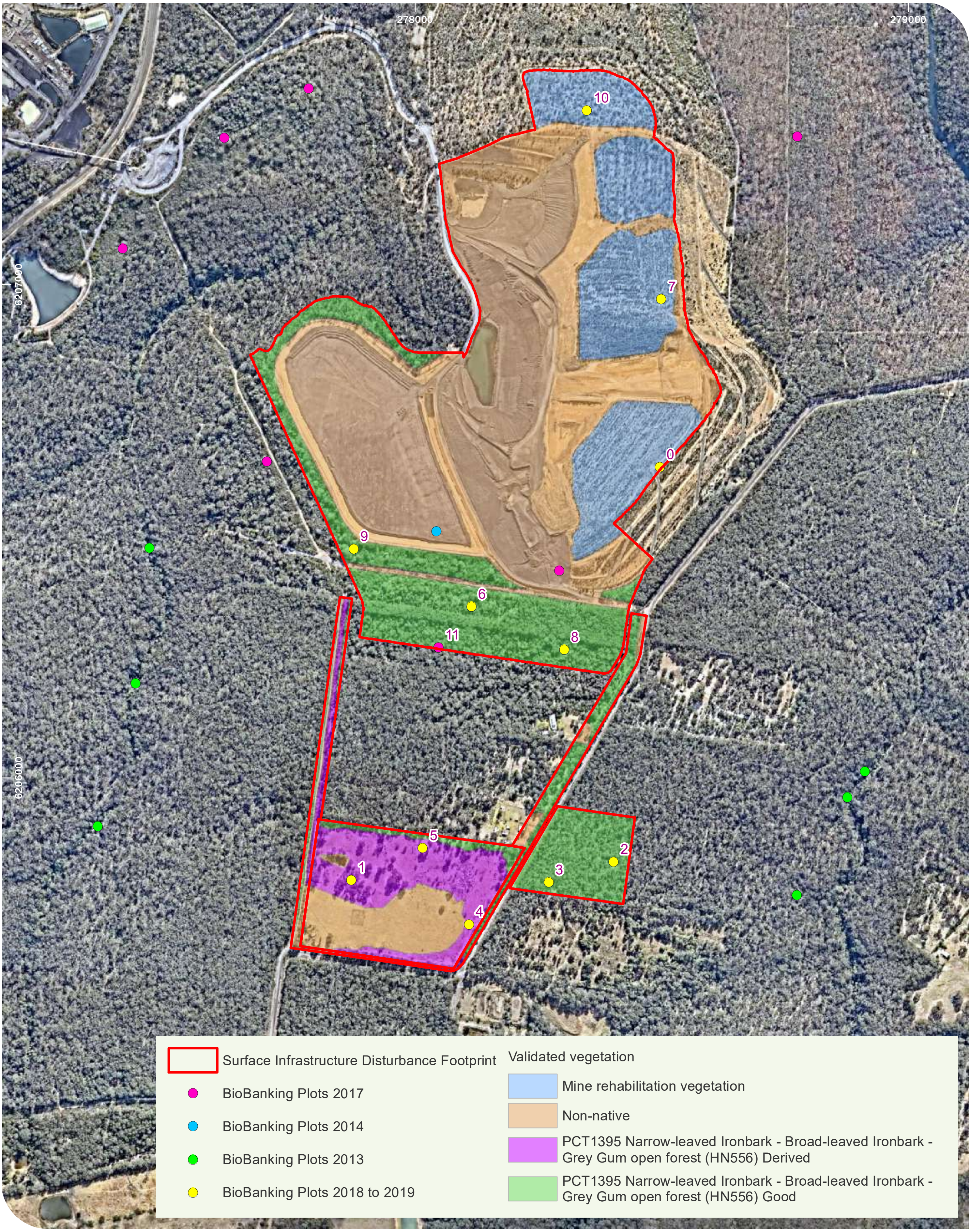

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niche Environment and Heritage

0 200
Meters
GDA 1994 MGA Zone 56

Validated vegetation mapping with survey effort

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. 5315
Client: SMEC

Figure 10

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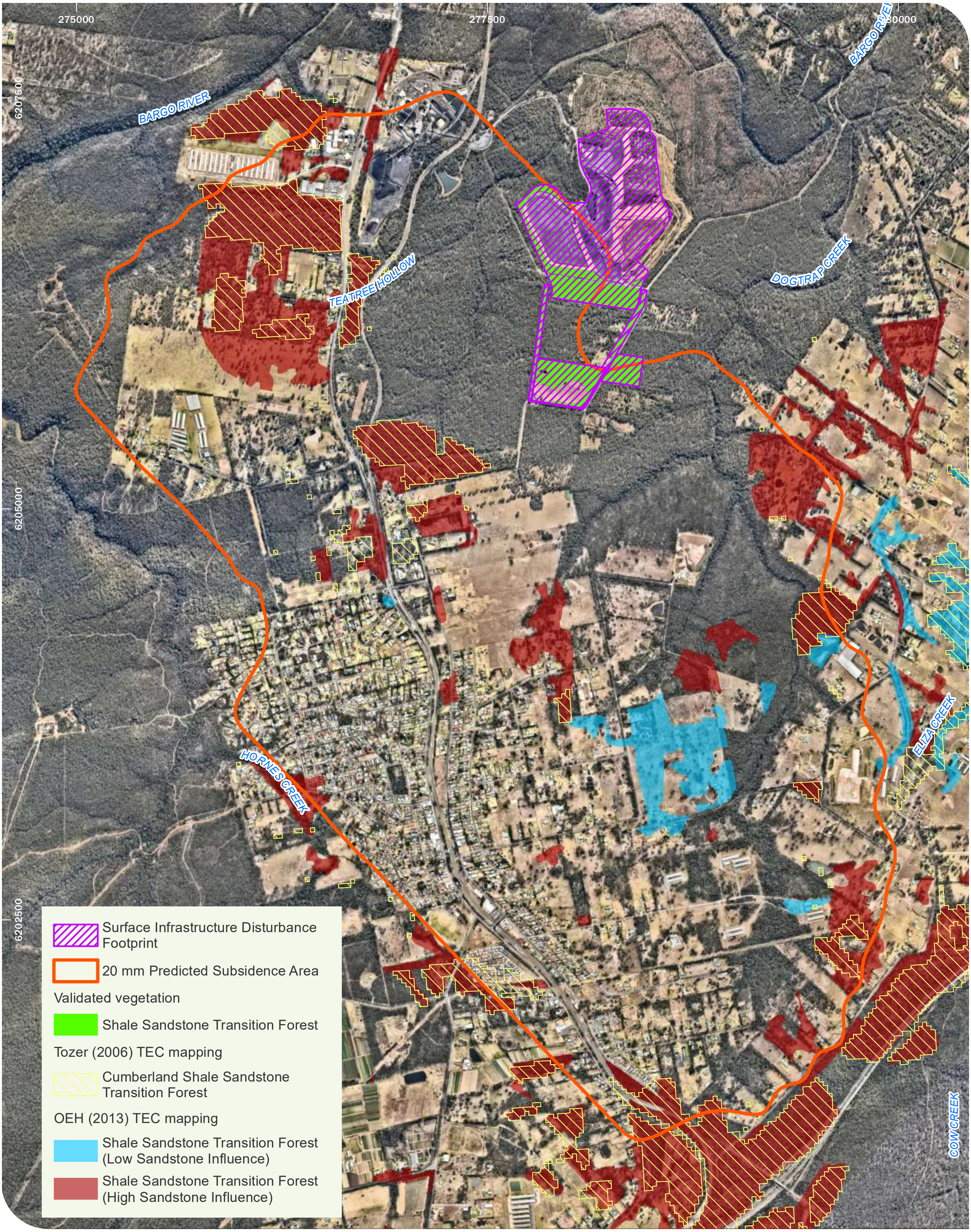

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Environment and Heritage

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0 500
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Niche PM: Luke Baker
Niche Proj. 3680
Client: SIMEC

Threatened Ecological Communities
Tahmoor South Project

Figure 11

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6. Assessing threatened species and populations

6.1 Threatened flora

6.1.1 Threatened flora survey

Based on the results of the database review, 47 threatened flora species have been recorded or have potential habitat within 10 km of the Study Area. The potential for the species to occur within the Study Area is discussed in Appendix 1.

Extensive targeted threatened flora survey has been completed by Niche across the Study Area since 2013. The survey, in the first instance was to detect the presence and habitat for those threatened flora listed as key species for consideration on the SEARs: *Persoonia bargoensis, Persoonia glaucescens, Persoonia hirsuta*; and secondly to detect all threatened flora that has the potential to occur within the Study Area.

The survey effort was completed during recommended survey times identified in the BBCC, which is consistent with survey times recommended in Commonwealth Guidelines.

The survey entailed the following:

- Targeted walking meanders through habitat types to be disturbed by the infrastructure footprint
- Targeted walking transects within riparian habitats of the Study Area
- Threatened flora population counts for *Epacris purpurascens* var. *purpurascens*, *Persoonia bargoensis, Grevillea parviflora* subsp. *parviflora* and *Pomaderris brunnea*.

Approximately 362 hours of threatened flora transects and random meanders have been completed within the Study Area since 2011. A further 160 hours was completed within watercourses in the Study Area associated with the Tahmoor South Riparian Monitoring Project. The survey effort, completed over different years and seasons, provides a greater level of certainty on the presence/absence of threatened flora within the Study Area.

A summary of the survey effort is provided in Table 12 with detailed effort provided in Appendix 3.

Table 12. Summary of the threatened flora survey effort

Survey	Survey details	Estimated total hours of survey effort
Pilot study (2011-2012)	A habitat based flora assessment and opportunistic threatened flora survey was completed over four days from the 5th to the 8th of December 2011, and on the 11th and 16th of April 2012.	6 hours
Riparian monitoring (2012-2013)	Threatened flora surveys were completed whilst traversing the Study Area on foot to get to monitoring site locations. Many of the traverses were along riparian zones within the following watercourses within the Study Area and outside– Teatree Hollow Creek, Dogtrap Creek, Hornes Creek, Eliza Creek, Carter Creek, Cow Creek, Waterhouse Gully and Dry Creek. The first year of riparian vegetation monitoring was conducted by two botanists from 18 to 27 June 2012, and again from 5 to 13 December 2012. The second year of riparian vegetation monitoring was conducted between the 3 of June and the 15 of June 2013.	80 hours during 2012 monitoring 80 hours during 2013 monitoring

Survey	Survey details	Estimated total hours of survey effort
REA detailed survey (2013)	Targeted threatened flora surveys were completed within the surface disturbance area surrounding the existing REA from November 2012 to January 2013. The proposed REA expansion and vegetation immediately surrounding the REA was investigated by four ecologists from November 2012 to January 2013. Targeted threatened flora survey and population counts for *Grevillea parviflora* subsp. *parviflora*, *Persoonia bargoensis*, and *Pomaderris brunnea* were completed.	100 hours
Ventilation shafts, haul road and powerline easement (2013)	The original location of the ventilation shaft sites, haul road and powerline were investigated by two ecologists over five days in June 2013 and a day in September 2013. The assessment included detailed vegetation mapping and threatened flora survey. The location of the ventilation shaft sites, haul road and powerline have since been removed from the current Project design.	40 hours
Detailed survey across Study Area (2017)	An update of the previous survey assessments was completed by two ecologists on 13th to the 17th of September 2017. The purpose was to inspect the condition of the vegetation, re-count flora populations, and gain additional floristic plot data. During the assessment an additional four BioBanking plots/transects were completed to accompany the 53 plots/transects completed during the 2013 survey. Targeted threatened flora surveys were undertaken across the disturbance areas, along with a population count for *Grevillea parviflora* subsp. *parviflora*.	24 hours
Ventilation shafts, Hornes Creek and carpark.	Survey assessments was completed by two ecologists on 12th September 2018 to the 19th of September 2018. The purpose was to validate the vegetation mapping within the ventilation shaft site and carpark, complete threatened flora survey and counts within these areas. During the assessment an additional seven BioBanking plots/transects were completed. Targeted threatened flora surveys were undertaken across the disturbance areas, along with a population count for *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis*. Following the results of the subsidence assessment, a small portion of Hornes Creek in the north-west of the Subsidence Study Area was surveyed given it was not originally in the area proposed to experience subsidence.	32 hours
Ventilation shafts, REA and powerline	Surveys were completed by two ecologists over 3 days in September 2019. Threatened flora population counts for *Grevillea parviflora* subsp. *parviflora*, *Persoonia bargoensis* and *Pomaderris brunnea* were undertaken within the powerline and the new REA footprint. Each individual was marked with a GPS location to accurately determine the number of individuals impacted by the Project. The survey also GPS located all Hollow-bearing trees within the surface infrastructure footprint.	32 hours

Table 13. Recommended threatened flora survey time matrix as specified in BBCC

Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Addressed in survey
Acacia gordonii	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Allocasuarina glareicola	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Persoonia bargoensis	Yes	Yes	Yes	Yes	Yes							Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Pomaderris brunnea	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Acacia bynoeana	Yes	Yes	Yes						Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Darwinia biflora	Yes	Yes							Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Darwinia peduncularis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Melaleuca deanei	Yes	Yes										Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Dillwynia tenuifolia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.

Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Addressed in survey
Dillwynia tenuifolia - endangered population Kemps Creek	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Acacia pubescens	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Epacris purpurascens subsp. *purpurascens*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Eucalyptus sp. *Cattai*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Grevillea parviflora subsp. *supplicans*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Gyrostemon thesioides	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Persoonia hirsuta	Yes	Yes	Yes	Yes	Yes							Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Haloragodendron lucasii	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Hibbertia superans							Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.

Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Addressed in survey
Lasiopetalum joyceae	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Leucopogon fletcheri subsp. *fletcheri*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Marsdenia viridiflora subsp. *viridiflora - endangered population*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Pultenaea pedunculata									Yes	Yes	Yes		Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Persoonia glaucescens	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Persoonia nutans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Persoonia mollis subsp. *maxima*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Pimelea curviflora subsp. *curviflora*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Grevillea parviflora subsp. *parviflora*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.

Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Addressed in survey
Pterostylis saxicola									Yes	Yes	Yes		Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Tetratheca glandulosa							Yes	Yes	Yes	Yes	Yes		Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Wahlenbergia multicaulis - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No habitat present. Survey completed during the flowering time for the species.
Leucopogon exolasius	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.
Zieria involucrata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during known flowering time. Conspicuous species unlikely to remain undetected.

6.1.2 Threatened flora survey results

Seven threatened flora species were recorded throughout the Study Area and surrounds during field surveys undertaken by Niche (Figure 12). These were: *Acacia bynoeana* (recorded outside Study Area), *Epacris purpurascens* var. *purpurascens, Grevillea parviflora* subsp. *parviflora, Persoonia hirsuta, Persoonia glaucescens* var. *glaucescens, Persoonia bargoensis,* and *Pomaderris brunnea*.

However, within the area proposed for the clearing of surface infrastructure, only *Grevillea parviflora* subsp. *parviflora, Persoonia bargoensis* and *Pomaderris brunnea* were recorded (Figure 13). As shown on the Figure, a population of *Pomaderris brunnea* was also recorded immediately adjacent to the riparian habitat of Teatree Hollow Creek which occurs within the Study Area adjacent to the existing REA.

No other threatened flora were recorded within portions of the Study Area that would be cleared, or within, or adjacent to riparian vegetation according to MSEC (2020) which may exhibit some localised die back in association with gas emissions from subsidence.

Acacia bynoeana

No individuals of *Acacia bynoeana* were recorded during the threatened flora surveys completed by Niche within the Study Area despite targeted survey. Furthermore, no records held by OEH occur within the Study Area (Figure 12).

Approximately 20 records for *Acacia bynoeana* were recorded during the 2018 survey immediately to the west of the Study Area within the land owned by Tahmoor Coal. The population was recorded sporadically along the entrance to a Fire Road off Ashby Close within PCT HN566 Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux, Sydney Basin. This PCT does not occur within the area to be cleared for the Project, and does not occur within any habitat that may be impacted by subsidence. For these reasons, and the absence of records for *Acacia bynoeana* within the Study Area, the species has not been assessed further.

Epacris purpurascens* var. *purpurascens

A large population of *Epacris purpurascens* var. *purpurascens* was recorded along both sides of Anthony Road, Bargo, and within Crown Land immediately to the north of Anthony Road (Figure 12). The population of *Epacris purpurascens* var. *purpurascens* within this area consists of more than 500 individuals.

Epacris purpurascens var. *purpurascens* was not recorded in the area proposed to be disturbed for surface infrastructure, and as such, the known population would be avoided. Furthermore, the population is located away from subsidence sensitive environments (eg. riparian areas). Therefore, impacts to *Epacris purpurascens* var. *purpurascens* have therefore not been discussed further.

Grevillea parviflora subsp. parviflora

Grevillea parviflora subsp. *parviflora* was recorded extensively within the Study Area (Figure 12 and Figure 13). Within the surface infrastructure development footprint the species was recorded in the powerline corridor and the REA.

A total of 491 individuals were recorded in the amended surface infrastructure disturbance footprint, the majority of which were located within the powerline line corridor. The individuals are likely part of a large population that extends north along Charlies Point Road, and east of the REA as shown in Figure 13.

Given 491 individuals of *Grevillea parviflora* subsp. *parviflora* occur within the surface infrastructure disturbance footprint, impacts towards this species are discussed further in section 8.4.

Persoonia bargoensis

In total, 692 individuals of *Persoonia bargoensis* were recorded in the Study Area during the surveys, with the bulk of the population occurring along Charlies Point Road to the north-east of the surface infrastructure disturbance footprint (Figure 13). The surface infrastructure disturbance footprint will impact on eight *Persoonia bargoensis* individuals from the larger population. As such, the species has been considered further in section 8.4.

Persoonia hirsuta

Persoonia hirsuta was not recorded within the area proposed for surface infrastructure, or the riparian areas of the Study Area despite targeted survey. One record obtained from the OEH bionet database occurs to the far west of the Study Area (Figure 12). The records occur within private landholdings which could not be verified as part of this assessment. The records coincide with Dry Sclerophyll Forest vegetation located away from riparian zones within the Study Area. The potential impacts to this record are discussed further in further in section 8.4.

Persoonia glaucescens

Persoonia glaucescens was not recorded within the area proposed for surface infrastructure, or the riparian areas of the Study Area despite targeted survey. However, a number of records obtained from the OEH bionet database occur throughout the Study Area (Figure 12). For the most part, the records occur within private landholdings which could not be verified as part of this assessment. The records coincide with Dry Sclerophyll Forest vegetation located away from riparian zones within the Study Area. The potential impacts to these records are discussed further in further in section 8.4

Pomaderris brunnea

Pomaderris brunnea was recorded along Teatree Hollow during the field survey, which occurs immediately to the west of the existing REA. A large population of the species was recorded in this location, with the greatest concentration of the population occurring within the Tahmoor Coal mining lease near the REA. Over 300 individuals were recorded along the mid and upper banks of Teatree Hollow Creek as shown in Figure 13.

One individual was also recorded along a historic easement which is the proposed location for the powerline. This one plant would therefore need to be removed for the surface infrastructure (Figure 13). The potential impacts to *Pomaderris brunnea* are discussed further in section 8.4.

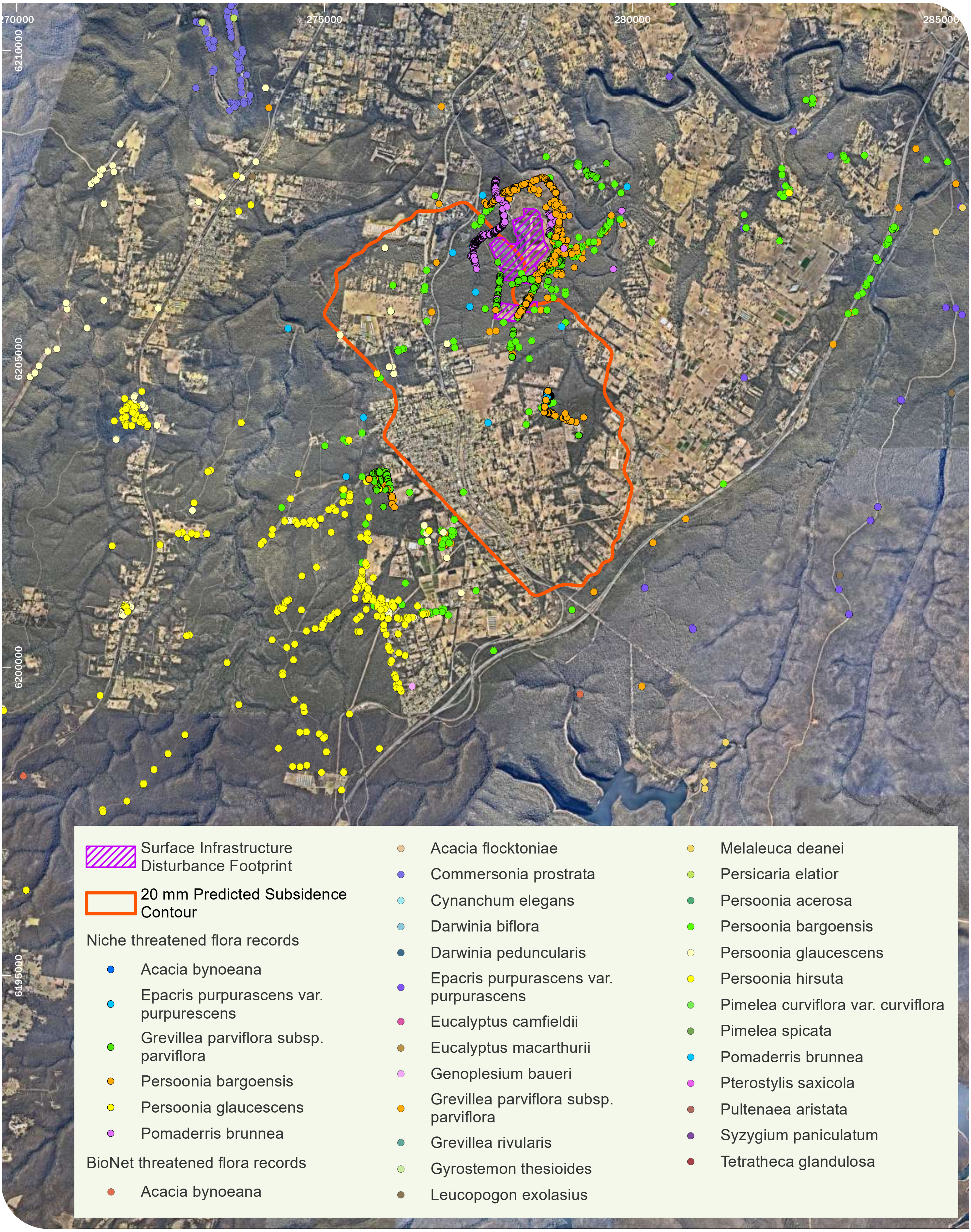
6.1.3 EPBC Act listed flora

Of the threatened flora recorded, *Acacia bynoeana, Grevillea parviflora* subsp*. parviflora, Persoonia hirsuta, Persoonia glaucescens var. glaucescens, Persoonia bargoensis,* and *Pomaderris brunnea*, are listed under the EPBC Act.

The remaining EPBC Act listed threatened flora determined from the database analysis have been assigned a low likelihood of occurrence due to not being detected during targeted threatened flora surveys or having limited habitat within the Study Area (Appendix 1).

Of particular note, *Leucopogon exolasius* has been nominated by DoEE as potentially being impacted by the Project. However, this species was not recorded during the current survey, nor has it been recorded previously within the Study Area. The species is known to prefer woodland on sandstone amongst rocky hillsides along creek banks. Such features are present along the creek-lines of the Study Area; however, the species is relatively conspicuous, and unlikely to remain undetected during the riparian monitoring program. Furthermore, the areas proposed for surface infrastructure would not clear habitat for the species as it is situated away from riparian areas. The closest known record occurs approximately 1.8 kilometres to north-west of the Study Area, and another approximately 2.2 kilometres to the south of the Study Area. Neither records would be impacted by the Project. Given the lack of detection, and no known records in the Study Area, it is unlikely that *Leucopogon exolasius* would be present within the Study Area.

The impacts on EPBC Act listed flora are discussed in section 8.4.3.



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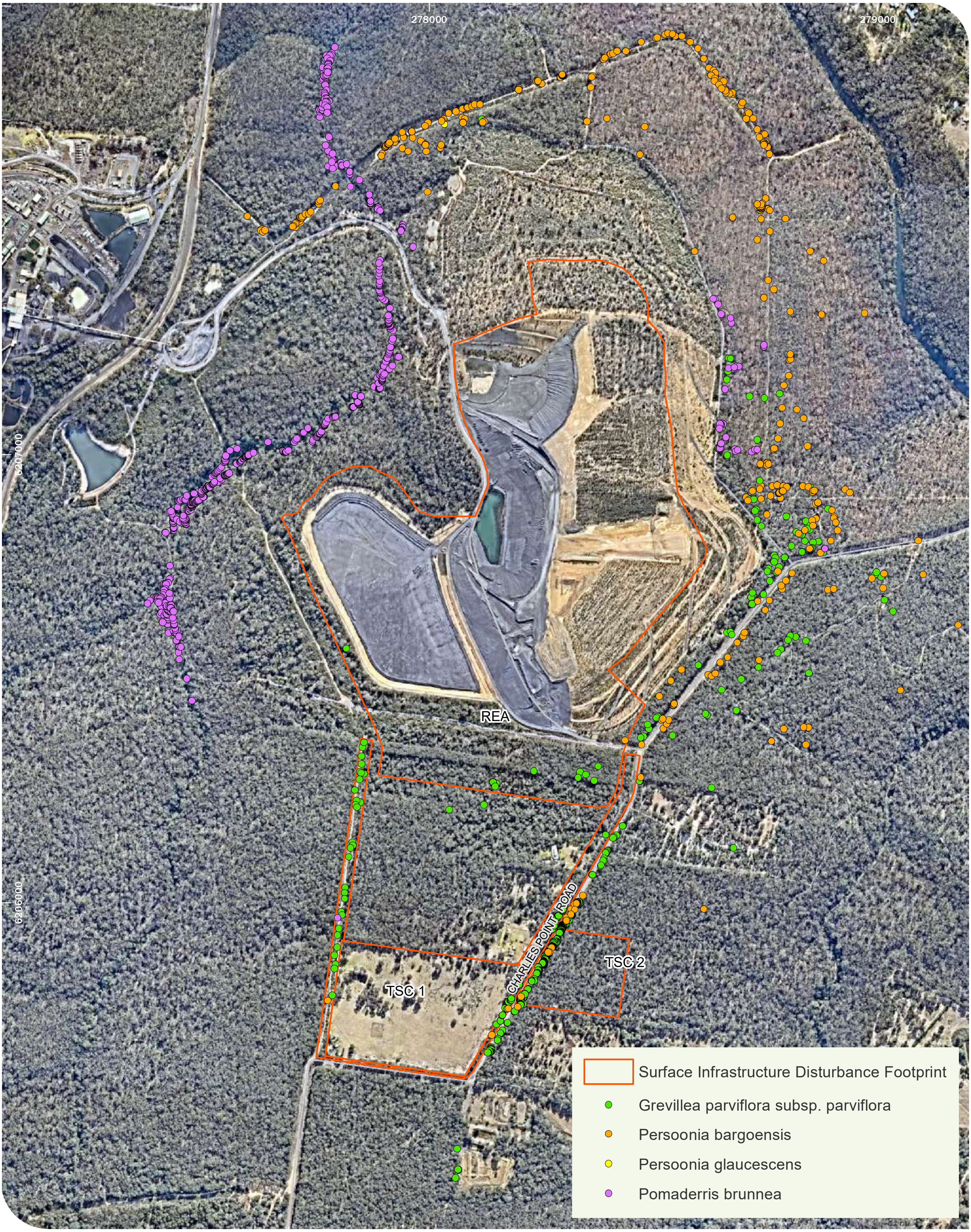
GDA 1994 MGA Zone 56

Threatened flora recorded in the surface infrastructure footprint

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 12



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Threatened flora recorded in the surface infrastructure footprint

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 13

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Persoonia bargoensis population extent

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 14

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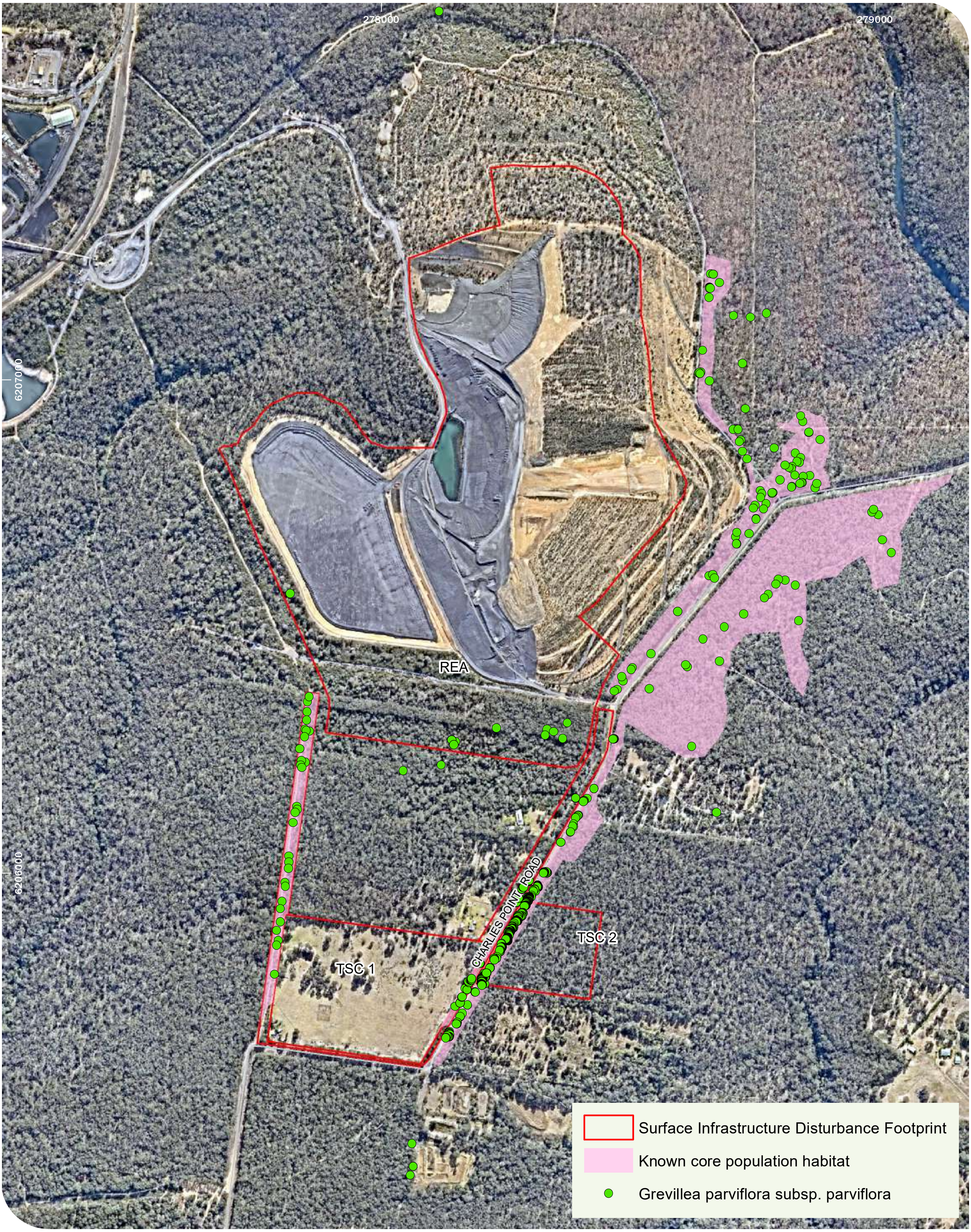

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GDA 1994 MGA Zone 56

Grevillea parviflora subsp. parviflora population extent

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 15

6.2 Threatened fauna

6.2.1 Database analysis

Seventy-four threatened fauna species have been recorded or predicted to occur within 10 km of the Study Area (Appendix 1). Of these species listed under the BC Act, 21 are regarded as 'species credit species' or 'dual credit species', which unlike 'ecosystem credit species' cannot be assumed present based on the presence of habitat surrogates. Species credit fauna include:

- **Birds:** Eastern Bristlebird, Red Goshawk
- **Amphibians:** Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet
- **Reptiles:** Broad-headed Snake (only if breeding habitat present)
- **Invertebrates:** Cumberland Plain Land Snail
- **Mammals:** Eastern Pygmy-possum, Large-eared Pied Bat, Southern Brown Bandicoot, Eastern Bent-wing Bat (only if breeding habitat present), Little Bent-wing Bat (only if breeding habitat present), Large-footed Myotis, Squirrel Glider, Brush-tailed Rock-wallaby, Koala (only if breeding habitat present), Grey-headed Flying-fox (only if breeding habitat present), Eastern Cave Bat and Greater Glider.

The results of the database search assisted in formulating the targeted fauna survey design, which had an emphasis on species credit fauna, and the Broad-headed Snake and Koala as both these species were specified for consideration in the SEARs.

6.2.2 Fauna survey effort

The fauna field surveys incorporated both targeted surveys using established survey techniques (as described in Table 14 and Appendix 4) and habitat-based assessment taking into consideration State and Commonwealth survey guidelines. The survey also took into consideration those threatened fauna and the recommended survey timing as specified in the BBCC which have been included in Table 18.

The fauna survey design had an emphasis on the detection of species credit fauna where habitat was present. Since ecosystem credit species (see Appendix 1) have a high likelihood of being present on the site (based on the presence of habitat surrogates) specific targeted survey was not always performed for these species. However, the design attempted to detect the range of fauna using the Study Area in order to assist with evaluating its importance to fauna more generally.

Details regarding the survey effort and techniques employed are provided below, and the location of each survey are provided in Figure 16 and Figure 17. Further detail regarding dates of field survey and weather details during the survey period are provided in Appendix 4.

Table 14. Fauna survey details and effort

Method	Survey effort (hours/trap nights)	Total hours	Species credit fauna targeted	EPBC Act listed fauna targeted
2019 survey effort (focused on the REA and ventilation shaft sites)				
Spotlighting	12 hours over 2 nights	12 hours	Koala, Greater Glider, Squirrel Glider.	Koala, Greater Glider.
Koala scat searches	3 hours	3 hours	Koala.	Koala.
Cumberland Plain land Snail Searches within	4 hours	4 hours	Cumberland Plain Land Snail.	-

Method	Survey effort (hours/trap nights)	Total hours	Species credit fauna targeted	EPBC Act listed fauna targeted
ventilation shaft sites and REA				
2018 survey effort (focused on the ventilation shaft sites, Hornes Creek)				
Camera traps	10 camera traps over 10 nights	2,400 hours	Threatened mammals: Eastern Pygmy-possum, Southern Brown Bandicoot, and Brush-tailed Rock-wallaby. Reptiles including Rosenberg's Goanna.	Eastern Pygmy-possum, Spotted-tail Quoll, Southern Brown Bandicoot, Long-nosed Potoroo, New Holland Mouse and Brush-tailed Rock-wallaby.
Call play-back	2 hours over 2 nights	2 hours	Koala, Greater Glider, Squirrel Glider.	Koala, Greater Glider.
Spotlighting	12 hours over 2 nights	12 hours	Koala, Greater Glider, Squirrel Glider.	Koala, Greater Glider.
Birds surveys	3 mornings	2.5 hours	All threatened birds.	All threatened and migratory birds.
Koala scat searches	6 hours	6 hours	Koala.	Koala.
Cumberland Plain land Snail Searches within ventilation shaft sites and REA	24 hours	24 hours	Cumberland Plain Land Snail.	-
Songmeters	3 nights in one location	68 hours	Large-eared Pied Bat, Eastern Bent- wing Bat, Little Bent-wing–Bat, Large-footed Myotis, Eastern Cave Bat.	Large-eared Pied Bat.
Songmeter (Hornes Creek)	3 nights in one locations	72 hours	Large-eared Pied Bat, Eastern Bent- wing Bat, Little Bent-wing–Bat, Large-footed Myotis, Eastern Cave Bat.	Large-eared Pied Bat.
2017 survey effort (focused on the REA and surrounds)				
Camera traps	29 camera traps over 10 nights	6,980 hours	Threatened mammals: Eastern Pygmy-possum, Southern Brown Bandicoot, and Brush-tailed Rock-wallaby. Reptiles including Rosenberg's Goanna.	Eastern Pygmy-possum, Spotted-tail Quoll, Southern Brown Bandicoot, Long-nosed Potoroo, New Holland Mouse and Brush-tailed Rock-wallaby.
Call play-back	3 hours over 3 nights	3 hours	Koala, Greater Glider, Squirrel Glider.	Koala, Greater Glider.
Spotlighting	24 hours over 3 nights	24 hours	Koala, Greater Glider, Squirrel Glider.	Koala, Greater Glider.
Birds surveys	3 mornings	2.5 hours	All threatened birds.	All threatened and migratory birds.
Koala scat searches	6 hours	6 hours	Koala	Koala
Frog searches (Dogtrap Creek, Teatree Hollow Creek, Eliza Creek)	3 days and 2 nights	24 hours	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet.	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet.
Cumberland Plain land Snail Searches	18 hours	18 hours	Cumberland Plain Land Snail	-
Niche 2013 survey effort within REA and surrounds				

Method	Survey effort (hours/trap nights)	Total hours	Species credit fauna targeted	EPBC Act listed fauna targeted
Camera traps	9 days (18 camera traps)	3,888 hours	Threatened mammals, reptiles including Rosenberg's Goanna, Eastern Pygmy-possum, Southern Brown Bandicoot, and Brush-tailed Rock-wallaby.	Eastern Pygmy-possum, Spotted-tail Quoll, Southern Brown Bandicoot, Long-nosed Potoroo, New Holland Mouse and Brush-tailed Rock-wallaby.
Koala scat searches	7 hours, 2 ecologists	14 hours	Koala	Koala
Spotlighting/stag watch	16 hours, 2 ecologists	32 hours	Koala, Squirrel Glider, and threatened owls	Koala, threatened owls
Snail searches	3.25 hours, 2 ecologists	6.5 hours	Cumberland Plain Land Snail	Cumberland Plain Land Snail
Call playback	24 hours	24 hours	Koala, Greater Glider, Squirrel Glider.	Koala, Greater Glider, Powerful Owl
Cumberland Plain land Snail Searches	17.5 hours	17.5 hours	Cumberland Plain Land Snail	-
Frog searches	12 hours, 2 ecologists	24 hours	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet.	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet.
Songmeters	5 nights in one location	60 hours	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet.	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet.
Harp traps	5 nights in four locations	72 hours	Large-eared Pied Bat, Eastern Bent- wing Bat, Little Bent-wing–Bat, Large-footed Myotis, Eastern Cave Bat.	Large-eared Pied Bat
Songmeters	9 nights in three locations	324 hours	Large-eared Pied Bat, Eastern Bent- wing Bat, Little Bent-wing–Bat, Large-footed Myotis, Eastern Cave Bat.	Large-eared Pied Bat,
Arboreal cage traps	150 trap nights (30 traps, 5 nights)	1,800 hours	Greater Glider, Squirrel Glider	Greater Glider, Squirrel Glider
Hair tubes	9 days (30 tubes)	6,480 hours	Southern-brown bandicoot, Squirrel Glider, Greater Glider	Eastern Pygmy-possum, Spotted-tail Quoll, Southern Brown Bandicoot, Long-nosed Potoroo, New Holland Mouse and Brush-tailed Rock-wallaby.
Reptile spotlighting	4 hours, 2 ecologists	8 hours	Broad-headed Snake	
Reptile habitat search/rock turning	4 hours, 2 ecologists	8 hours	Broad-headed Snake	
Bird searches	20 minutes each site (6), 2 ecologists + opportunistic	5 hours	All threatened birds	All threatened and migratory birds

Method	Survey effort (hours/trap nights)	Total hours	Species credit fauna targeted	EPBC Act listed fauna targeted
Habitat search and site familiarisation	2 hours, 2 ecologists	4 hours	All species	All species
Niche 2013 Survey effort within ventilation shaft and tranine (locations since removed from Project)				
Camera traps	5 traps, 10 days	1,200 hours	Threatened mammals Eastern Pygmy-possum, Southern Brown Bandicoot, and Brush-tailed Rock-wallaby and reptiles ncluding Rosenberg's Goanna,	Eastern Pygmy-possum, Spotted-tail Quoll, Southern Brown Bandicoot, New Holland Mouse and Brush-tailed Rock-wallaby.
Spotlight	2 hours, 2 ecologists, 2 nights	8 hours	Koala, Squirrel Glider	Koala
Habitat assessment - Vent Shaft TSC1	4 hours	4 hours	All species	All species
Habitat assessment - Vent Shaft TSC2	8 hours	8 hours	All species	All species
Habitat assessment - Vent Shaft TSC3	8 hours	8 hours	All species	All species
Habitat assessment - Powerline	8 hours	8 hours	All species	All species
Niche 2012-2013 Amphibian Monitoring Project				
Targeted amphibian monitoring - Dogtrap Creek	4 hours per ecologist	8 hours	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Red-crowned Toadlet.	Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog.
Songmeter - Dogtrap Creek	4 nights	36 hours		
Targeted amphibian monitoring - Teatree Hollow	4 hours per ecologist	8 hours		
Songmeter - Teatree Hollow	3 nights	36 hours		
Targeted amphibian monitoring - Eliza Creek	3.5 hours per ecologist	7 hours		
Targeted amphibian monitoring - Dry Creek	3.25 hours per ecologist	6.5 hours		
Targeted amphibian monitoring - Hornes Creek	5.5 hours per ecologist	11 hours		
Targeted amphibian monitoring - Cow Creek	4.5 hours per ecologist	9 hours		
Songmeter - Cow Creek	8 nights	72 hours		
Targeted amphibian monitoring - Carter Creek	2 hours per ecologist	4 hours		
Targeted amphibian monitoring - Bargo River tributary	2.25 per ecologist	4.5 hours		
Targeted amphibian monitoring - Bargo River	2 hours per ecologist	4 hours		

Niche 2018 survey effort

The trapping techniques used during the survey are detailed in the table below.

Table 15. Trapping methodology employed during the 2018 survey

Trapping technique	Details
Infra-red Camera traps	Camera trapping was conducted over 10 nights. Ten infra-red motion sensing cameras were deployed across the ventilation shaft site and the surrounding habitat. A PVC tube baited with a mixture of honey, oats and peanut butter was placed in front of the camera traps.
Koala searches	Searches were conducted during two days by two ecologists within areas of potential habitat in ventilation shaft sites. Potential Koala habitat was determined by the presence of known feed tree species (mostly *Eucalyptus punctata*) and trees suitable for shelter. Two ecologists conducted the searches, focusing on separate trees. Each tree was examined for scratches and a scat search was performed for at least one minute around the base of the tree and under the tree canopy.
Spotlighting/stag watch	Spotlighting surveys were conducted over two nights. The spotlighting survey targeted Koalas, owls and arboreal mammals. Opportunistic stag watch occurred during the spotlighting survey. The surveys were performed on foot throughout the ventilation shaft footprint and immediate surrounds.
Call playback	Call playback was conducted over two nights. After an initial listening period of up to 30 minutes, calls of the target species were broadcast through a 10 watt megaphone for five minutes followed by a five minute listening period and a period of spotlighting. Target species included: Koala, Powerful Owl, Barking Owl, Sooty Owl, Masked Owl, Squirrel Glider and Greater Glider.
Diurnal bird searches	Bird surveys were undertaken over three mornings when birds are at their most active, between 7 am and 10 pm. The surveys involved listening and searching for birds using binoculars. Each survey lasted 20 minutes and was conducted by one ecologist within areas of the surface infrastructure footprint and immediate surrounds. Opportunistic sightings of bird species (particularly threatened species) were also noted during other field work.
Cumberland Plain Land Snail	Two ecologists spent 6 hours each over three days looking for the Cumberland Plain Land Snail within the ventilation shaft sites, REA and immediate surrounds. This involved looking amongst leaf litter, bark, and under logs.

Niche 2017 survey effort

The trapping techniques used during the survey are detailed in the table below.

Table 16. Trapping methodology employed during the 2017 survey

Trapping technique	Details
Infra-red Camera traps	Camera trapping was conducted over 10 nights. Twenty-nine infra-red motion sensing cameras were deployed across REA Area 1 and REA 2 and the surrounding habitat. A PVC tube baited with a mixture of honey, oats and peanut butter was placed in front of the camera traps.
Koala searches	Searches were conducted during one day by two ecologists within areas of potential habitat in REA Area 1 and REA Area 2. Potential Koala habitat was determined by the presence of known feed tree species (mostly *Eucalyptus punctata*) and trees suitable for shelter. Two ecologists conducted the searches, focusing on separate trees. Each tree was examined for scratches and a scat search was performed for at least one minute around the base of the tree and under the tree canopy.
Spotlighting/stag watch	Spotlighting surveys were conducted over three nights. The spotlighting survey targeted Koalas, owls and arboreal mammals. Opportunistic stag watch occurred during the spotlighting survey. The surveys were performed on foot throughout the surface infrastructure area footprint and immediate surrounds.
Call playback	Call playback was conducted over three nights. After an initial listening period of up to 30 minutes, calls of the target species were broadcast through a 10 watt megaphone for five minutes followed by a five minute listening period and a period of spotlighting. Target species included: Koala, Powerful Owl, Barking Owl, Sooty Owl, Masked Owl, Squirrel Glider and Greater Glider.
Reptile habitat search	Herpetological surveys were conducted opportunistically and included diurnal targeted searches under rocks, timber, logs and tree bark in identified potential habitat throughout the surface infrastructure footprint.
Diurnal bird searches	Bird surveys were undertaken over three mornings when birds are at their most active, between 7 am and 10 pm. The surveys involved listening and searching for birds using binoculars. Each survey lasted 20 minutes and was conducted by one ecologist within areas of the surface infrastructure footprint and immediate surrounds. Opportunistic sightings of bird species (particularly threatened species) were also noted during other field work.
Amphibian survey	An amphibian survey of Teatree Hollow Creek, Eliza Creek, Dry Creek and Dogtrap Creek was conducted by Dr Frank Lemckert (amphibian expert) to determine habitat potential for threatened amphibians including: Red-crowned Toadlet, Giant Burrowing Frog and Littlejohn's Tree Frog. This involved traversing portions of the creeks to identify key areas of habitat, and inspecting existing pools for exotic fish which may inhibit tadpole development/survival should the species occur.
Cumberland Plain Land Snail	Two ecologists spent 6 hours each over three days looking for the Cumberland Plain Land Snail within the ventilation shaft sites, REA and immediate surrounds. This involved looking amongst leaf litter, bark, and under logs.

Niche 2013 survey effort

During the 2013 survey effort, six fauna trap sites were established. Each trapping area incorporated infra-red camera traps, hair tubes and tree mounted cage traps. All other survey techniques were conducted broadly within each of the six sites, in and around the trapping areas.

Table 17. Trapping methodology employed during the 2013 survey

Trapping technique	Details
Infra-red Camera traps	Camera trapping was conducted in November 2012 and March 2013. Eighteen infra-red motion sensing cameras were deployed at the six trapping sites, with three cameras at each trapping site. A PVC tube baited with sardines or a mixture of honey, oats and peanut butter was placed in front of the camera traps. Upon recovery, the pictures were individually analysed and animals were identified to the lowest possible taxonomic level. Each camera trap was deployed for nine days (and nights). In March 2013, three cameras were deployed to address gaps in previous survey effort. The cameras were deployed for seven days (and nights).
Koala searches	Searches were conducted during November 2012 and March 2013 in the proposed REA and control sites within areas of potential habitat. Potential Koala habitat was determined by the presence of known feed tree species (mostly *Eucalyptus punctata*) and trees suitable for shelter. Two ecologists conducted the searches, focusing on separate trees. Each tree was examined for scratches and a scat search was performed for at least one minute around the base of the tree and under the tree canopy.
Spotlighting/stag watch	Spotlighting surveys were conducted in November 2012 and March 2013. The spotlighting survey targeted owls and arboreal mammals. Opportunistic stag watching occurred throughout the spotlighting survey. The surveys were performed either on foot or via a vehicle around roads and tracks of the proposed REA and adjacent areas.
Call playback	Call playback was conducted during November 2012 and March 2013. Call-playback sites were established at each trapping site to enable maximum coverage. After an initial listening period of up to 30 minutes, calls of the target species were broadcast through a 10 watt megaphone for five minutes followed by a five minute listening period and a period of spotlighting. Target species included: Koala, Powerful Owl, Barking Owl, Sooty Owl and Masked Owl.
Remote bat detectors - SM2 detection	Wildlife Acoustics SM2 Bat detector units were deployed along identified flyways and around watercourses throughout the proposed REA and control sites during November 2012 and March 2013 survey. Data was analysed by qualified specialists: Amy Rowles (Ecotone) and Matthew Stanton (Niche).
Harp trapping	During November 2012 survey, harp traps were set up in trapping areas at REA 1 and in areas adjacent to the Study Area. The harp traps were set up in areas which were regarded as ideal flyways. Traps were checked at sunrise daily.
Arboreal cage traps	Trapping was conducted during the November 2012 field work. At each of the six trapping areas, five wire cage traps were used to target arboreal mammals (approximate cage dimensions of 18 x 18 x 55 centimetres). Each trap was mounted at a height of approximately three metres above the ground, with the Elliott and cage traps mounted on

Trapping technique	Details
	wooden brackets. Each trap tree was sprayed daily with a brown sugar/honey mixture. Traps were checked daily at sunrise.
Cage trap	Where suitable habitat occurred for ground dwelling mammals (e.g. Spotted-tail Quoll), one wire cage trap was placed on the ground within the trap line.
Hair tubes	Hair tubes were set up in November 2012 for nine days (and nights). PVC hair tubes were attached to trees with electrical tape and secured under logs or other debris on the ground at each of the six sites. Double sided tape was only adhered to the upper and lateral inner surface of the tubes so as to limit the incidence of 'by catch'. Tubes were baited with a mixture of honey, oats and peanut butter. Hair samples were sent to Barbara Triggs (Dead Finish) for analysis. Targeted fauna included arboreal and ground dwelling mammals.
Reptile spotlighting	Herpetological surveys were conducted in November 2012 and March 2013. Surveys were conducted during spotlighting for other species and were performed either on foot or via a vehicle around roads and tracks of the proposed REA and control sites.
Reptile habitat search	Herpetological surveys were conducted in November 2012 and March 2013, and included diurnal targeted searches under rocks, timber, logs and tree bark in identified potential habitat throughout the proposed REA and along the ridgetop environments when traversing to the amphibian and riparian monitoring sites.
Diurnal bird searches	Bird surveys were undertaken in the morning when birds are at their most active, between 7 am and 10 pm. The surveys involved listening and searching for birds using binoculars. Each survey lasted 20 minutes and was conducted by two ecologists at each of the six sites during November 2012. Opportunistic sightings of bird species (particularly threatened species) were also noted during other field work.
Habitat based assessment	Habitat assessments were conducted at each of the vent shaft sites and along the powerline route. At each site, observations of important fauna habitat were made. Habitat characteristics and parameters that were assessed included: ▪ Aspect/slope of the site ▪ Dominant vegetation, floristic composition and structure ▪ Composition of ground layer (bare earth, litter, fungi, moss, lichen etc.) ▪ Presence and relative abundance of key habitat features (e.g. tree hollows, large logs, exfoliating rock, flowering resources, aquatic features) ▪ Vegetation age structure. Key habitat features were recorded on a GPS. Bird species were opportunistically surveyed for during habitat assessment at each of the sites.

Table 18. Recommended threatened fauna survey time matrix as specified in BBCC

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Addressed in survey
Cumberland Plain Land Snail	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Targeted surveys completed during September and June.
Eastern Pygmy-possum													None specified, however targeted surveys completed during September, November and June.
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Surveys completed during November, December. Not in LGA regardless.
Giant Burrowing Frog	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes	Amphibian monitoring completed in April, May, November, and December.
Green and Golden Bell Frog	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes	Amphibian monitoring completed in November, December.
Koala	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Targeted surveys completed during September, November and June.
Large-eared Pied Bat	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Anabats used during September and November.
Red-crowned Toadlet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Targeted surveys completed during September, November and June.
Regent Honeyeater	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Targeted surveys completed during September, November and June.
Rosenberg's Goanna	Yes	Yes									Yes	Yes	Targeted surveys completed during November.
Squirrel Glider	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Targeted surveys completed during September, November and June.

Targeted amphibian monitoring

The amphibian monitoring was conducted by two ecologists during spring and autumn in 2012, and again in 2013. Details regarding the survey dates and weather conditions are provided in Appendix 4.

A total of 39 locations were surveyed for frogs at riparian sites covering 13 creeks in the Study Area. The monitoring locations consisted of 18 control sites and 21 impact sites (Figure 16).

Surveys at each site were conducted along a 200 metre transect that was searched once in each of the two above mentioned survey periods.

The monitoring surveys along transects comprised:

- Nocturnal aural and visual searches of selected watercourses to locate and record the presence of Red-crowned Toadlet, Green and Golden Bell Frog, Littlejohn's Tree Frog, Giant Burrowing Frog and Stuttering Frog. The searches were area constrained, searching within 10 m either side of the selected 200 m length of stream.
- Nocturnal call playback, based on OEH guidelines for effort, to further increase survey success for the above-mentioned species. This was conducted at the same time as the aural/visual searches.
- Tadpole searches, using effort-constrained dip net surveys, was conducted as part of daytime transect surveys, providing on-going monitoring of reproductive success within the Study Area. Dip netting was undertaken in permanent pools greater than 1m in diameter and other selected pools where tadpoles were located. The number of sweeps required to thoroughly sample the pool was recorded along with the size of the pool at the time of sampling. This provided a unit of effort per sample that could be standardised for comparisons. Diurnal searches and call playbacks were carried out opportunistically at the same time as the tadpole sampling.
- Automated recording of frog calls using Song Meters to monitor the presence of the listed threatened species of concern along transects located in areas that are difficult/unsafe to reach for night surveys.

6.3 Fauna survey results

6.3.1 Fauna

A total of 78 fauna species were recorded between 2013 and 2019. This included: eight amphibians, 45 birds, 17 mammals and eight reptiles. The results of the survey are provided in Appendix 7.

6.3.2 Threatened fauna

A total of 14 threatened fauna species have been previously recorded in the Study Area according to OEH BioNet records (Figure 19). Species include: White-bellied Sea-Eagle, Black Falcon, Sooty Tern, Powerful Owl, Brown Treecreeper, Black-chinned Honeyeater, Varied Sittella, Dusky Woodswallow, Diamond Firetail, Koala, Grey-headed Flying-fox, Eastern Freetail-Bat, Large-eared Pied Bat, and Greater Broad-nosed Bat. The record for Sooty Tern was an isolated occurrence and unusual as the Study Area does not provide habitat for this species.

During the Niche survey, eleven threatened fauna listed on the BC Act were recorded within the Study Area, within, or immediately adjacent to the proposed surface infrastructure disturbance footprint (Figure 18, Figure 19). Threatened fauna recorded include: Glossy Black Cockatoo, Varied Sittella, Little Eagle, Powerful Owl, Scarlet Robin, Sooty Owl, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Free-tail Bat, Large-footed Myotis and Eastern Cave Bat.

Two threatened amphibians - Red-crowned Toadlet (*Pseudophryne australis*) and Giant Burrowing Frog (*Heleioporus australiacus*), were recorded during the Niche Amphibian Monitoring Program in 2013, however both records were outside the Study Area (Figure 18). The Giant Burrowing Frog was recorded within Waterhouse Gully Creek, whilst the Red-crowned Toadlet was recorded at Hornes Creek. Both species are also likely to have habitat within Cow Creek, which occurs outside of the Study Area within the Upper Nepean Conservation Area.

Given the size of the Study Area, the relatively mobile nature of the majority of the threatened fauna predicted to occur within the locality, and the presence of suitable habitat, an additional 18 threatened species have a moderate to high likelihood of occurring in the Study Area and/or the surface infrastructure disturbance footprint.

Each of the species have been included in included in Table 18, along with their associated 'credit class', and if the species needs to considered further in the impact assessment chapter of this report.

It should be noted that the Broad-headed Snake, whilst nominated in the SEARs and listed as a species credit fauna for breeding habitat only, has been attributed a low likelihood of occurrence to occur in the Study Area and the area proposed for surface infrastructure works. The Broad-headed Snake has not been recorded in the Study Area during current surveys, nor has the species previously been recorded within the Study Area.

The closest records for the Broad-headed Snake are approximately 4.5 km to the south-west of the Study Area along the ridgeline of the Bargo River, and 6.1 km to the south along Avon River. Both these areas are within conservation lands managed by NSW NPWS and WaterNSW respectively.

Important rock outcrops for this species are those on ridgelines facing north or west, as the species relies upon specific thermal conditions that are only attained in such ridgelines. These outcrops must have limited to no shading from the woodland canopy, again to allow penetration of high levels of sunlight. Finally, the outcrop must also include suitable rock exfoliations, which take the form of thin layers of rock resting directly on larger rock and without sand or debris between the layers (Pringle et al. (2003), Webb and Shine (1994) and Webb and Shine (1998a, 1998b & 1998c).

Table 19. Threatened fauna recorded during Niche surveys or with a moderate to high likelihood of occurrence

Common Name	Scientific Name	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	BC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species	Consideration
Gang-gang Cockatoo	*Callocephalon fimbriatum*	High	Moderate	V	-	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat is impacted by the Project. Breeding habitat is described in BioNet (2019) as the presence of suitable habitat AND 1. presence of nest OR; 2. observation indicates a pair of birds on site. Given no individuals were observed on site during targeted surveys and hollows are uncommon in the surface infrastructure area (Figure 19). As such, the species is considered as an ecosystem credit species for this assessment and not discussed further.
Glossy Black Cockatoo	*Calyptorhynchus lathami*	Known	Known	V	-	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat is impacted by the Project. The species was recorded during the survey, however, the 'species credit' listing only occurs if living or dead tree with hollows greater than 15 cm diameter and greater than 5 m above ground for nest sites (BioNet 2019) are recorded. Large hollow-bearing eucalypts are uncommon in the surface infrastructure area, and no evidence of breeding pairs or usage by the species was recorded, thus indicating that breeding habitat is unlikely. As such, the species is considered as an ecosystem credit species for this assessment and not discussed further.
Brown Treecreeper	*Climacteris picumnus victoriae*	High	High	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Varied Sittella	*Daphoenositta chrysoptera*	Known	Known	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Little lorikeet	*Glossopsitta pusilla*	Moderate	Moderate	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Little Eagle	*Hieraaetus morphnoides*	Known	Known	V	-	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat is impacted by the Project. Breeding habitat is described in BioNet (2019) as consisting of live (occasionally dead) large old trees occurs within suitable vegetation AND the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy (BioNet 2019). One bird was observed flying over the Study Area, no large stick nests or pairs were observed within the surface infrastructure footprint and the species is unlikely to be

Common Name	Scientific Name	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	BC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species	Consideration
							affected by subsidence impacts. As such, the species is considered as an ecosystem credit species for this assessment and not discussed further.
Swift Parrot	*Lathamus discolor*	High	Low	E	E	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat or important habitat is present. The species was not detected during the survey, nor are there records within the Study Area. No areas of important habitat are mapped within the Study Area. As such, the species is considered as an ecosystem credit species for this assessment and not discussed further.
Hooded robin	*Melanodryas cucullata cucullata*	Moderate	Moderate	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Black-chinned Honeyeater	*Melithreptus gularis gularis*	High	High	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Rainbow bee-eater	*Merops ornatus*	Moderate	Moderate	-	M	Not listed on EPBC Act	Not listed under the BC Act. A discussion on the impacts to EPBC Act listed species is provided in section 8.6.
Satin flycatcher	*Myiagra cyanoleuca*	Moderate	Moderate	-	M	Not listed on EPBC Act	Not listed under the BC Act. A discussion on the impacts to EPBC Act listed species is provided in section 8.6.
Turquoise Parrot	*Neophema pulchella*	Moderate	Moderate	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Barking owl	*Ninox connivens*	High	High	V	-	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat is present within the area impacted. No breeding habitat would be impacted for the Barking Owl. The Barking Owl requires living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground for nesting sites. BioNet (2019) identifies that breeding can be identified by suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified. Although suitable foraging habitat is present, the species was not recorded despite extensive surveys, and hollow bearing trees are uncommon in the surface infrastructure footprint. As such, the Barking Owl will be considered as an ecosystem credit species only and therefore will not be discussed further in this assessment.
Powerful Owl	*Ninox strenua*	Known	Known	V	-	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat is present within the area impacted. Although suitable foraging habitat is present, the species was not recorded despite extensive surveys, and hollow bearing

Common Name	Scientific Name	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	BC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species	Consideration
							trees are uncommon in the surface infrastructure footprint. As such, the Powerful Owl will be considered as an ecosystem credit species only and therefore will not be discussed further in this assessment.
Scarlet Robin	*Petroica boodang*	Known	Known	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Speckled Warbler	*Chthonicola sagittata*	Moderate	Moderate	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Diamond Firetail	*Stagonopleura guttata*	High	High	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Masked Owl	*Tyto novaehollandiae*	High	High	V	-	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat is present within the area impacted. Although suitable foraging habitat is present, the species was not recorded despite extensive surveys, and hollow bearing trees are uncommon in the surface infrastructure footprint. As such, the Masked Owl will be considered as an ecosystem credit species only and therefore will not be discussed further in this assessment.
Sooty Owl	*Tyto tenebricosa*	Known	Known	V	-	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if breeding habitat is present within the area impacted. This species is described in BioNet (2019) as utilising caves, cliff lines, ledges, living or dead trees with hollows greater than 20 cm diameter for nesting sites. On sites where the species is determined to be present AND suitable caves are present AND breeding has been detected/proven any impact could be serious and irreversible. Any other impact on the species habitat is unlikely to be a potential serious and irreversible impact. Although suitable foraging habitat is present, and the species was recorded, there was no evidence of a breeding pair utilising the surface infrastructure footprint. As such, the Sooty Owl will be considered as an ecosystem credit species only and therefore will not be discussed further in this assessment.
Regent Honeyeater	*Anthochaera phrygia*	Moderate	Low	CE	CE	Dual credit	'Dual credit' species – The 'species credit' component is only triggered if important habitat is impacted. These mapped areas do not require survey as it is presumed that the species is present. The Study Area does not include any mapped important areas, nor was the species recorded during targeted surveys. As such, the species is considered as an ecosystem credit species for this assessment.
Red-crowned Toadlet	*Pseudophryne australis*	Low-Moderate	Low	V	-	Species	The Red-crowned Toadlet was recorded outside the Study Area at Hornes Creek during the Tahmoor South Project Amphibian Monitoring Program. It was not

Common Name	Scientific Name	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	BC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species	Consideration
							recorded within any riparian area in the Study Area during the amphibian monitoring program. Given the only confirmed records of the Red-crowned Toadlet occur outside the predicted subsidence impact area, and the habitat within the Study Area is degraded by surrounding landuses, the species is unlikely to be impacted and will not be offset. Further discussion on species has been provided in section 8.5.5.
Large-eared Pied Bat	*Chalinolobus dwyeri*	Moderate (previously recorded by OEH).	Moderate	V	V	Species	Potential breeding habitat is PCTs associated with the species within 100 m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings, and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*) (BioNet 2019). Crevices in sandstone overhangs are known to occur along the cliff lines within the Study Area. However, breeding habitat is quite specific to caves. According to DERM (2010) the following is known about the specific breeding habitat: 'the structure of maternity roosts appears to be very specific (arch caves with dome roofs) - Caves need to be high and deep enough to allow juvenile bats to learn to fly safely inside and have indentations in the roof. These physical characteristics are very uncommon in the landscape'. No caves were encountered during surveys completed by Niche, nor have any caves been reported to occur in the Study Area by MSEC (2020). Although the species was not recorded by Niche in the Study Area, a record existing in BioNet for the species. OEH has also identified this species as being likely to be significantly impacted. Whilst we disagree that a significant impact would occur, the species has been assumed present and discussed further in section 8.5.2.
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Known	Known	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	Known	Known	V	-	Dual credit	The Eastern Bent-wing Bat is a dual credit species, with the presence of breeding habitat triggering the species credit requirement. This species was recorded within the surface area footprint during targeted surveys. The species is likely to use the range of habitat types present in the Study Area for foraging. Not a great deal is known about the Eastern Bent-wing bat however it is known that the species uses caves for breeding (OEH 2014). The maternity caves are reported to have very specific temperature and humidity regimes, and populations can disperse within about 300 km range of maternity caves (OEH 2014).

Common Name	Scientific Name	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	BC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species	Consideration
							Within the Study Area, no caves were encountered during surveys completed by Niche, nor have any caves been reported by MSEC (2020). Furthermore, cliff line environments which may indicate cave-like habitat, are generally limited to the Nepean River to the north of the Study Area with some scattered cliff lines along the Dogtrap Creek, and Hornes Creek. Given the specific cave requirements, the ability of the species to traverse over 300 kms from a breeding site, lack of known breeding colonies in the area, it seems quite unlikely that breeding habitat occurs within the Study Area. As such, this species has been regarded as an ecosystem credit species for this assessment.
Eastern Free-tail Bat	*Mormopterus norfolkensis*	Known	Known	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Large-footed Myotis	*Myotis macropus*	Known	Known	V	-	Species	This species was recorded within the surface area footprint of the REA during targeted surveys. The large-footed Myotis is regarded as a species credit species given its dependence of habitat surrounding waterways for roosting. Impacts to the species are discussed in section 8.5.2.
Koala	*Phascolarctos cinereus*	High (previously recorded by OEH).	Moderate	V	V	Dual credit	The Koala was not recorded in the area proposed for surface infrastructure despite targeted survey. However, numerous records from OEH Bionet exist for the Koala within the Study Area. Most of these records occur toward the far south of the Study Area, which borders the Upper Nepean State Conservation Area and land managed by WaterNSW. A number of other records exist near the Bargo township toward the far south of the Study Area, and one record for the Koala along Eliza Creek. Potential habitat for the Koala is within the dry sclerophyll vegetation communities throughout the Study Area, in particular, areas of habitat that are connected to larger vegetated parcels of land. Whilst no records for the Koala were detected during the current survey despite targeted survey, the habitat features of the area proposed for surface infrastructure form part of a corridor of vegetation along Tea Tree Hollow Creek which may support movement of the Koala throughout the area. The Koala will be offset as a species credit species under the precautionary principle and on the advice of the Department. Impacts to the Koala are discussed further in section 8.5.2.

Common Name	Scientific Name	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	BC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species	Consideration
Grey-headed Flying-fox	*Pteropus poliocephalus*	High	High	V	V	Dual credit	The Grey-headed Flying Fox is a dual credit species, with breeding habitat triggering the species credit requirement. Whilst the species may utlise the Study Area for foraging, no known breeding camp sites have been recorded in the Study Area by Niche and no camp sites have been previously recorded in the area. It is highly unlikely that camp sites exist in the Study Area. Therefore, the species is regarded as an ecosystem credit species for this assessment. Given the species is listed on the EPBC Act, further discussion has been provided in section 8.6.
Greater Broad-nosed Bat	*Scoteanax rueppellii*	High	High	V	-	Ecosystem	Ecosystem credit species - As such, the species has not been discussed further.
Eastern Cave Bat	*Vespadelus troughtoni*	Known	Known	V	-	Dual credit	This species was recorded within the surface area footprint during targeted surveys and was listed as a dual credit species at the time of submission of the original EIS. As the species was recorded within the surface area footprint, it is likely that the vegetation is suitable foraging habitat. Further discussion has been provided in section 8.5.2.
Greater Glider	*Petauroides volans*	Moderate	Low	-	V	Not listed on BC Act	Not listed under the BC Act. A discussion on the impacts to EPBC Act listed species is provided in section 8.6.
Eastern Pygmy Possum	*Cercartetus nanus*	Moderate	Moderate	V	-	Species	No Eastern Pygmy-possums were recorded in the Study Area during the surveys. It must be noted that only camera trapping was undertaken; nest boxes, nest tubes and pit fall trapping generally result in better success for detecting this species. However, the Eastern Pygmy-possum can be a difficult species to detect regardless of the survey method. The Study Area, including the surface infrastructure area supports suitable potential foraging habitat (eucalypt forest) and shelter/nesting resources (14 hollow-bearing trees) for the species. It must be noted that key food species, Callistemon and Banksia's were scarce within this community within the surface infrastructure area, indicating that it may not constitute optimal habitat for the species. The closest record (BioNet) is 3.3 km to the west of the surface impact area; in wooded habitat next to Bargo River. Given the fact that the home range of the species is relatively small (0.35-0.68 ha, OEH 2019), it is unlikely that individuals at that location would use the habitat within the surface impact area. There is also a lack of connectivity between the two areas with a large expanse of cleared, urban/rural land in between.

Common Name	Scientific Name	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	BC Act Status	EPBC Act Status	Species credit or Ecosystem Credit species	Consideration
							Regardless, based on the presence of potentially suitable habitat, and the presence of records in forested habitat in the locality, we have assumed that this species is present and offset accordingly.

Key: V = Vulnerable, CE = Critically Endangered, M = Migratory under relevant legislation

6.3.3 EPBC Act listed fauna

None of the threatened fauna recorded during the field survey are listed under the EPBC Act.

Whilst not detected, the results of the database analysis in Appendix 1 has indicated the following threatened and migratory fauna species have a moderate to high likelihood of occurrence within the Study Area:

- Migratory birds: Fork-tailed Swift, Great Egret, Cattle Egret and Rainbow Bee-eater, Satin Flycatcher
- Endangered birds: Swift Parrot, Regent Honeyeater
- Vulnerable mammals: Large-eared Pied Bat, Grey-headed Flying Fox, Koala, Greater Glider.

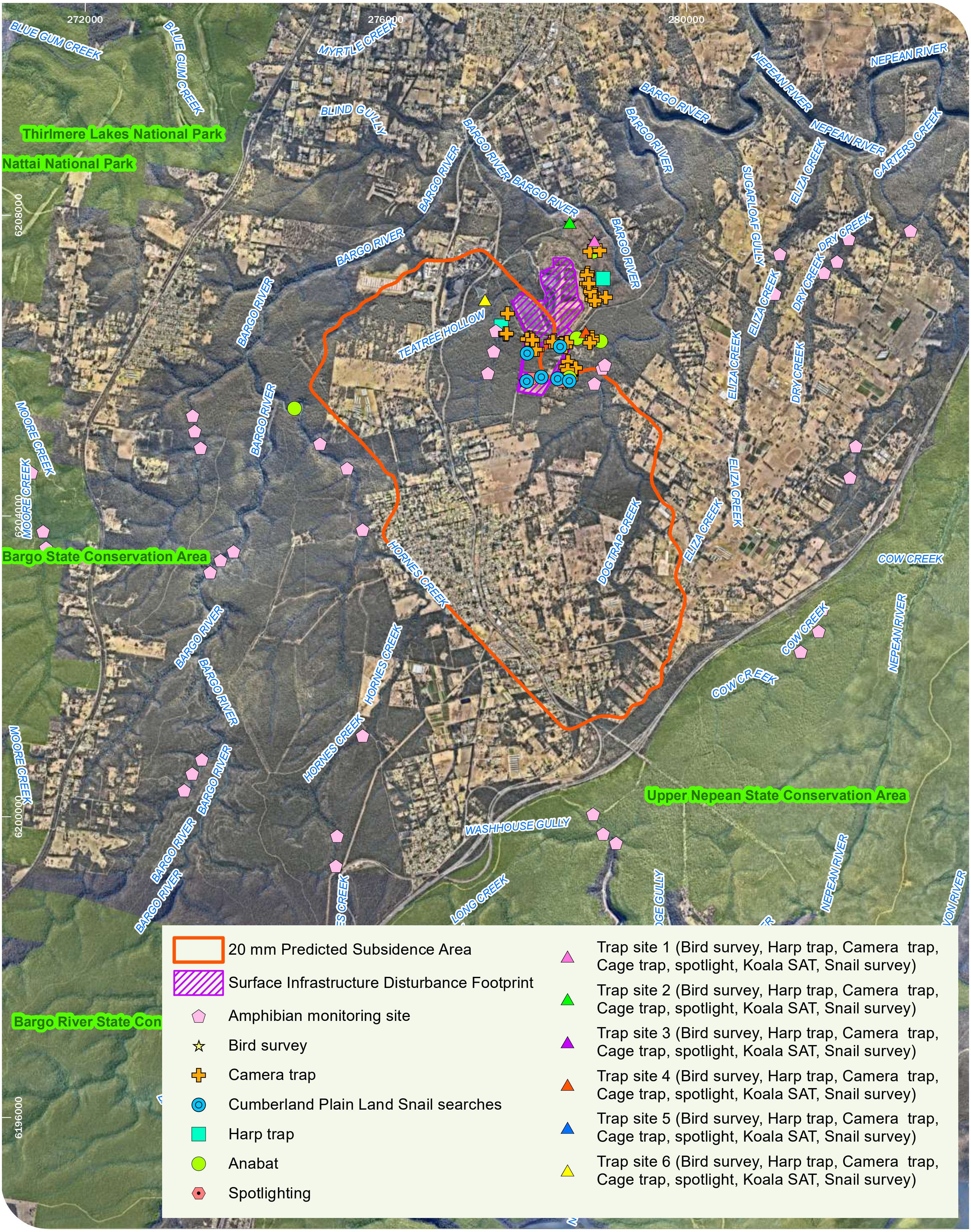
The threatened and migratory birds may utilise a wide range of habitat types for foraging, and as such cannot be ruled out from occurring within the Study Area. Similarly, as discussed in section 6.3.2, the Grey-headed Flying Fox may forage within the Study Area given the species may use a wide variety of eucalypts as a food source.

The Koala and Large-eared Pied Bat are both discussed in 6.2 and 8.5. The Koala has not been detected during previous targeted surveys, however records throughout the Locality exist for the species. The habitat features of the area proposed for surface infrastructure form part of a corridor of vegetation along Tea Tree Hollow Creek which may support movement of the Koala throughout the area. As such, the species has been assigned a high likelihood of occurrence within the Study Area.

The Large-eared Pied Bat was not detected during the field survey, however records for the species occur within the Study Area north of Teatree Hollow Creek, and to the north of the Study Area which coincides with cliff lines of the Nepean River. It is possible that crevices within the Study Area may provide some marginal habitat for the species. As such, the species has been assigned a moderate likelihood of occurrence within the Study Area.

The Greater Glider is highly unlikely to be present within the areas proposed for surface infrastructure given the lack of detection over differing time periods. The species is also typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows, which is limited within the area proposed for surface infrastructure. Few records obtained from BioNet for Greater Glider occur along the Bargo River, approximately 500 metres to the far north of the Study Area. This area of the Bargo River is more deeply incised than the other creek lines in the Study Area and may offer a more sheltered moist eucalypt forest to which the species is known to prefer. Within the Study Area Area, some marginal habitat exists along the upper gullies of Dogtrap Creek and Teatree Hollow Creek given the vegetation is part of a corridor of bushland that adjoins both the Bargo and Nepean Rivers. As such, the Greater Glider has been given a moderate likelihood of occurrence within the Study Area.

Potential impacts to these species are discussed further in section 8.5.



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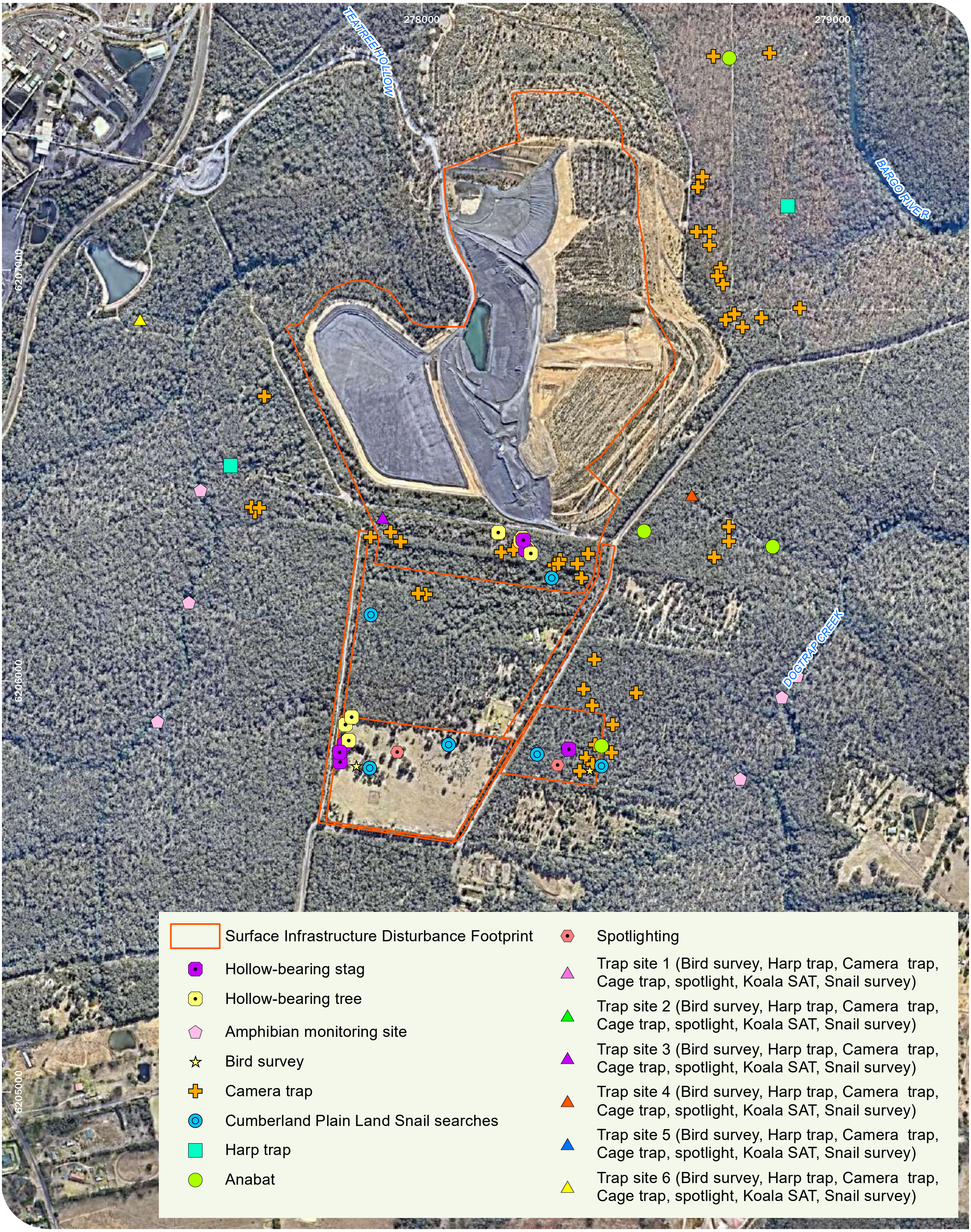
Threatened fauna survey effort in the Study Area

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 16



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Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Threatened fauna survey effort in surface infrastrucure disturbance area

Tahmoor South Project

Figure 17

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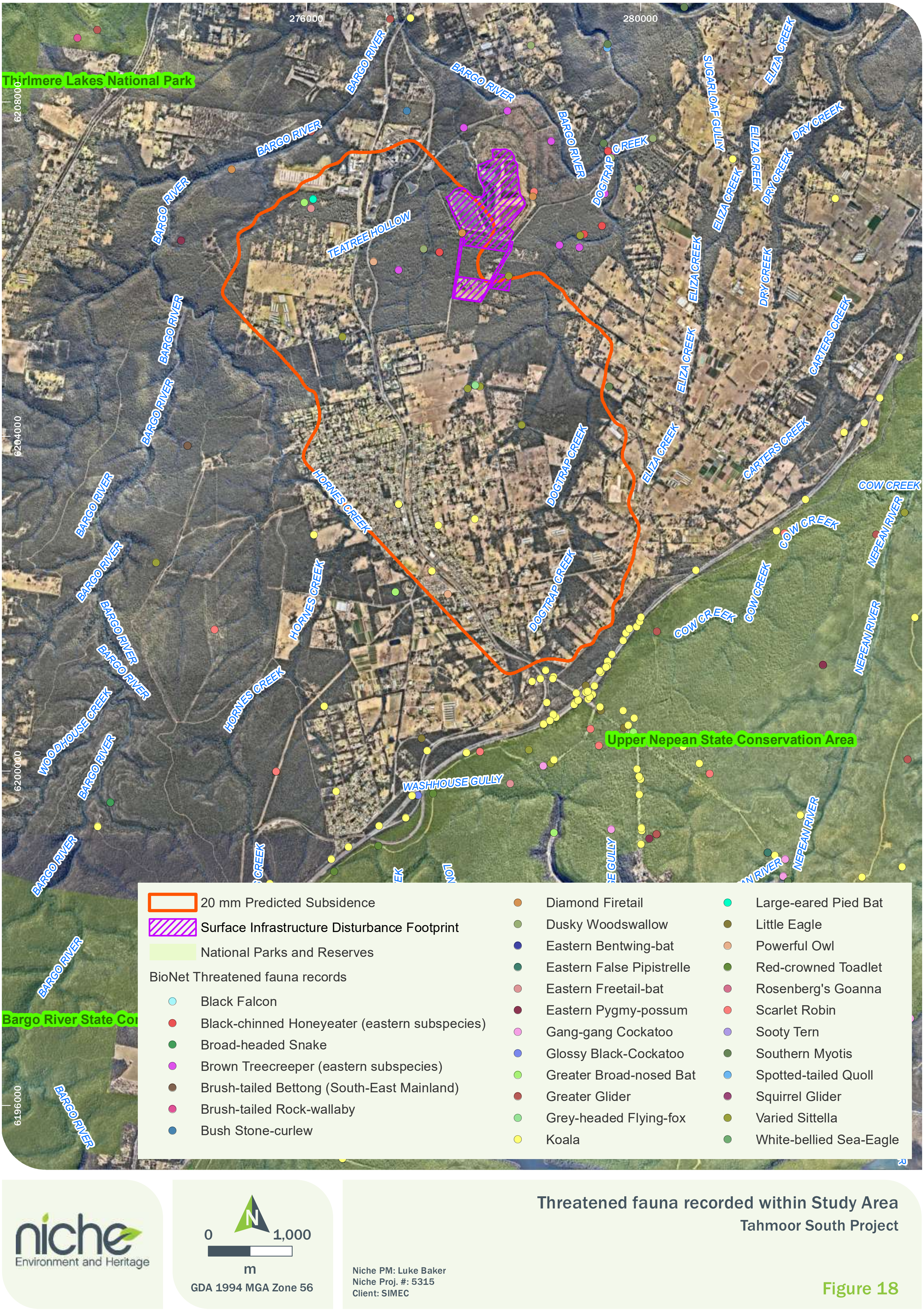

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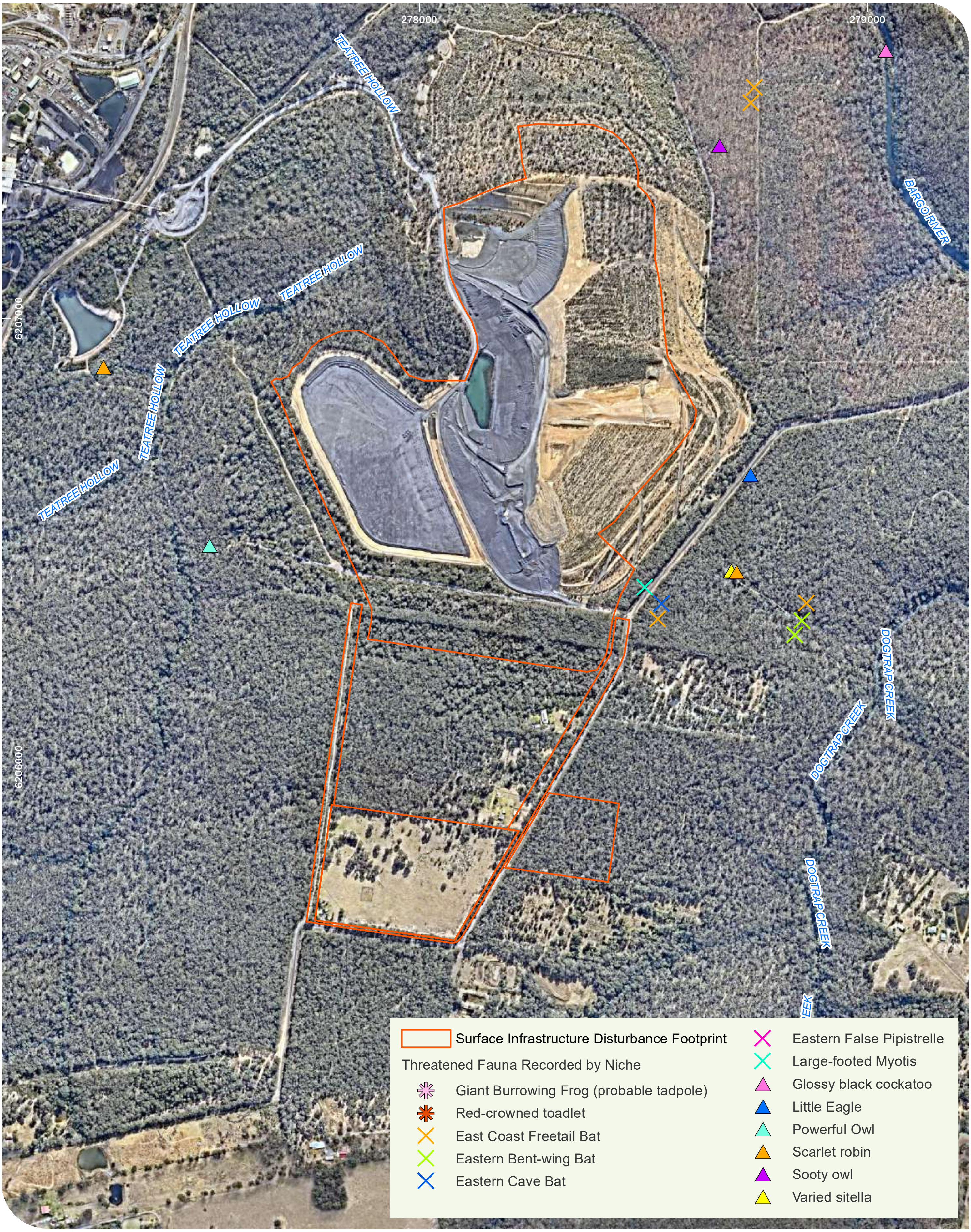
Threatened fauna recorded within Study Area

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 18



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Threatened fauna recorded in the surface infrastructure footprint

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 19

7. Avoidance and minimisation

In accordance with the NSW Biodiversity Offsets Policy for Major Projects and the FBA, proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a Project on biodiversity values. This section of the report outlines the avoidance, management and mitigation measures that Tahmoor Coal has incorporated into the Project design or will employ during construction, operation and completion of the Project to reduce impacts on biodiversity values. Section 12 of this report describes the offset strategy for the Project to account for residual impacts that cannot be avoided or mitigated.

7.1 Avoidance – Design Process

Chapter 5 of the EIS details the process of Project development and design which has been informed by information obtained within detailed technical studies, cost benefit analysis, and stakeholder engagement. The information below outlines the Project development and design process and the steps taken to avoid and minimise impacts to biodiversity values within the Study Area, which has taken into consideration the submissions received following public exhibition of the EIS (section 2.1.4) in relation to avoiding impacts to biodiversity.

7.1.1 Preliminary investigations

Revision and optimisation of the Project design in consideration of Project constraints (including biodiversity constraints) and risks (including biodiversity impacts and offsetting) have been undertaken over the past 7 years, with the most recent changes to Project design taking place following the submissions received on the publicly exhibited EIS, which were received in March 2019.

The core tasks that have been undertaken at a preliminary stage of the Project have included the following:

- Risk, project definition and constraints workshop: Project definition and constraints workshops were attended by Tahmoor Coal planning teams and specialist in the early phases of the Project. During the workshop, all technical study leads developed an environmental, social and economic values and constraints framework to inform development of the Project. In regard to biodiversity, vegetation mapping of the Tahmoor landholdings (completed by Niche), identified areas of native vegetation, and areas of Shale Sandstone Transition Forest, populations of threatened flora (Grevillea parviflora subsp. parviflora, Pomaderris brunnea, Persoonia bargoensis), and areas of habitat corridors as key considerations.
- **Ongoing Project team meetings and communication:** Regular Project team meetings have been held to update Tahmoor Coal's mine planning and operations team and all technical study leads on outcomes from other technical studies and issues raised through the stakeholder and community consultation process. Through this process, the weighting of the values assigned to each issue identified in the early Project constraints and definition phase, and possibly changed due to early stakeholder and community input, was revisited and revaluated decisions made as to whether further changes should be made.
- **Environmental risk assessment:** The approach for the environmental impact assessments have considered the hierarchy of avoid, manage, mitigate and offset. Specifically:
    - During preliminary planning, where environmental features with high value and significance were identified that could be avoided, Tahmoor Coal has revised the Project design to avoid impacts to these areas by relocating infrastructure (such as internal roads, overburden emplacements and ancillary infrastructure); and
    - Where environmental features could not be avoided and would be directly impacted, it was assumed that these areas would be impacted, and the EIS prepared on this basis with a view to identify best practice measures to manage, mitigate or offset the impact.

7.2 Alternatives considered for the Mine Plan

7.2.1 Alternative Mine Plan

Tahmoor Coal considered alternatives to the Project during the concept (prefeasibility) and detailed design (feasibility) stages of the Project planning.

The alternatives considered related to:

- A do nothing option whereby the coal resource within the Project Area would not be developed
- Sequential mining operations or the concurrent operation of two mining operations, including various associated infrastructure configurations
- A single or multi-seam operation, whereby the proposed development would extract coal from the Bulli and the Wongawilli seams
- Various mine plan scenarios with regards to extent and configuration of longwalls
- Methods of coal extraction
- Options for rejects emplacement.

The pre-feasibility and feasibility investigations were driven by the aim of avoiding or minimising environmental, social and economic impacts, particularly to key sensitive surface features and achieving operational Project objectives including:

- Providing a safe solution, causing no hazards to mine operations and with low impact on mine stability
- Minimising the impact on the environment where possible, including dust emissions, visual impact, groundwater and sub-surface contamination, use of foreign reagents
- Provide an economic solution, with minimal capital and operating cost, returning a positive benefit to cost ratio, providing employment and minimising impacts on mine production
- Adopt a sound technical solution, utilising proven technology with high availability and reliability, versatility and flexibility
- Avoidance of significant biodiversity
- provide a solution that would enable the disposal of the total volume of rejects forecast for the Tahmoor South Project.

In this context, several configurations of Project components were considered, to identify the 'optimum' balance between Project objectives and minimisation of associated impacts. These alternatives are discussed in detail in the EIS, and have been replicated in part, with reference to biodiversity impacts and outcomes.

7.2.2 Do Nothing

Without development consent, the extraction of coal at Tahmoor Mine cannot continue beyond the completion of mining within the Tahmoor North mining area. Closure of the mine would lead to the loss of approximately 400 jobs in approximately 2022 and loss of the potential for around $784 million in net benefits over the Project life including flow-on implications for local businesses, and royalties and revenue for government.

Without development approval, mining could continue within the Tahmoor North mining area under Tahmoor Mine's existing development consents (1975 Tahmoor Consent, 1979 Tahmoor Consent, 1994 Tahmoor North Consent and 1999 Tahmoor North Consent). However, the remaining coal reserves within this approved area would be exhausted by approximately 2022, projected at the current rate of extraction. Subsequent to completion of mining within the Tahmoor North mining area, and in the absence of development approval for the expansion of mining, Tahmoor Mine would be subject to mine closure and site rehabilitation.

The negative consequences of not proceeding with the proposed development therefore relate to lost employment opportunities, and unrealised financial benefits to Tahmoor Coal, local and regional communities and the government.

From a biodiversity perspective, the 'do nothing' approach would not result in the loss of any biodiversity. However, it should also be noted that the 'do nothing' approach would not result in the establishment of Stewardship Sites with in-perpetuity management.

7.2.3 Separate, Concurrent Operation of Tahmoor Mine and Bargo Mine

In the early stages of mine planning in 2012-2013, Tahmoor Coal investigated the continuation of operations at the existing Tahmoor Mine against an alternate option to duplicate this operation through the establishment of a second, separate mining operation within the Tahmoor South mining area that would operate in addition to the current facilities. Production at the second mine would occur concurrently with operation of the existing Tahmoor Mine Surface Facilities Area.

Establishment of a second mine to the south of the existing operations would enable a significant increase in the rate of ROM coal extraction, product coal production and transport per annum for the company. To enable this production, a second mine would also require duplication of surface facilities, personnel and equipment as well as increased capacity to the coal chain infrastructure. This duplication of mining operations would see increased employment and economic benefits. However, it would rely upon the injection of significant additional capital and operational expenditure by Tahmoor Coal.

The surface infrastructure options investigated during the pre-feasibility assessment were:

1. Establishment of a second, separate, independent mining operation to allow concurrent operations, with new surface infrastructure located:
    - A. Within and relying on previously approved development at the Bargo Colliery (the Bargo Option), or
    - B. Immediately to the north of the existing surface infrastructure area of Tahmoor Mine (the Northern Option), or
    - C. South of the existing surface infrastructure area of Tahmoor Mine (the Southern Option).
2. Continued use of existing surface infrastructure of the existing mining operation, integrated and augmented to facilitate mining into the coal resource areas to the south.

Bargo Option

As outlined in Section 1.2.2 of the EIS, new surface infrastructure associated with the Bargo Mine, was approved in 1975/76 by both Wollondilly and Mittagong (now Wingecarribee) Councils for a location approximately 5.5 km to the south-west of the existing Tahmoor Mine between the town of Bargo and the Bargo River.

Development of a separate underground mine at this location was considered during the pre-feasibility assessment for the Project. The Bargo Option would have involved the duplication of surface infrastructure facilities to process coal extracted from the Tahmoor South mining area.

The Bargo Option consisted of:

- Construction of new surface infrastructure, product stockpile area and rail loop

- Excavation of a new drift entry
- Sinking of additional ventilation shaft sites
- Establishment of an additional REA
- Extraction of coal from the Bulli seam via longwall mining.

The Bargo Option was ultimately not pursued due to the requirement for significant capital expenditure and the environmental constraints associated with establishment of this additional mining infrastructure, including impacts to key sensitive surface features. The capital expenditure of the Bargo Option was estimated to be almost double the expenditure required for either of the Northern or Southern options (outlined in the following sections) and approximately triple that required for the continuation of activities at the existing Tahmoor Mine Surface Facilities Area.

The Bargo infrastructure option would also have required the Surface Facilities Area to be located within native bushland which would result in:

- Clearing of up to 220 ha of remnant vegetation and associated fauna habitat
- Removal of a range of threatened flora, and important fauna habitat
- Extensive loss of hollow-bearing trees
- Exposure to areas of high bushfire risk
- Undisturbed condition and potential for Koala habitat
- Potential impacts to archaeologically sensitive areas associated with Hornes Creek.

To provide context, the area that was proposed for the Bargo Colliery option has been proposed as a Stewardship Site for the Project (Figure 23). The biodiversity values within this area include:

- The presence of a large population of *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora*
- Populations of *Acacia bynoeana, Persoonia hirsutata, P. glaucescens* and highly likely *Epacris purpurascens* var. *purpurascens*.
- Population of Red-crowned Toadlet
- Extensive intact native bushland and hollow-bearing trees
- Habitat for a range of threatened fauna.

Northern Option

The Northern Option included the construction of a new Surface Facilities Area immediately to the north of Tahmoor Mine's existing Surface Facilities Area, and the configuration of new ROM and product stockpiles. However, analysis of the Northern Option during the pre-feasibility assessment found it too capital intensive, to be a viable option to be carried forward in development of the Project.

The pre-feasibility assessment also highlighted the likelihood of increased environmental impacts associated with concurrent operation of the Northern Option and the existing Surface Facilities Area.

The Northern Option would require additional clearing of vegetation compared to the current Project, including vegetation which aligned to Shale Sandstone Transition Forest. Additionally, the Northern Option would be located closer to residences than the existing Surface Facilities Area, potentially resulting in adverse construction and operational noise impacts.

Southern Option

The Southern Option considered the construction of a new Surface Facilities Area to the south of the existing Tahmoor Mine Surface Facilities Area, along with upgrades to the existing Surface Facilities Area and rail loop. Similar to the Northern Option, analysis of the Southern Option during the prefeasibility assessment identified this option to be too capital intensive to be viable, and it was discounted from further assessment.

With regards to environmental consequences of this option, the Southern Option would have also resulted in clearing of Shale Sandstone Transition Forest. The Southern Option would also have been located closer to residences than the existing Surface Facilities Area, with a greater potential for adverse noise impacts.

Option for Sequential Extension of Operations

The alternative to the concurrent operation of two separate mines to access the coal resource is the option to sequentially extend longwall mining into the Tahmoor South mining area via the existing surface infrastructure facilities at Tahmoor Mine.

The pre-feasibility assessment found this option to be the least capital-intensive option with fewer environmental impacts. Sequential extraction of the coal resource within the Project Area would allow the continued use of the existing Tahmoor Mine surface infrastructure area and coal chain logistics, with only upgrades and augmentation of these facilities needed to meet required production rates.

This option would not introduce increased cumulative amenity impacts associated with the concurrent operation of an adjacent mine. However, by its nature, the sequential extension of mining has the potential to extend the period over which operational impacts may occur.

7.2.4 Multi-seam Operation

Options for developing the coal resources for the proposed development included either:

- Mining the Bulli seam only; or
- Mining the Bulli seam and the Wongawilli seam.

Tahmoor Coal investigated the feasibility of a single or multi-seam operation whereby coal would be extracted from the Bulli seam and the Wongawilli seam below. The pre-feasibility study concluded that mining of the Bulli seam only is the preferred option for the following reasons:

- Capital expenditure implications:
    - The existing Tahmoor Mine infrastructure is currently configured for extraction from the Bulli seam and additional mine infrastructure, including drifts, shafts and CHPP would be required to extract from the Wongawilli seam.
- Operational expenditure implications:
    - Mining of the Wongawilli seam requires greater expense due to the increased depth of the seam, when compared to the Bulli seam; and
    - Higher ash content and partings within the Wongawilli seam results in decreased yield in comparison to the Bulli seam, which would require additional capital for CHPP upgrades and additional reject disposal considerations.
- Market considerations:
    - The coal from the Bulli Seam meets the specifications of the coal currently supplied by Tahmoor Coal under its existing contracts.
- Environmental considerations:
    - A higher level of subsidence would likely result from a greater seam thickness extraction in the Wongawilli than the Bulli seam. This, coupled with cumulative subsidence levels of a multi-

seam operation would introduce increased environmental and social consequences and the need for additional mitigation and management measures at the surface than those required for mining the Bulli seam alone.

- Resolution of the current expenditure constraints and market limitations, along with development of suitable subsidence management measures in future years, may allow mining of the Wongawilli seam under a future consent. However, at the current time single seam mining of the Bulli seam is preferred.

7.2.5 Alternative Mine Plan – Tahmoor South Project

The mine plan for the Project has been developed over a period of several years, taking into account the coal quality, sensitive environmental features and geological constraints of the Project Area, and consideration of the submissions on the project received during public exhibition. The mine plan refers to the orientation, extent and configuration of longwalls and associated mains, as well as the number and location of ventilation shafts.

A formal constraints analysis was undertaken to determine the presence of key sensitive surface features within the Project Area, including those related to biodiversity – including bedrock rivers with standing pools, river gorges and steep slopes. Based on this constraints analysis, key features, such as the Bargo River gorge, were identified and longwall configurations were designed to avoid those sensitive surface features.

Early mine plans for the Project included longwalls beneath the Bargo River in the west and south of the mining lease areas. However, due to the environmental and social significance of this river, the initial mine plan underwent a revision to avoid longwall mining directly under these sensitive surface features. The proposed longwalls have also been designed to avoid mining beneath four rock shelter sites along Dogtrap Creek with artwork that is of high cultural and archaeological significance. The proposed longwalls were also set back from Hornes Creek, thus avoiding potential subsidence impacts to Red-crowned Toadlet habitat along the creek lines.

Additional mine planning undertaken in 2017/2018 identified that mining within the Eastern Domain would not be optimal due to geological and technical mining considerations, in particular, difficulties associated with safe mine personnel egress in the case of a seismic event along the Nepean fault. The removal of longwall mining within the Eastern Domain would result in reduced subsidence impacts to Eliza Creek, which was proposed to be undermined by longwalls within this domain. The reduced area of longwall mining would also reduce the length of mining at the Tahmoor South Project from an estimated 18 years (under both the Central and Eastern Domains) to 13 years (under the current proposed Central Domain only), thereby reducing the overall length of operational impacts of the Project.

The change to mining area has also allowed the rationalisation of the number of additional ventilation shafts required for the Project from four ventilation shafts to two, thereby reducing native vegetation clearing requirements associated with electricity and service connections to the ventilation shaft sites. When taking into account the vegetation clearing savings associated with the changes to ventialtion shaft number and locations, the Central Domain-only option would require around four hectares less of native vegetation clearance and habitat clearing compared to the combined Central and Eastern Domain option.

Alternative Coal Extraction Methods

Alternative coal extraction methods which have been considered by Tahmoor Coal during the feasibility studies for the Project included alternative methods of coal extraction and longwall widths. These alternative methods of coal extraction are limited by technical, economic, subsidence, environmental and safety reasons. Consequently, they have not been pursued as part of the Project.

The alternative coal extraction options considered were:

- Open cut mining. Feasibility dismissed on economic and environmental grounds, with the strip ratio considered to be impractical and too high to be technically viable due to the depth to the Bulli seam (350-420 m below ground level) – note that the biodiversity impact associated with this approach was highly likely to be extensive compared to the Project
- Bord and pillar mining methods. Although these methods may result in lower levels of subsidence and fewer environmental consequences, they would result in low production rates and were assessed as not economically viable
- Top coal caving. The Bulli seam is not thick enough to support this extraction method within the Project Area, therefore this method was deemed not to be a technically viable option
- Longwall mining. This mining method is considered to be the best mining method for the depth and thickness of the Bulli seam, and would enable financially viable production rates to be achieved. This method has reduced environmental consequences when compared to open cut mining, could utilise existing mine infrastructure, and was assessed as being technically and economically viable within the Project Area.

The alternative longwall width options considered were:

- Longwalls of 305 m in width: assessed as being able to best balance subsidence levels and associated environmental consequences with viable production rates and cost efficiencies within the Project Area
- Longwalls wider than 305 m: wider longwalls would result in increased subsidence risk and environmental consequences at the surface, as well as the introduction of increased geological constraints. This alternative was not considered to be technically viable.

7.2.6 Alternative Options for Rejects Disposal

Options Study

Nine disposal options were initially considered, incorporating both underground and surface disposal areas. A multi criteria analysis approach was adopted to determine the relative merit of each option and to shortlist options for further detailed assessment. Key considerations in the shortlisting of options included insufficient volume for storing of rejects in old workings or former goaf areas, the velocity required to move slurry (rather than paste) through a pipeline and the resulting excessive pipe wear, impact to operations and consequential reduced productivity, excessive capital and operating costs.

The options that were identified for further detailed investigation were:

- Surface disposal at an expanded existing REA
- Underground disposal as paste material (active goafs via a trailing pipe).

The surface disposal option would involve a continuation of the current rejects disposal methods and an expansion of the existing REA. The technical risks are therefore known and the operation is well established. As this operation is undertaken completely on the surface, personnel would not be exposed to the hazards of the underground environment and this option is therefore considered to be safer than underground alternatives. Although there is sufficient space to expand the existing REA on the surface, the expansion would require clearing of native vegetation. The surface disposal option would also generate noise and dust impacts which require appropriate management.

The option to dispose of the rejects as paste material into the active goaf is detailed in SKM (2014), and is technically complex. The void above the caved zone is highly variable in nature and even under ideal rock conditions, the available volume would be significantly less than required over the life of the mine. When taking into account less than ideal situations, the available volume would be limited and could be reduced to zero.

A further study was completed by Palaris (2020) concluded that there is unlikely to be any new knowledge obtained since 2014, or gaps in the original work, that would have the potential to materially alter the fundamental conclusions and recommendations provided in SKM (2014).

As detailed in Palaris (2020), the emplacement of the coal rejects in active longwall goaves remains to be techanically challenging. It was determined in the assessment that there is a relative degree of certainty that fines and ultrafines can be emplaced in a longwall goaf of favourable seem dip, however this is done at a consideratable capital and operating cost disadvantage compared to on-site surface emplacement.

Palaris concluded that the current proposal of 100% surface emplacement represents a financially viable option and does not unduly increase operational complexity and risk.

7.3 Final Project Design

The pre-feasibility and feasibility studies and investigation into alternative options determined that the preferred option is the Ammended Project Design (as assessed in his repor) for the proposed development which is: the sequential extension of operations at Tahmoor Mine; use of the existing surface infrastructure area at Tahmoor Mine; single seam mining within the Bulli seam; the use of longwall mining methods; the development of a mine plan that avoids impacts to sensitive surface features; developing longwalls with a maximum panel width of 285 m; and surface rejects disposal with an expanded REA.

Sequential operations, rather than duplication of production and establishment of a second mining operation, was identified as feasible due to the cost savings associated with using existing infrastructure and the avoidance of greater environmental and amenity impacts associated with the development of a separate Surface Facilities Area. Sequential extraction of the coal resource within the Project Area would allow for the continued use of existing infrastructure and workforce, providing benefits by way of continuation of employment for the existing, established workforce for a further 13 years. The preferred mine plan precludes longwalls beneath the Nepean and Bargo Rivers, resulting in fewer impacts to the environment while maximising project feasibility. The preferred option proposes mining from the Bulli seam via longwalls optimised at up to 285 m in width. The preferred mine plan and chosen method of coal extraction forms an optimised outcome for mining which was derived from the careful consideration of potential impacts on sensitive surface features, consistent with recommendations of the Southern Coalfield Inquiry and recent PAC reports for the Metropolitan Coal and Bulli Seam Operations projects. On the basis of a comparative assessment, it was determined that, on balance, when considered against a number of economic, environmental, social, technical and safety criteria, the surface disposal at an expanded REA was the preferred strategy for disposing of reject material associated with the Project. This conclusion is supported by a cost benefit analysis which found that the benefits of surface disposal at an expanded REA far exceeded those associated with the underground co-disposal option.

7.4 Amendments to the proposed REA expansion

During exhibition of the EIS, concerns regarding the proposed management of coal rejects were raised in Government agency, local Council, stakeholder and community submissions. The EIS proposed to expand the existing REA by 43 ha, which would result in the clearance of native vegetation consisting of Shale Sandstone Transition Forest and impacts to population of *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora*. Agency and community concerns related to the impacts of the proposed REA expansion on native vegetation and habitat, and whether alternatives to expanding the REA had been properly explored.

In direct response to these concerns, Tahmoor Coal has:

- Amended the proposed development to reduce the extent of the expansion from 43 ha to 11.06 ha;
- Undertaken further investigations into alternatives to surface emplacement of rejects.

The Amended Project has reduced the REA, which has been made possible by the proposed amendments to the EIS mine plan, which would reduce the total coal production from the proposed development, and by increasing the proposed height of the REA.

The reduction in area greatly reduces the biodiversity impacts of the Amended Project in comparison to that presented in the EIS.

Key Project modifications include a revised surface disturbance area and subsequent reduction in clearance of native vegetation (from 49.2 ha to 37.77 ha – noting that 14.8 ha is native mine rehabilitation within the existing REA) and impacts to the following key threatened flora:

- *Persoonia bargoensis*: from 96 to eight (8) individuals
- *Grevillea parviflora* subsp. *parviflora*: from 2,324 to 491 individuals.

The most significant reduction in native vegetation impacts were associated with the amendments to REA and Project design are in relation to Shale Sandstone Transition Forest. Impacts to Shale Sandstone Transition Forest have been reduced from 43.50 ha to 23.57 ha.

The re-design of the REA has avoided the core population of both *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora* as shown on Figure 14 and Figure 15

8. Impact assessment

The Impact Assessment forms Stage 2 of the Biodiversity Assessment Report as detailed in the FBA. Further Assessments of Significance have been carried out for those species listed under the EPBC Act that may potentially be impacted by the Project. The impact assessment has incorporated the findings from the specialist studies in order to determine the severity and potential for impacts on biodiversity.

8.1 Vegetation clearing and removal of habitat

The Project would result in the direct impact to approximately 37.77 hectares of native vegetation including 14.2 ha of rehabilitated land, associated with the clearing for surface infrastructure.

A breakdown of the vegetation clearing associated with each surface infrastructure components includes:

- REA: Approximately 25.26 ha of native vegetation, which includes 14.20 ha of native rehabilitation.
- Powerline: Approximately 2.99 ha of native vegetation
- Ventilation shaft TSC 1: Approximately 6.05 ha of native vegetation
- Ventilation shaft TSC 2: Approximately 3.47 ha of native vegetation.

All cleared areas would be rehabilitated following decommissioning as per the Rehabilitation and Closure Strategy developed for the Project, and all potential indirect impacts minimised using the mitigation measures detailed in section 10.

The current amended Project has decreased the overall native vegetation clearing from 49.2 ha to 37.77 ha. It should be noted that 14.20 ha of native vegetation associated with the amended Project which is to be cleared, is native vegetation rehabilitation that has been planted via tubestock and seed on the existing REA.

Table 20. Native vegetation impacted in EIS Project (2018) compared to Amended Project

Project component	Native vegetation impacted (ha)	
	EIS Project design (2018)	Amended Project
REA	39.7	25.26 (noting that 14.20 is native rehabilitation on the existing REA)
Ventilation shaft TSC 1	6.1	6.05
Ventilation shaft TSC 2	3.3	3.47
Powerline	Not proposed	2.99
Carpark	0.1	Not proposed
Total	49.2	37.77 (noting that 14.20 is native rehabilitation on the existing REA)

8.2 Subsidence and its potential to impact terrestrial ecology values

Predictions regarding the likelihood and potential impact of subsidence for the Tahmoor South Project were investigated and reported by MSEC (2020). Natural surface features sensitive to subsidence movements identified by MSEC (2020) include rivers, streams and cliffs. These features provide habitat for a range of biodiversity, and therefore consideration of the potential effects of subsidence on these features and threatened biodiversity has been addressed in this report.

The potential effects of subsidence include:

- Fracturing of river and creek beds, which may result in:
    - increased or decreased levels of ponding, scouring or desiccation due to mining tilt;
    - fracturing and surface water flow diversion in the streams;
    - potential water quality changes/contamination;
    - contamination of surface waters by gas drainage;
    - potential for gas emissions and changes to water quality.
- Instability and rock falls along cliff-faces;
- Slippages, erosion and rock falls on steep slopes and rock ledges.

A summary of the predicted impacts that the Project may have on natural surface features sensitive to subsidence (as described by MSEC 2020), and the associated potential impacts to ecology, is described in Table 21 below. An assessment of the potential subsidence related impacts on native vegetation and species credits species are discussed in the sections following.

Table 21. Predicted effects of subsidence on natural features within the Tahmoor South Study Area (MSEC 2020)

Type	Description of natural feature	Subsidence impact	Potential biodiversity impact
Bargo River	The Bargo River commences north of Colo Vale and near the townships of Hill Top and Yerrinbool and flows generally towards the north and to the west of the Bargo township. The Bargo River then flows to the west and north of the proposed Tahmoor South longwalls. The Bargo River then drains into the Nepean River approximately 4.9 kilometres north-east of the proposed Longwall 101a. Only a 165 metres long length of the Bargo River that is immediately upstream from the Picton Weir is located inside the Subsidence Study Area. This length of the river that is within the Subsidence Study Area is a 4th order perennial stream as defined by the Strahler Stream Order Method.	The surface water flows in this section of the river are controlled by the Picton Weir, (also called the Bargo Weir) with discharge regulated by a fixed discharge valve. The reports by Fluvial Systems (2020) and Hydro Engineering and Consulting (HEC 2020a) provide a detailed description of the River. The 165 metre length of the Bargo River that is immediately upstream from the Picton Weir and located inside the Subsidence Study Area is approximately 890 metres from the nearest amended longwall panel, i.e. the north west corner of the proposed Longwall LW106A, and this section of the river is also 500 metres from the nearest part of the Extent of Longwalls boundary. At this distance from the amended longwall panels and with these low predicted ground movements, the river is not expected to experience any noticeable subsidence or upsidence movements. There has been a long history of mining directly beneath or near the Bargo River at Tahmoor Mine. While impacts have occurred when various previously extracted longwalls were mined directly beneath the river, impacts have been not observed when mining has been undertaken more than 500 metres away from the river. Based on the previous experience at Tahmoor Mine, it is unlikely, that the extraction of the proposed longwalls would result in any adverse impacts on the river. Even if the predictions and impact assessments were exceeded, the likelihood of pool drainage is considered extremely low given the water flows in the river.	If subsidence were to occur within the Bargo River, there would be the potential to impact on the range of aquatic, riparian and terrestrial flora and fauna dependant on the riverine habitat and its water. However, given it has been concluded in MSEC (2020) that it is highly unlikely that the extraction of the proposed longwalls would result in any adverse impacts on the river, it is considered unlikely that ecological values dependant on the river would be significantly or adversely impacted by the Project. An updated aquatic ecology assessment for the Project undertaken by Niche (Niche 2020) similarly concluded that, given the above, the quality and quantity of available aquatic habitat in the Bargo River is unlikely to be impacted by the Project.
Creeks	Creeks in the Subsidence Study Area include Dogtrap Creek, Hornes Creek, Teatree Hollow, Tributary 1 to Dogtrap Creek, Tributary 2 to Dogtrap Creek, Tributary to Teatree Hollow. MSEC (2020) notes that the streams have controlling features along their alignments including rockbars, riffles, knick points and debris accumulations.	**Potential for increased levels of ponding, scouring or desiccation due to mining tilt** Change in the grade of a stream has the potential to lead to increased ponding, scouring, desiccation. MSEC (2020) states: 'Mining can potentially result in increased levels of ponding in locations where the mining induced tilts oppose and are greater than the natural stream gradients that exist before mining. Mining can also potentially result in an increased likelihood of scouring of the stream beds in the locations where the mining induced tilts considerably increase the natural stream gradients that exist before mining'. MSEC (2020) state that there is a predicted reversal of grade along a naturally flat section of Dogtrap Creek, upstream of the tailgate of Longwall 103B. Hence there is increased potential for ponding upstream of this location, which is estimated to be up to 0.2 metres deep and 150	Increased ponding may result in a change to microhabitats (debris, riffles, etc.) that may impact upon existing amphibian habitat along the creeks within the Study Area, in particular along Dogtrap creek. This may decrease habitat for amphibians that are sensitive to changes to microhabitats. However it is noted that MSEC predicts that such changes to be relatively minor, and if occurred would be localised and not result in adverse impacts on these streams.

Type	Description of natural feature	Subsidence impact	Potential biodiversity impact
		metres long. Elsewhere, there are no other predicted reversals of grade due to the proposed mining. It is possible that there could be localised areas along the streams which could experience small increases in the levels of ponding, where the predicted maximum tilts occur in the locations where the natural gradients are low. As the predicted changes in grade are typically less than 1 %, however, any localised changes in ponding are expected to be minor and not result in adverse impacts on these streams. The streams flow predominantly over Hawkesbury Sandstone, which has a high resilience to scouring. As discussed in the report by Fluvial Systems (2020), mud was commonly found in the channel bed with soft knickpoints in small streams on the plateau. The predicted maximum increases in grade are up to 0.8 %, which are relatively small compared to the natural gradients and, therefore, the potential for increased scouring is not expected to be substantial. Further discussions on the potential changes in ponding and flooding along the streams and the impacts, consequences and implications of the changes are provided by the specialist surface water consultant in the report by Hydro Engineering and Consulting (2020a).	
		Potential for fracturing and surface water flow diversion in the streams MSEC (2020) states that 'Where the longwalls mine directly beneath the streams it is considered likely that fracturing could result in surface water flow diversions. Upsidence and compressive strains due to valley closure are expected to be of sufficient magnitude to cause the underlying strata to buckle and induce cracking at the surface at some locations. This can lead to the diversion of water from the stream beds into the dilated strata beneath it'. It is unlikely, however, that there would be any net loss of water from the catchment since any redirected flow would not intercept any flow path that would allow the water to be diverted into deeper strata or the mine. If substantial fracturing were to occur, partial or complete diversion of surface water and drainage of pools could occur at locations and times where the rate of flow diversion is greater than the rate of incoming surface water. The majority of the streams are ephemeral and so water typically flows during and for a period of time after each rain event. In times of heavy rainfall, most of the runoff would flow over the beds of the streams and would not be diverted into the dilated strata below the stream beds. In times of low flow, however, some or all of the water could be diverted into the strata below the stream beds for those sections of the streams that are located over the mined panels. Based on the previous experience of mining beneath streams at Tahmoor Mine, it is likely that fracturing and surface flow diversions will occur in the sandstone bedrock along the streams, particularly for streams that are located directly above the proposed longwalls. In some of these	The fracturing and changes to surface water flow may result in a decrease in the number of existing pools along the creeks in the Study Area. This may impact upon pools which amphibians rely on for breeding and lifecycle development. Whilst, not all pools are predicted to be impacted and impacts are likely to be relatively minor and localised, during times of low rainfall may see breeding amphibian pools dry habitat.

Type	Description of natural feature	Subsidence impact	Potential biodiversity impact
		locations, the fracturing could impact the holding capacity of the standing pools, particularly those located directly above the proposed longwalls’.	
		Potential water quality changes due to subsidence The following has been extracted from HECONS (2020a): ‘Liberation of contaminants can occur from subsidence induced fracturing in watercourses, causing localised and transient increases in iron concentrations and other constituents due to flushing of freshly exposed fractures in the sandstone rocks which contain iron and other mineralisation. This sort of impact has the potential to affect Teatree Hollow, Dogtrap Creek, and Eliza Creek, Cow Creek and Carters Creek and downstream watercourses. Fracturing of bed rock is predicted to occur and upsidence related buckling of stream beds is predicted along some sections of these creeks.’ Based on past experience in the Southern Coalfields, including experience at Tahmoor North, it is expected that upsidence induced fracturing may lead to releases of aluminium, iron, manganese and zinc. It is likely these will be seen as transient spikes in the concentration of these and possibly other metals which would be relatively localised. The extent of these impacts is expected to be similar to impacts observed in similar streams in the Southern Coalfield i.e. iron staining and flocs in pools and localised and transient spikes in iron, manganese and aluminium in waterways previously undermined. Changes to chemical characteristics of surface flows can also occur as a result of changes in baseflow. One of the effects of longwall subsidence on watercourses commonly reported is the emergence of ferruginous springs. These concentrated (point) inflows have a distinctive orange to red/brown colouration caused by enhanced groundwater inflows and oxidation of iron commonly present in shallow groundwater in the area. This is often accompanied by iron flocs, staining of the bed, increased turbidity and the build-up of iron rich slimes. Changes can also occur to the chemical composition of surface flows due to either increased or decreased groundwater fed baseflow.	The potential changes to water quality through subsidence are predicted to be localised (HECONS 2020a; MSEC 2020). This may have an impact to local amphibians if they were to occupy a pool that has had a change in water quality.

Type	Description of natural feature	Subsidence impact	Potential biodiversity impact
		Contamination of surface waters by gas drainage Drainage of strata gas and expression to the surface through surface water has occurred to varying degrees in the Southern Coalfields. It is most readily detectable in permanent slow moving pools. Studies of the phenomena have shown that the gas flow does not affect the quality of surface waters that it drains through, due to the very low solubility of methane and the short residence time in the water column however there have been rare instances of reported vegetation die back. It has not been reported as an issue at Tahmoor North, most likely due to the relative absence of perennial water bodies. MSEC (2020) also note that such gas emission events are rare, temporary and localised and as such, are not anticipated for the Tahmoor South Project.	Given that the very low solubility of methane and the short residence time of the gas in the water column precludes changes to water quality, no impacts to biodiversity are expected to result from contamination of surface waters. Gas emission has the potential to result in localised die back of vegetation where the vegetation occurs immediately adjacent. However, as noted in MSEC (2020), these occurrences are rare, temporary and localised and as such, are not anticipated for the Tahmoor South Project.
		Potential for gas emissions and changes to water quality MSEC (2020) states gas emissions from the sandstone strata have been previously observed above and adjacent to mining areas in the Southern Coalfield, and some gas emissions have also been observed in water bores. Analyses of gas compositions indicate that the Bulli Seam is not the direct and major source of the gas and that the most likely source is the Hawkesbury Sandstone (APCRC, 1997). It is possible that gas emissions occur as a result of the mining of the longwalls. Gas may be released into rivers and streams as these areas form topographical low points in the landscape. Where these gas releases occur into the water column there is insufficient time for any significant amount of gas to dissolve into the water. The majority of the gas is released into the atmosphere and is unlikely to have an adverse impact on water quality. As mentioned above, however, it is possible for substantial gas emissions at the surface to cause localised vegetation die-back. This is a rare event and has only occurred previously on one occasion at Tower Mine, over small areas in the base of the Cataract Gorge that had been directly mined beneath by Longwalls 10 and 14. These impacts were limited to small areas of vegetation, local to the points of emission, and when the gas emissions declined, the affected areas were successfully restored.	As discussed above, the potential for localised vegetation modification from gas emissions is rare. In the unlikely event it were to occur, impacts are likely to be localised. This is discussed further in section 8.3.2.
Cliffs	MSEC (2020) states that a total of 24 cliffs are located within the Subsidence Study Area. A cliff has been defined as a	According to MSEC (2020), a total of 24 cliffs are located within the Subsidence Study Area. The cliffs are generally located within the valleys of the Dogtrap Creek and the lower reaches of	Some fauna species are dependent on the specialised habitat of the cliff faces/ rock ledges and overhangs for survival. This habitat has the potential to support reptile

Type	Description of natural feature	Subsidence impact	Potential biodiversity impact
	continuous rockface having a maximum height greater than 10 metres, a minimum length of 20 metres and a minimum slope of 2 in 1, i.e. having a minimum angle to the horizontal of 63 degrees. The cliffs within the Study Area are generally located within the valleys Bargo River, Dogtrap Creek and Lower Reaches of Hornes Creek	Hornes Creek. The cliffs are commonly between 10 and 20 metres in height and less than 100 metres in length. The great majority of cliffs within the Subsidence Study Area, i.e. for 23 out of a total of 24, will not be directly mined beneath by the proposed development. These include the cliffs along the Bargo River and Hornes Creek, which are all located outside the extents of the proposed basecase longwalls at minimum distances of 800 metres and 810 metres, respectively. There are also some cliffs located along Dogtrap Creek that will not be directly mined beneath by the proposed longwalls. It is noted by MSEC (2020) that it is extremely difficult to assess the likelihood of cliff instabilities based upon predicted ground movements. The likelihood of a cliff becoming unstable is dependent on a number of factors which are difficult to fully quantify. These factors include jointing, inclusions, weaknesses within the rock mass, groundwater pressure and seepage flow behind the rockface. Even if these factors could be determined, it would still be difficult to quantify the extent to which these factors influence the stability of a cliff naturally or when it is exposed to mine subsidence movements. It is possible, therefore, that cliff instabilities may occur during mining that may be attributable to either natural causes, mine subsidence, or both. The likelihood of cliff instabilities along the Nepean River, Bargo River and Hornes Creek has been assessed by MSEC (2020) using case studies where previous longwall mining has occurred close to but not directly beneath cliffs. The case studies have indicated that very minor rock falls have been observed outside the extracted goaf areas of longwall mining in the Southern Coalfield, however there have been no recorded large cliff instabilities. Based on this previous experience of mining at Tahmoor, Appin and Tower Collieries, it is unlikely that cliffs beyond the extent of the longwall mining area will experience large instabilities. It is possible that isolated rock falls could occur, particularly at those that have weathered to be marginally stable naturally and at those located closest to previously extracted longwall panels and the proposed longwall mining area. Any impacts are expected to represent less than 0.5 % of the total face area of the cliffs. The cliffs along Hornes Creek and Bargo River will not be directly mined beneath by the proposed Tahmoor South longwalls. One cliff along Dogtrap Creek (55 metres in length, 10 metres in height) is located directly above the proposed amended Longwall 103B. It is expected that this cliff could experience the full range of predicted subsidence movements. Dogtrap As discussed in MSEC (2020), previously experience in the southern coalfield have indicated that cliffs which are directly mined beneath may exhibit instabilities It is expected that these cliffs could experience the full range of predicted subsidence movements and based on previous experience in the southern coalfields, there is a moderate to	species, and microbat species for roosting. Potential impacts to threatened fauna as a result of impacts to cliffs within the Study Area are addressed in 8.5.

Type	Description of natural feature	Subsidence impact	Potential biodiversity impact
		likely probability that rock falls and cliff instabilities will occur somewhere along the cliff lines which are directly mined beneath, including those along Dogtrap Creek. MSEC (2020) states that any impacts to the cliffs that are directly mined beneath, are expected to affect between 3% and 5 % of the total length of cliffs that are directly mined beneath.	
Steep slopes and rocky outcrops	MSEC (2020) states that a steep slope has been defined as an area of land having a gradient greater than 1 in 3 (33% or 18.3°). The locations of the steep slopes within the Study Area are detailed in MSEC (2020) and encompass: a) Steep slopes on the sides of valleys, b) Batters of road and railway embankments and cuttings, c) Slopes on Farm dams, d) Slopes around Tahmoor Mine infrastructure, including spoil heaps, coal piles and dams, and e) Slopes on Wollondilly Shire Council waste disposal area	Potential impacts on steep slopes would generally result from the down slope movement of soils, causing tension cracks to appear at the tops of the slopes and compression ridges to form at the bottoms of the slopes. If tension cracks were left untreated it is possible that erosion could occur. The steep slopes on the sides of valleys are predominantly found in Hawkesbury Sandstone and consist of a mixture of cliffs and rock outcrops, which are stable at vertical to overhanging, and steep slopes with rocky soils and loose rock fragments. The majority of slopes are stabilised, to some extent, by natural vegetation. There has been extensive experience of mining beneath steep slopes in the Southern Coalfield. These include steep slopes along the Cataract, Nepean, Bargo and Georges Rivers and streams such as Myrtle Creek and Redbank Creek above Tahmoor Mine Longwalls 22 to 32, and slopes on Redback Range above Tahmoor Mine Longwalls 26 and 27. No large-scale slope failures have been observed along these slopes, even where longwalls have been mined directly beneath them. Minor rock falls along cliff lines or rock outcrops have been observed, for example, during the mining of Appin Longwalls 301 and 302 adjacent to the Cataract River. While in most cases impacts to slopes are likely to consist of surface cracking, there remains a low probability of large-scale slope slippage. The probability is assessed to be very low for slopes that will not be directly mined beneath by the longwalls. Experience indicates that the probability of mining-induced large-scale slippages is extremely low due to significant depth of cover.	Slippage of earth and rocks down steep slopes and rock falls have the potential to impact vegetation, flora and fauna. Biodiversity more likely to be impacted are those species dependant on rocky outcrops and ledges, and include microbats, reptiles and some mammals. While the probability of rock falls and large-scale slippages is considered to be very low, the potential impact on threatened biodiversity that may be impacted is discussed throughout section 8.

8.3 Native vegetation

8.3.1 Impact from surface infrastructure

The Project would result in the direct impact to approximately 37.77 hectares of native vegetation associated with the clearing for surface infrastructure. Approximately 37 % (14.20 hectares) of this is made up of planted vegetation (mine rehabilitation on the REA).

The PCTs to be cleared include:

- 23.57 hectares of HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin, including 6.31 ha of derived native grassland;
- 14.20 hectares of planted vegetation that does not align to a PCT, therefore has been assigned to HN564 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin, which has been approved for clearing under a previous application.

As discussed in section 5.3, HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest aligns to the CEEC Shale Sandstone Transition Forest listed under the BC Act and EPBC Act.

The impact to native vegetation has been discussed in the offset strategy for the Project (Section 12).

8.3.2 Impact from subsidence

Subsidence from the Project may result in the following impacts to native vegetation, which are discussed in detailed below:

- Temporary vegetation die-back around strata gas emission/drainage sites within creeks.
- Changes to the floristic composition of vegetation communities immediately adjacent to creeks/ponds where fracturing may result in changes to water flow and water retention periods.
- Tree fall by rock falls and/or slippage of earth and rocks down steep slopes.

Strata gas emissions and vegetation modification

The release of gas emissions from fracturing of sandstone strata is a potential consequence of subsidence, which may be visible within the lower lying areas of a landscape, such as in watercourses. Where there is native vegetation that overhangs the gas emission point, the release of strata gas has the potential to cause vegetation modification in the vicinity of the gas release point.

MSEC (2020) states that vegetation dieback as result of gas emissions is a rare event and has only occurred previously on one occasion at Tower Mine, over small areas in the base of the Cataract Gorge that had been directly mined beneath by Longwalls 10 and 14 (Eco Logical Australia, 2004 in TEC 2007), and small localised changes to riparian vegetation along a section of the Waratah Rivulet (HC 2007). These impacts were short term impacts, and limited to small areas of vegetation, local to the points of emission, and when the gas emissions declined, the affected areas were successfully restored. No similar impacts have been reported during the mining of Tahmoor North.

The PCT that occurs along a majority of the more incised riparian zones of the Study Area is HN586 (PCT 1181) Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest, which is not listed as a TEC. Should gas emissions occur, it is possible that some localised die back from gas emissions may affect this PCT where plants immediately occur above or adjacent to the point of gas emission. Given MSEC (2020) has not predicted any significant gas emission releases along any of the water courses within the Study Area, and such occurrences are rare within the Southern Coalfields, it is therefore similarly expected that any impacts to the PCT as a result of gas emissions from Tahmoor South would be limited in extent and temporal in nature. And, as for the sites previously affected by gas emissions (Waratah Rivulet), if it was to occur, it is highly likely the vegetation would regenerate once the gas emissions declined. As such, it is unlikely that gas emissions from subsidence would result in a decrease in the extent of the PCT and habitat within the Study Area.

Changes to riparian floristic composition due to increased levels of ponding, scouring or desiccation

Changes in the grade of a stream as a result of subsidence has the potential to lead to increased ponding, scouring and/or desiccation. MSEC (2020) states 'It is possible that there could be very localised areas along the streams which could experience small increases in the levels of ponding, where the predicted maximum tilts occur in the locations where the natural gradients are low. However, as the predicted changes in grade are typically less than 1%, any localised changes in ponding are expected to be minor and not result in adverse impacts on these streams. Predicted maximum increases in grade (which may lead to scouring) are relatively small compared with natural grades and the potential increase for scouring is not expected to be significant'.

Vegetation communities which are independent of ground-water and not closely associated with the water levels and hydrology of the creeks are unlikely to be impacted by subsidence due to underground mining.

The localised changes to ponding are predicated by MSEC (2020) to be relatively minor and not result in adverse impacts on the streams. It is similarly expected that any potential impacts to riparian vegetation that may affect the floristic composition of the community would be subtle, and highly localised to the area adjacent to the water source. In the Southern Coalfield, previous impacts to riparian vegetation as a result of subsidence have been minor in occurrence, and mostly attributed from gas release causing relatively short-term damage to the vegetation, rather than changes to hydrological regimes (as mentioned above).

To date, no impacts to riparian vegetation have been observed at Tahmoor Mine. The creeks within the Study Area are all ephemeral in nature with many being consistently dry throughout the years of survey there. It is highly likely that the vegetation along the watercourses is accustomed to periodically dry conditions. The riparian vegetation is not solely reliant upon ground-water for its survival and regularly experiences dry conditions. As such, should water diversion occur as a result of subsidence, it is unlikely to result in significant alterations to the composition of the community or vegetation die back.

As detailed in HEC (2020b), it is unlikely that the bed and banks of overlying creeks would be indirectly affected by subsidence induced fracturing and enhanced drainage of groundwater, leading to loss of riparian vegetation. This type of impact has generally not been reported in the Southern Coalfields and has not been observed at Tahmoor North to date, and has been considered by HEC (2020b) to be unlikely at Tahmoor South.

Therefore, it is considered unlikely that subsidence would result in any extensive or significant impact to native riparian vegetation within the Study Area. Should any impact occur, it is likely to be highly localised with only some subtle changes to species composition likely depending on interaction of that species with the change in watercourse. It is highly unlikely that potential impacts as a result of a predicted change to stream hydrology, would decrease the area of PCTs or vegetative habitat that currently occurs along the creek lines of the Study Area.

Tree fall by rock falls and earth slippages

The steep slopes on the sides of valleys are predominantly found in Hawkesbury Sandstone and consist of a mixture of cliffs and rock outcrops, which are stable at vertical to overhanging, and steep slopes with rocky soils and loose rock fragments. Steep slopes have been mapped by MSEC (2020) (Figure 5) as occurring along all creek lines within the Study Area. The majority of the slopes are stabilised, to some extent, by natural vegetation (MSEC 2020).

Slippage of earth and rocks down steep slopes and rock falls have the potential to directly impact vegetation, flora and fauna.

Subsidence may result in the downslope movement of soils, causing tension cracks to appear at the tops of the slopes, and compression ridges to form at the bottoms of the slopes, which in turn has the potential to cause erosion (MSEC 2020). However, as indicated by MSEC (2020), there is a low probability of large-scale slope slippage as a result of the Project. The probability is assessed to be very low for slopes that will not be directly mined beneath by the longwalls.

MSEC (2020) further supports this prediction due to the following:

- Experience in the Southern Coalfield indicates that the probability of mining-induced large-scale slippages is extremely low due to significant depth of cover.
- There has been extensive experience of mining beneath steep slopes in the Southern Coalfield. These include steep slopes along the Cataract, Nepean, Bargo and Georges Rivers and streams such as Myrtle Creek and Redbank Creek above Tahmoor Mine Longwalls 22 to 32, and slopes on Redback Range above Tahmoor Mine Longwalls 26 and 27. No large-scale slope failures have been observed along these slopes, even where longwalls have been mined directly beneath them.
- Minor rock falls along cliff lines or rock outcrops have been observed, for example, during the mining of Appin Longwalls 301 and 302 adjacent to the Cataract River. These have resulted in minor and localised rock collapses.

As such, it is considered likely that any impacts to vegetation as a result of earth and rock-face instability will be highly localised and relatively minor in nature. Large-scale impacts to vegetation as a result of large-scale slope failures are highly unlikely based on the predication of MSEC (2020). The potential impact to PCTs along creek lines are therefore likely to be so small and localised to be relatively insignificant.

8.3.3 Impact from Subsidence - Coastal Upland Swamps / Groundwater Dependent Ecosystems (GDEs)

No Coastal Upland Swamps have been mapped in the Study Area by Tozer et al (2006), OEH (2013) or Niche. Coastal Upland Swamps are more likely to be within the Upper Nepean State Conservation Area, Metropolitan Special Area and Bargo State Conservation Area which would not be impacted by the Project (section 8.7). Coastal Upland Swamps therefore do not need to be considered further.

No High Priority GDEs are known to occur within the Study Area (Hydro Simulations 2019). The closest High Priority GDE is Thirlmere Lakes, which approximately 3.5 km to the west of the Study Area. The potential impacts to Thirlmere Lakes in relation to biodiversity has been discussed further in section 8.8.

8.3.4 Impact on EPBC Act listed Threatened Ecological Communities

The Project would result in an impact to 23.57 hectares of Shale Sandstone Transition Forest (HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin), including 6.31 hectares of derived native grassland. Both of which are listed as Critically Endangered under the EPBC Act. The amount to be cleared for the Project, is a reduction of 19.79 ha (43.7%), when compared to the 43.7 ha of Shale Sandstone Transition Forest originally proposed to be cleared in the 2018 EIS.

A detailed discussion on the occurrence, distribution and impacts to Shale Sandstone Transition Forest has been provided in section 9.2.1. An Assessment of Significance has been also been completed in Appendix 8 for the impacts to Shale Sandstone Transition Forest. The assessment concluded that a significant impact to the TEC is likely.

A biodiversity offset for the impact to Shale Sandstone Transition Forest has been proposed in section 12.

8.4 Threatened flora

8.4.1 Clearing of habitat for surface infrastructure

The Project would result in the clearing of the following threatened flora that occur within the area proposed for surface infrastructure:

- *Grevillea parviflora* subsp. *parviflora*: a total of 491 individuals will be impacted;
- *Persoonia bargoensis*: eight individuals to be impacted;
- *Pomaderris brunnea*: one individual will be impacted.

No other threatened flora would be directly impact by clearing for surface infrastructure.

A biodiversity offset for each impacted threatened flora species has been discussed in section 11and 12.

8.4.2 Subsidence related impacts to threatened flora

Subsidence impacts on threatened flora may occur as a result of the following:

- Die-back that occurs immediately adjacent to a strata gas emission/drainage event;
- Individual and habitat loss as a result of a changed hydrological regime;
- Damage or loss resulting from rock falls and/or slippage of earth and rocks down steep slopes.

These impacts are generally centred on habitat types along riparian areas, immediately above and below cliff lines and steep slopes. Vegetation and habitat that occurs on the flat terrain of the Study Area are located away from areas that may be prone to subsidence related impacts.

Of the threatened flora recorded, only *Pomaderris brunnea* was recorded within the gully habitat of the Study Area. The remainder of the threatened flora were located away from the subsidence sensitive areas. Threatened flora records obtained from BioNet also indicate that most of the threatened flora occur away from these areas (Figure 12).

Pomaderris brunnea

As discussed in section 6.1.2, a population of *Pomaderris brunnea* was recorded along Teatree Hollow Creek, with one outlying individual in a decommissioned powerline easement. For the most part, the population typically occurred on the mid-bank to higher banks of Teatree Hollow Creek, away from the creek bed within the sheltered gully environment. The creek was dry for much of its traverse during the survey and monitoring years, with intermittent shallow pools occurring in the area where the majority of the population resided. As such, it could reasonably assumed that there is a disconnection of *Pomaderris brunnea* to the water within the creek given the species persistence during periods where water in the creek was absent. The species persistence is likely due to the sheltered gully habitat and association with the Peppermint Gully Forest to which the species is known to be associated with. Any potential drying of pools or predicted changes to the hydrological regime as a result of subsidence is therefore unlikely to result in die back of the *Pomaderris brunnea* population.

Similarly, as discussed in section 8.3.2 gas emissions as a result of subsidence are predicted to be rare. If gas emissions were to occur along the portion of Teatree Hollow Creek where *Pomaderris brunnea* resides, it may be reasonable to assume that given the plants position away from the lowest points in the topography, the potential for die back would largely be avoided.

Furthermore, the chances of a rock fall or steep slope collapse occurring directly above the population of *Pomaderris brunnea* resulting in the loss of individuals within the population seems quite unlikely given such events are predicted to be minor in occurrence by MSEC (2020), and that no cliffs occur within this portion of Teatree Hollow Creek.

For the above reasons, we have concluded that potential subsidence-related impacts to threatened flora, in particular *Pomaderris brunnea,* are highly unlikely.

8.4.3 Impact on EPBC Act listed threatened flora

Assessments of Significance have been completed for those threatened flora that have a moderate to high likelihood of occurrence within the Study Area, and for species identified by DoEE (*Grevillea parviflora* subsp. *parviflora, Persoonia hirsutata, Leucopogon exolasius* and *Pomaderris brunnea)* as having potential to experience a significant impact (Appendix 8).

The Assessments of Significance concluded that given the amendment of surface infrastructure disturbance associated with the Project, a significant impact to threatened flora listed under the EPBC Act is unlikely and therefore a Commonwealth offset for these species is not required. It should be noted however, that State biodiversity offset for *Persoonia bargoensis, Grevillea parviflora* subsp. *parviflora* and for one individual of *Pomaderris brunnea* has been proposed in section 12 as per the requirements of the FBA.

Leucopogon exolasius has been nominated by DoEE as potentially being impacted by the Project. As such, an Assessment of Significance has been completed for the species on a precautionary basis despite having a low likelihood of occurrence within the Study Area, and not being detected despite extensive surveys by Niche. The assessment concluded that a significant impact was unlikely given the species is unlikely to have habitat with the area proposed for surface infrastructure, and subsidence is unlikely to result in a loss to any important population given the species occurs on hillsides near creeks and not within the immediate riparian zone that would be affected by valley closures. Thus, any hydrological change from subsidence is unlikely to impact upon *Leucopogon exolasius.* Furthermore, as discussed in section 8.3.2, gas emissions as a result of subsidence are predicted to be rare, and because the species is known to occur on rocky hill slopes adjacent to creeks, the portenital for die back from gas emission would largely be avoided. The species is therefore considered unlikely to be significantly impacted by the Project.

8.5 Threatened fauna

The Project may result in impacts to threatened fauna as a result of clearing of habitat for the surface infrastructure, or via subsidence which is predicted to have impacts on cliffs and watercourses in the Study Area. Avoidance measures attempting to limit these impacts are described in section 7.

The likelihood of occurrence, habitat requirements and potential for impacts for all subject threatened fauna species is considered in Table 19 and Appendix 1. Additional detailed impact assessment for particular threatened fauna such as species credit species, has been conducted below depending on the severity of potential impacts, sensitivity of the species to impacts or due to legislative requirements.

8.5.1 Koala

Koalas are a species credit species were breeding habitat is identified by evidence of breeding such as the presence of courting males and females or young-bearing females. Where foraging and shelter habitat for dispersing individuals is present but breeding habitat is not evident, the species is treated as an ecosystem credit species. No evidence of Koalas was detected during the field surveys (observations of animals, scats or scratches on trees), which precludes the need for offsetting Koalas as species credits. Nonetheless, the Koala will be offset as a species credit species under the precautionary principle and on the advice of DPIE.

Within the area proposed for surface infrastructure, Koala feed trees (*Eucalyptus punctata*, with the occasional *Eucalyptus tereticornis*) were recorded, both of which are listed as Schedule 2 feed trees on the State Environment Planning Policy 44 Koala Protection (SEPP 44). These trees are associated with PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556), and have been planted in the rehabilitation area, both of which will be directly impacted.

Despite the presence of the feed trees, it is considered unlikely that Koalas would occur regularly within the area proposed for surface infrastructure, as there was no evidence of Koalas detected despite targeted spotlighting and Koala SAT plots. However, considering the number of records for Koalas in the locality, the area to be cleared for the surface infrastructure would result in the loss of potential Koala habitat.

Subsidence as a result of the Project is unlikely to significantly impact the Koala. Subsidence is unlikely to result in the loss of Koala feed trees, or native vegetation loss that would restrict Koala movement. Furthermore, it is highly unlikely that steep slope slippage or rock fall would result in the loss of a Koala.

Local and regional koala habitat linkages

The proposed clearing associated with the surface infrastructure disturbance footprint will increase the existing surface footprint of Tahmoor Mine by 11.41 ha to the south of the current REA to accommodate the extension, and 3.47 ha to the east for ventilation shaft TSC 2. The powerline and ventilation shaft TSC 1 will clear/impact on a combined total of 2.73 ha of Koala habitat.

The total area of potential Koala habitat to be impacted for the Project is 17.26 ha. This is a reduction of 25.90 ha when compared to the 43.50 ha of potential habitat proposed in the publicly exhibited EIS

The Koala corridors in south-west Sydney (OEH 2018b) identifies all the vegetated land in the Study Area and all vegetated land approximately 2 km to the east and 6 km to the west as primary Koala corridor, including Teatree Hollow Creek and Dogtrap Creek. The vegetation clearing will result in minor fragmentation of potential habitat; however the clearing is unlikely to impede Koala movement as no large barriers or hostile barriers to Koala dispersal will be erected as part of the Project. However this assessment notes the importance of habitat for the Koala in the locality, and as such, Koala habitat will be offset within the ecosystem credits required for the removal of 17.26 ha comprising good condition PCT HN556 (Section 12).

8.5.2 Large-eared Pied Bat

Although the Large-eared Pied Bat was not detected during the survey, there is one record of the species within the north of the broader Study Area. Several other records occur adjacent to the Bargo River to the north and north-east of the Study Area and also along the Nepean River.

The Large-eared Pied Bat may utilise caves and rocky crevices for roosting and breeding habitat but forages nearby in woodland or forested habitat (DERM 2011).The National Recovery Plan for the species (DERM2011) notes that all records of the species are within several kilometres of cliff lines or rocky terrain and that sandstone cliffs and fertile wooded valley habitat within close proximity of each other should be considered habitat critical to the survival of the Large-eared Pied Bat.

According to MSEC (2020), a total of 24 cliffs are located within the 'Subsidence Study Area'. The cliffs may provide roosting habitat for the species. The cliffs are generally located within the valleys of the Bargo River, Dogtrap Creek and Hornes Creek within areas outside of the Predicted 20 mm Subsidence Area.

Given the proximity of the cliff line along the Bargo River, to the surface infrastructure area (within two km), and the proximity of local records of the species, the species is considered likely to utilise the Study Area, including the surface infrastructure area, for foraging habitat. A total of 17.26 ha of forested habitat will be removed within the surface infrastructure area.

As detailed in MSEC (2020), most (23 out of a total of 24) cliffs will not be directly mined beneath. These include the cliffs along the Bargo River and Hornes Creek, which are all located outside the extents of the proposed longwalls. The cliffs that occur outside of the area directly above longwalls, are predicted to experience very low levels of vertical subsidence and are not expected to experience any substantial conventional tilts, curvatures or strains (MSEC 2020). The likelihood of cliff instabilities along the Bargo River and Hornes Creek has been assessed by MSEC (2020) using case studies where previous longwall mining has occurred close to but not directly beneath cliffs. The case studies have indicated that very minor rock falls have been observed outside the extracted goaf areas of longwall mining in the Southern Coalfield, although there have been no recorded large cliff instabilities. These case studies are supported by previous impacts from mining at Tahmoor, Appin and Tower Collieries, which have not experienced any large instabilities beyond the extent of the longwall mining area (MSEC 2020).

Based on the MSEC (2020) predictions and previous experience in the Southern Coalfields, it is unlikely that potential roosting habitat for the Large-eared Pied Bat within the cliffs to be directly mined beneath would be impacted by large scale instabilities which may impact this potential habitat.

As discussed in MSEC (2020), previous experience in the Southern Coalfield has indicated that cliffs which are directly mined beneath may exhibit instabilities. The one cliff that occurs above the longwalls and may exhibit instabilities occurs along Dogtrap Creek and is 55 metres long and 10 metres high.

There is the potential for the cliffs to support roosting habitat for the Large-eared Pied Bat. It is predicted by MSEC (2020) that the cliff to be undermined could experience the full range of predicted subsidence movements, and based on previous experience in the southern coalfields that there is a moderate to likely probability that rock falls and cliff instabilities would occur somewhere along this cliff line. MSEC (2020) states that any impacts to the cliffs that are directly mined beneath, are expected to affect between 3-5 % of the total length of the cliffs. Based on this prediction, the length of the cliff along Dogtrap Creek that may be impacted by subsidence is relatively small (about 2.75 metres).

Given the relatively small length of the cliff line that would potentially be impacted by subsidence, the probability that roosting habitat would be impacted is very low. Even more unlikely is that subsidence would result in impacts to a crevice in which a roosting population of Large-eared Pied Bat is present, particularly given no caves are known to occur above the longwalls. As such, it is unlikely that the species would be impacted by subsidence related impacts.

Given the Large-eared Pied Bat is regarded as a ‘species credit’ fauna, impacts to the species need to by offset as per the FBA. A species polygons of 17.26 ha of foraging habitat has therefore been assigned to the Large-eared Pied Bat (Figure 20), and a credit offset requirement detailed in section 11.

8.5.3 Large-footed Myotis

The Large-footed Myotis was recorded within the surface area footprint of the REA during targeted surveys. The Large-footed Myotis is regarded as species credit fauna given its dependence on waterways with pools of 3 m wide or greater for foraging, and habitat surrounding waterways for breeding and roosting.

The BioNet database notes that hollow-bearing trees, bridges, caves or artificial structures within 200 metres of a riparian zone are areas of important habitat for the species. Portions of the proposed surface infrastructure for the REA contain hollow-bearing trees that are within 200 metres of Tea Tree Hollow Creek.

Given the species was recorded within the surface infrastructure disturbance footprint, foraging habitat would be impacted by the Project. A total of 17.26 ha of habitat would be impacted made up of PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556).

It is unlikely that subsidence would impact on roosting habitat for the Large-footed Myotis. Predictions by MSEC (2020) indicate that cliff lines that are not directly mined beneath are unlikely to result in any large-scale rock fall or instabilities. As discussed for the Large-eared Pied Bat, given the very small length of the cliff line that would potentially be impacted by subsidence (i.e. 3-5 % of the total length of the cliffs), the probability that roosting habitat would be impacted is very low. Furthermore, no bridges or culverts within the Study Area that provide roosting habitat for the Large-footed Myotis are likely to be impacted by subsidence. As such, roosting habitat for the species is unlikely to be impacted by the Project.

The Large-footed Myotis is known to forage over streams and pools catching insects and small fish by raking their feet across the water surface. The length of watercourses in the Study Area that provide potential foraging habitat exceeds 20 kms.

Subsidence has the potential to result in the loss or decrease in some potential foraging pools within the watercourses of the Study Area. HECONS (2020b) has indicated that subsidence from the Project may result in the reduced frequency of pools overflowing, lowering of pool water levels and periodic loss of interconnection between pools during dry weather. Streams or sections of streams located away from the proposed longwalls, are less likely to have fracturing and surface flow diversions, compared to stream sections located directly above the proposed longwalls.

As noted in HEC (2020b), it is not possible to predict the precise locations where diversion of surface flow induced fracturing will occur, or to predict the flow capacity of the subsurface fracture networks that could form following subsidence. It is therefore difficult to determine the extent of impact, if any, on potential foraging habitat pools for the Large-footed Myotis. Diversion of surface flows is thought to occur predominantly via pools where the fractures intersect the bed of permanent pools creating a permanent head and supply of water to 'feed' the fracture system. Detailed analysis of mapped pools by HEC (2020b) in combination with subsidence predictions by MSEC (2020) has indicated stated following:

- *"There were eight pools mapped in Tea Tree Hollow and five pools mapped on a tributary of Tea Tree Hollow (note that two pools located outside of the Subsidence Study). The total predicted closure for seven of the eight pools mapped in Tea Tree Hollow and for two of the eight pools mapped in the tributary of Tea Tree Hollow, is less than 210 mm, which indicates that less than 10% of these pools are expected to be impacted.*
- *One pool on Tea Tree Hollow and one pool on the tributary of Tea Tree Hollow are predicted to have a total closure of less than 290 mm, which indicates that less than 20% of pools are expected to be impacted.*
- *Two pools on the tributary of Tea Tree Hollow have a predicted total closure of 300 and 325 mm respectively. At this total closure prediction, less than 30% of pools are expected to be impacted.*
- *The largest number of pools (in excess to 70), were mapped on Dog Trap Creek. For 40 of these pools, less than 20% of pools are expected to be impacted. For eighteen pools, less than 30% are expected to be impacted and for fourteen pools, less than 50% are expected to be impacted."*

Whilst there may be some loss in potential foraging habitat, according to MSEC (2020) a change in the grade of a stream has the potential to lead to increased ponding. MSEC (2020) states: 'that there is a predicted reversal of grade along a naturally flat section of Dogtrap Creek... There is increased potential for ponding upstream of this location, which is estimated to be up to 0.2 metres deep and 150 metres long'. MSEC (2020) also states that it is 'possible that there could be very localised areas along the streams which could experience small increases in the levels of ponding… however any localised changes in ponding are expected to be minor and not result in adverse impacts on these streams'.

The potential for ponding may therefore increase the availability of foraging habitat for the Large-footed Myotis. As discussed in Niche (2020), increased ponding is likely to provide localised increase in available habitat for aquatic macroinvertebrates and if there is stream connectivity in the area of ponding, it may also provide additional habitat for fish and macrophytes.

Whilst there may be changes to water capacity to some pools within the Study Area (as detailed in HEC 2020b), there is also potential that ponding will occur following subsidence that creates additional foraging habitat for the Large-footed Myotis. Furthermore, not all foraging pools within the watercourse of the Study Area would be impacted or completely drained and, as such, the potential impacts pool habitat is unlikely to disrupt the life cycle of the species such that the population would decline. Based on these reasons, a biodiversity offset for impacts as a result of subsidence has therefore not been proposed.

Given the Large-footed Myotis is regarded as a 'species credit' fauna, impacts to the species need to by offset as per the FBA. A species polygons of 17.26 ha of foraging habitat has therefore been assigned to the Large-eared Pied Bat (Figure 20) given the species occurrence within the surface disturbance area, and a credit offset requirement detailed in section 11.

Given the Large-footed Myotis is regarded as a 'species credit' fauna, impacts to the species need to be offset as per the FBA. A species polygons of 17.26 ha of foraging habitat has therefore been assigned to the Large-eared Pied Bat (Figure 20), and a credit offset requirement detailed in section 11.

8.5.4 Eastern Cave Bat

The Eastern Cave Bat, a species credit species, was recorded within the surface infrastructure development area during targeted surveys. The species is known to have breeding habitat identified by the presence of rocky areas containing caves, or overhangs or crevices or escarpments, old, tunnels or culverts.

The BioNet database regards important habitat for this species to occur within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds. This definition of important habitat means the entire Study Area contains potential habitat.

Although the vegetation to be cleared for the Project occurs within two kilometres of overhangs, old building and sheds, the site does not occur within close proximity to any known maternity or roost site.

If a maternity or roost site was located within the Study Area, it is highly likely that more recordings of the Eastern Cave Bat would be on the Anabats. Our survey only recorded the species on one Anabat, over one night. This Anabat was located in the far east of surface disturbance footprint (Figure 19). More Eastern Cave Bat activity would be expected if a breeding colony was nearby. As such, this assessment does not regard the vegetation to be cleared for the surface works to contain important foraging or breeding habitat for the species.

As for the Large-eared Pied Bat and Large-footed Myotis, the likelihood of subsidence impacting upon a roosting site is very low. Predictions by MSEC (2020) indicate that cliff lines that are not directly mined beneath are unlikely to result in any large-scale rock fall or instabilities. Given the very small length of the cliff lines that would potentially be impacted by subsidence (i.e. 3-5 % of the total length of the cliffs), the probability that roosting habitat would be impacted is very low. Furthermore, no sheds or old buildings are predicted by MSEC (2020) to collapse. As such, roosting habitat for the species is unlikely to be impacted by the Project.

Given the Eastern Cave Bat is regarded as a 'species credit' fauna, impacts to the species need to by offset as per the FBA. A species polygons of 17.26 ha of foraging habitat has therefore been assigned to the Eastern Cave Bat based on loss of foraging habitat (Figure 20), and a credit offset requirement detailed in section 11.

8.5.5 Red-crowned Toadlet

A population of the Red-crowned Toadlet was recorded outside of the Study Area at Hornes Creek during the Tahmoor South Project Terrestrial Ecology Monitoring Program (Figure 18). The Red-crowned Toadlet was not recorded within any other riparian areas within the Study Area and surrounds, including Dogtrap Creek, Tea Tree Hollow Creek, Bargo River and its tributaries, Eliza Creek, Cow Creek, Dry Creek and Carter Creek.

The Red-crowned Toadlet is known to occur within periodically wet drainage lines below sandstone ridges, sheltering under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Such features occur in all the catchments within the Study Area. However, during the Amphibian Monitoring Program, these environments were more often found to be inhabited by the common Bibron's Toadlet (*Pseudophryne bibronii*), a close relative of the Red-crowned Toadlet. *Pseudophryne spp.* often do not occupy the same locations (e.g. White 1993, Dewaly *et al.* 2015), which may explain why the Red-crowned Toadlet was absent from the watercourses within the Study Area.

It is noted that the species has not been recorded breeding in waters that are mildly polluted or with a pH outside the range 5.5 to 6.5 (DEC 2005). For many of the creeks in the Study Area, impacts from the surrounding rural and residential area has resulted in iron floc, which is clearly evident by the orange staining of rocks and sediment. It is thus possible that the absence of the Red-crowned Toadlet within the majority of watercourses within the Study Area could be also be attributed to the presence of pollutants in the water. Hornes Creek, where the species was recorded, is situated amongst bushland with less pollution influences from nearby rural and residential developments.

Contamination of the water bodies may also arise from subsidence due to releases of aluminium, iron, manganese and zinc from the sandstone strata (MSEC 2020). It is likely these would be seen as transient spikes in the concentration of these and possibly other metals which would be relatively localised. The extent of these impacts is expected to be similar to impacts observed in similar streams in the Southern Coalfield (i.e. iron staining and flocs in pools and localised and transient spikes in iron, manganese and aluminium in waterways previously undermined). Such an impact may affect the suitability of the pools as breeding habitat for the species given the Red-crowned Toadlet is sensitive to water chemistry. However, no changes to water chemistry have been specified in the specialist water quality assessment for the Project.

The vegetation clearing associated with the Project would not impact the Red-crowned Toadlet, given the species was not detected within Teatree Hollow Creek, Dogtrap Creek or tributaries.

Subsidence associated with the Project has the potential to result in a reduced frequency of pools overflowing, lower pool water levels and periodic loss of interconnection between pools during dry weather (HEC 2020b). However, it is noted that streams or sections of streams located away from the proposed longwalls, are less likely to have fracturing and surface flow diversions compared to stream sections located directly above the proposed longwalls (HEC 2020b).

The revised Predicted 20 mm Subsidence Area provided in this assessment will not impact upon Hornes Creek as previously assessed in the original EIS. No longwalls are proposed directly under the portion of Hornes Creek (or upstream) where the population of Red-crowned Toadlet occurs. As such, based on the predictions of MSEC (2020), the likelihood for the standing capacity of pools to be reduced or lost along this section of Hornes Creek are very low. HECONS (2020b) do not specifically report on any impacts to the pool capacity or the risk of impact to the water holding capacity of Hornes Creek. This is likely due to the creek not occurring above the proposed longwalls.

Surface water modelling completed by HEC (2020b) in relation to the creeks within close proximity to the Study Area, has also not detected any significant impacts to baseflow reduction and reduction of pool holding capacity as a result of the Mine workings. Of the creeks outside of the study area, only Cow Creek has some potential habitat for the Red-crowned Toadlet. Cow Creek differs in terms of habitat potential compared to Eliza Creek, Dry Creek and Carters Creek, and the creeks within the Study Area, given Cow Creek occurs within intact sandstone dry sclerophyll forest which is located away from the urban and rural pressures. Cow Creek contains a number of larger, deep pools, surrounded by sandstone and overhanging native vegetation, which the Red-crowned Toadlet is known to prefer. We have therefore assigned Cow Creek as being moderate likelihood of occurrence for the Red-crowned Toadlet, noting that it was not detected during the amphibian monitoring.

Regardless, HEC (2020b) have concluded that modelling of baseflows outside of the study area along Cow Creek has predicted relatively minor/negligible changes to baseline flow reduction. The main channel of Cow Creek is located approximately 1 km from the nearest Project longwall, which, as detailed in MSEC (2020) report that, at this distance, the maximum predicted subsidence, upsidence and valley closure are less than 20 mm. Accordingly, the potential for localised impacts on Cow Creek such as fracturing and surface water flow diversion are extremely low.

As stated in HECC (2020b), the estimated reduction in water level would likely be imperceptible and very small compared to natural variability in catchment conditions and is therefore considered to be negligible. As such, we have concluded that the Project is unlikely to impacts the Red-crowned Toadlet within Cow Creek, or other watercourses. No offset for the species have therefore been proposed.

8.5.6 Eastern Pygmy-possum

No Eastern Pygmy-possums were recorded in the Study Area during the surveys. It must be noted that only camera trapping was undertaken; nest boxes, nest tubes and pit fall trapping generally result in better success for detecting this species. However, the Eastern Pygmy-possum can be a difficult species to detect regardless of the survey method.

The Study Area, including the surface infrastructure area supports suitable potential foraging habitat (eucalypt forest) and shelter/nesting resources (14 hollow-bearing trees) for the species. It must be noted that key food species, Callistemon and Banksia's, were scarce within this community within the surface infrastructure area, indicating that it may not constitute optimal habitat for the species. However, removal of 17.26 ha of potential habitat within the surface infrastructure area has the potential to impact on foraging species should it occur.

The closest record (BioNet) is 3.3 km to the west of the surface impact area; in wooded habitat next to Bargo River. Based on the presence of potentially suitable habitat, and the presence of records in forested habitat in the locality, we have assumed that this species is present and have calculated offsets for impacts to 17.26 ha of potential foraging and shelter habitat for the species within the surface infrastructure area.

Subsidence as a result of the Project is unlikely to impact on the potential foraging or shelter habitat for the Eastern Pygmy-possum within the Study Area. Subsidence is unlikely to result in the loss of feed trees, or native vegetation loss that would restrict movement of the species. Furthermore, it is highly unlikely that steep slope slippage or rock fall would result in the death or injury of an Eastern Pygmy-possum.

Given the Eastern Pygmy Possum is regarded as a 'species credit' fauna, impacts to the species need to be offset as per the FBA. A species polygons of 17.26 ha of foraging habitat has therefore been assigned to the Eastern Pygmy Possum based on loss of foraging habitat (Figure 20), and a credit offset requirement detailed in section 11.

8.6 Impact on EPBC Act listed Fauna

Assessments of Significance have been completed for those threatened fauna that have a moderate to high likelihood of occurrence within the Study Area (Appendix 8). These included:

- Broad-headed Snake (assessment undertaken as a precautionary approach)
- Large-eared Pied Bat
- Koala
- Grey-headed Flying-fox
- Greater Glider
- Threatened and/or migratopry birds: Swift Parrot, Regent Honeyeater, Cattle Egret, Great Egret, Fork-tailed Swift, Rainbow Bee-eater and Satin Flycatcher.

For all species, the Assessments of Significance concluded a significant impact as a result of the Project is unlikely. Of particular note, a significant impact to the Koala and Greater Glider is considered unlikely to occur. Both of these species were noted by DoEE to potentially be impacted by the Project (section 2.1.2).

The potential impacts to the Koala have been discussed in section 8.5, and regardless of a non-significant impact to the Koala, the species will have a State offset requirement in accordance with the FBA (section 11).

The Greater Glider has a moderate likelihood of occurrence within the Study Area (6.3, Appendix 1). The species was considered unlikely to utilise the habitat features of the surface infrastructure footprint given it was not detected during targeted surveys across differing months. As such, the removal of native vegetation for surface infrastructure is unlikely to impact the species. Subsidence is unlikely to impact upon tree hollows which the species may utilise. Similarly, subsidence is unlikely to result in a decline in the availability of foraging habitat for the species, as no large-scale vegetation die back events are likely (section 8.3.2). As such, no significant impact to the Greater Glider is likely.

The Large-eared Pied Bat has been recorded in the Study Area is considered to have a high likelihood of occurrence within the potential foraging habitat of the surface infrastructure area. However, the removal of 17.26 ha of potential foraging habitat was considered unlikely to have a significant impact on the species, and similarly potential subsidence-related impacts to potential roosting habitat were considered unlikely. Regardless, the removal of 17.26 ha of potential foraging habitat for the Large-eared Pied Bat will have a State offset in accordance with the FBA (section 11).

8.7 Impact on conservation areas

In relation to the Study Area, the closest conservation areas include:

- Upper Nepean Conservation Area and Metropolitan Special Area located approximately 300 m to the far south of the Study Area;
- Bargo State Conservation Area, located approximately 3.8 km to the west of the Study Area;
- Bargo Dingo Sanctuary, located within the Study Area, located to the south of Tahmoor Colliery along Remembrance Drive
- Wirrimbirra Sanctuary, located within the Study Area, to the south of the proposed ventilation shaft TSC 1.

No vegetation clearing is proposed within any conservation area. Mitigation measures proposed would ensure that no indirect impacts from vegetation clearing during construction and operation would impact any conservation area.

In relation to potential subsidence impacts, we have utilised the predictions of MSEC (2020) and specialist studies to inform the impact assessment on biodiversity within the Study Area. Based on the conclusions of the specialist studies, we have determined that subsidence related impacts towards threatened biodiversity are likely to be minor in nature or negligible. Such conclusions are discussed throughout sections 8.3.2, 8.3.3, 8.4.2 and 8.5.

Furthermore, as detailed in the HEC (2020b), surface water modelling in relation to the creeks immediately outside of the Study Area (such as Cow Creek within the Upper Nepean Conservation Area, Metropolitan Special Area), has also not detected any significant impacts to baseflow reduction and reduction of pool holding capacity as a result of the Mine workings. The modelling of baseflows along Cow Creek has predicted relatively minor/negligible changes to baseline flow reduction. As detailed in HEC (2020b), there is no apparent effect for flows greater than about 0.5 ML/day. The largest effect is seen on flows less than approximately 0.1 ML/day. The probability that flow would be greater than 0.01 ML/day would reduce from 83% to 79% of days based on the maximum predicted baseflow reduction. This level of change may be detectable during normal periods of low flow and distinguishable from natural variability in catchment conditions.

In the long-term (greater than 100 years), the baseflow reduction is predicted to be 0.014 ML/day (HydroSimulations, 2020). The probability that flow would be greater than 0.01 ML/day would reduce from 83% to 80% of days based on the long-term predicted baseflow reduction. This level of change may be detectable during normal periods of low flow and distinguishable from natural variability in catchment conditions.

Although the predicted baseflow reduction in Cow Creek, which is within the Metropolitan Special Area, may be detectable during normal periods of low flow, the combined effects of the Project, consumptive groundwater extraction and the effects of other existing mining projects are predicted to have a negligible impact on Sydney's water supply sources. HEC (2020b) presents an assessment of the potential water supply impact in three management zones in the Upper Nepean River water source, namely Pheasants Nest Weir, Stonequarry Creek and Maldon Weir, based on the maximum and long-term predicted baseflow reduction due to the Amended Project and cumulative impacts. The assessment outcomes indicate that the predicted baseflow reductions are likely to have a negligible observable impact on mean daily flow at these locations. Based on this analysis, it is highly unlikely that any threatened biodiversity within the Upper Nepean Conservation Area, Metropolitan Special Area would be impacted by the Project. Similarly, no significant baseflow reduction changes are predicted to occur within the Bargo State Conservation Area.

The Wirrimbirra Sanctuary is a heritage-listed fauna sanctuary, native plant nursery, education centre and flora sanctuary located within the Subsidence Study Area. A tributary of Tea Tree Hollow and a small portion of Tea Tree Hollow flow through the property. As stated above, no vegetation clearing would occur within the Wirrimbirra Sanctuary, and it is highly unlikely that any native vegetation or threatened flora would be impacted by subsidence (section 8.3.2, 8.3.4, 8.4.2, 8.4.2), and similarly, threatened fauna (section 8.5). Notably, impacts to threatened biodiversity and native vegetation are unlikely from clearing and subsidence due to the following:

- Subsidence is highly unlikely to impact dry sclerophyll forest woodland / forest vegetation communities that occur away from watercourse as these are not soley reliant upon groundwater for survival.
- MSEC (2020) has not predicted any significant gas emission releases along any of the water courses within the Study Area, and such occurrences are rare within the Southern Coalfields. As such, vegetation communities that occur along watercourses are unlikely to experience such impacts, and in the unlikely event it did occur, would be highly localised and regenerate following the event.
- Vegetation communities which are independent of groundwater and not closely associated with the water levels and hydrology of the creeks are unlikely to be impacted by subsidence due to underground mining.
- To date, no impacts to riparian vegetation have been observed at Tahmoor Mine, as supported in the End of Panel Reports associated with Tahmoor Mine. The creeks within the Study Area (including that of Tea Tree Hollow Creek located adjacent to the Bargo Dingo Sanctuary and Wirrimbirra Sanctuary) are ephemeral in nature, and Tea Tree Hollow Creek was relatively dry throughout the years of survey there. It is therefore highly likely that the vegetation along the watercourses is accustomed to periodically dry conditions. The riparian vegetation is not solely reliant upon groundwater for its survival and regularly experiences dry conditions and as such, should water diversion occur as a result of subsidence, it is unlikely to result in significant alterations to the composition of the community.
- Impacts to vegetation as a result of earth and rock-face instability will be highly localised and relatively minor in nature. Large-scale impacts to vegetation as a result of large-scale slope failures are highly unlikely based on the predictions of MSEC (2020).
- Threatened flora, including that of *Pomaderris brunnea* which occurs along Tea Tree Hollow Creek, occur within and near Wirrimbirra Sanctuary. For the most part, *Pomaderris brunnea* was typically recorded on the mid-bank to higher banks of Tea Tree Hollow Creek, away from the creek bed. The creek was dry for much of its traverse during the survey and monitoring years, with intermittent shallow pools occurring in the area where the majority of the population resided. As such, it could be reasonably assumed that there is a disconnection of *Pomaderris brunnea* to the water within the creek given the species persistence during periods where water in the creek was absent. Any potential drying of pools or predicted changes to the hydrological regime as a result of subsidence is therefore unlikely to result in loss of the Pomaderris brunnea population.
- Threatened fauna that may utilise both the Wirrimbirra Sanctuary are unlikely to be significant impacted as detailed in section 8.5.

In relation potential changes to baseflow reduction from Mine workings within Wirrimbirra Sanctuary, this has been investigated in HEC (2020b). Surface water modelling in relation to Tea Tree Hollow Creek that occurs within the Wirrimbirra Sanctuary has identified three pools (referred to as TTH-PO2, TTH-PO3, TTHPO4 within HEC (2020b)). Based on the predictions within HEC (2020b), it seems unlikely that any significant loss of pools is likely to occur:

- TTH-PO2 is unlikely to be impacted by subsidence given less than 10% of pools are expected to be impacted at the level of predicted total closure associated with the pool.
- There is a moderate chance that pools TTH-PO3 or TTH-PO4 may be impacted (30% of rock bars or upstream pools are expected to be impacted at this level of predicted total closure).

- HydroSimulations (2020) have predicted a maximum baseflow reduction rate of 0.016 ML/d for Tea Tree Hollow and the tributary of Tea Tree Hollow at the northern boundary of Wirrimbirra Sanctuary. Modelled flow statistics of Tea Tree Hollow at Wirrimbirra predicts that there is no apparent effect for flows greater than about 0.5 ML/day.

Based on such predictions, it seems unlikely that any large-scale, significant loss of water-related habitat would occur within the Wirrimbirra Sanctuary portion of Tea Tree Hollow Creek.

8.8 Impact on Thirlmere Lakes

The Thirlmere Lakes lay to the west of the existing Tahmoor Mine (approximately 3km from the subsidence area), in the upper reaches of Blue Gum Creek, which ultimately flows to Lake Burragorang (Warragamba Dam). Thirlmere Lakes are in the Thirlmere Lakes National Park which is part of the Greater Blue Mountains World Heritage Area. The Lakes are a series of five interconnected Lakes (in order from most upstream to downstream): Gandangarra, Werri Berri, Couridjah, Baraba and Nerrigorang. The nearest Tahmoor Mine longwall panels to the Thirlmere Lakes were mined between 1996 and 2002 and were located approximately 600 m from Lake Couridjah.

In order to assess any potential impacts from the Project on the Thirlmere Lakes, specialist groundwater and surface water studies were undertaken by HydroSimulations (2020) and HEC (2020b). The assessment included an investigation into the potential for project-related impacts to occur to the Thirlmere Lakes using a calibrated lake water balance model.

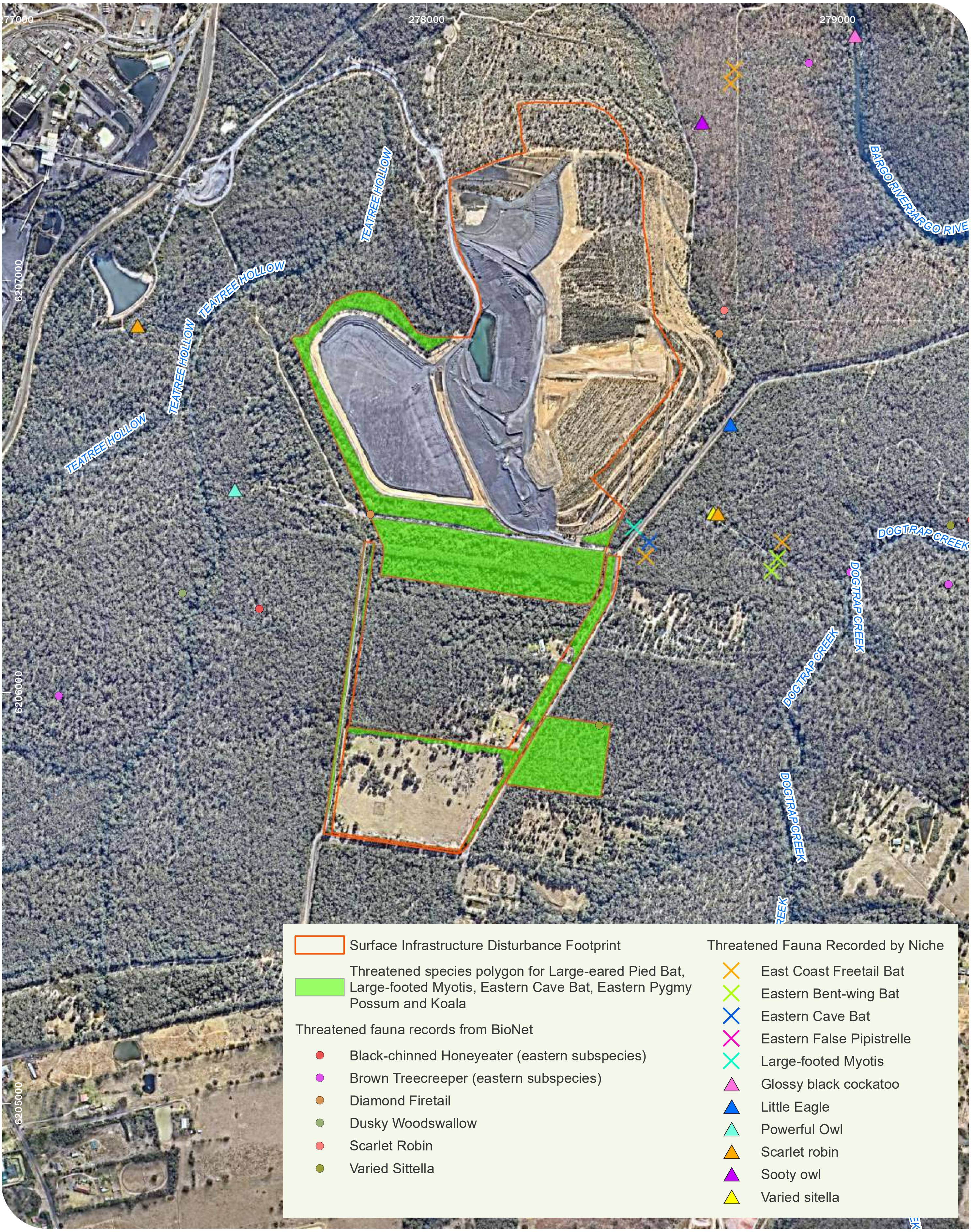
Key predictions from the modelling by HEC (2020b) and HydroSimulations (2020) include:

- The model predicts a negligible increase (approximately 2%) in groundwater recharge from the Lakes as a result of the project, and a negligible decrease (also about 2%) in outflows to Blue Gum Creek; changes which will both be imperceptible.
- The magnitude of this change in recharge/discharge would be very small compared to natural variability in downstream catchment conditions, and in the context of the potential impacts on inflow to downstream Lake Burragorang (Warragamba Dam), it would be imperceptible.
- Average Lake water levels would decrease by between 0.01 m and 0.06 m. The predicted average number of weeks per decade that the Lakes were without any discernible ponded water increases by between 3 and 5.2 weeks.

HECONS (2020) have regarded that the magnitude of change water levels to be imperceptible and very small compared to natural variability and are therefore considered negligible.

Hydro Simulations (2020) have indicated a gradual recovery in groundwater impacts following completion of mining. Therefore, the above changes would decrease with time following the end of mining.

Based on the relatively imperceptible impacts to the Thirlmere Lakes concluded in HyrdoSimulations (2020) and HEC (2020b) toward changes in groundwater and surface water, it is highly unlikely that the terrestrial biodiversity values of the Thirlmere Lakes system would be impacted in a manner that would result in loss of vegetation and habitat or die back of vegetation. As stated in HEC (2020b) compared to natural variability, any change would so minor to be negligible and essentially unquantifiable toward biodiversity. As such, it is highly unlikely that the biodiversity values of the Thirlmere Lakes would be impacted by the Project. A field survey of the biodiversity values of Thirlmere Lakes was therefore not required as part of the scope of this assessment.



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Threatened species polygons

Tahmoor South Project

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Figure 20

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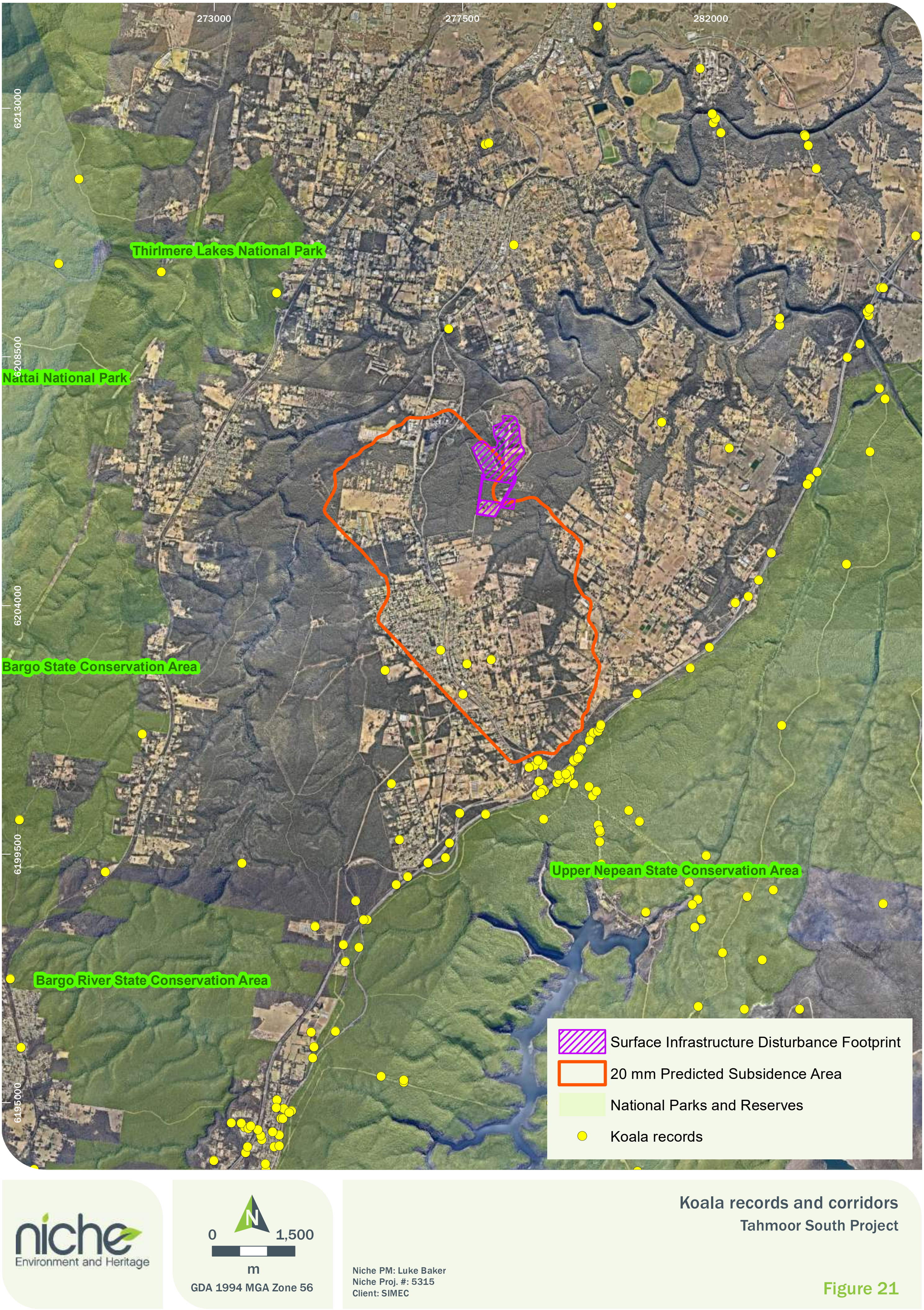

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Client: SIMEC

Koala records and corridors

Tahmoor South Project

Figure 21

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9. Impacts requiring further consideration

Under section 9.2 of the FBA, the assessor is required to identify impacts on biodiversity values that require further consideration.

Impacts on biodiversity values that require further consideration are:

(a) impacts on landscape features, being:

> (i) impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas in accordance with Subsection 9.2.3, or
>
> (ii) impacts that will prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state in accordance with Subsection 9.2.3, and

(b) impacts on native vegetation that are likely to cause the extinction of an EEC/CEEC from an IBRA subregion or significantly reduce its viability in accordance with Subsection 9.2.4, and

(c) impacts on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA subregion or significantly reduce its viability in accordance with Subsection 9.2.5.

Biodiversity values identified in the SEARs as requiring further consideration include:

- River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (EEC)
- Shale Sandstone Transition Forest in the Sydney Basin Bioregion (CEEC)
- Southern Highlands Shale Woodlands (CEEC)
- Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)
- *Persoonia bargoensis* (Bargo Geebung)
- *Persoonia glaucescens* (Mittagong Geebung)
- *Persoonia hirsuta* (Hairy Geebung)
- *Haplocephalus bungaroides* (Broad-headed Snake)

Each of these values is discussed below in relation to the requirements of the FBA.

9.1 Impact on landscape features

9.1.1 Riparian buffers

Under section 9.2.3 of the FBA, impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas are to be assessed.

The Project will not result in the clearing of native vegetation within:

- 20 m either side of a 4th and 5th order stream
- 50 m either side of a 6th order stream or higher, or
- 50 m around an estuarine area.

The clearing associated with the surface infrastructure will not result in the clearing of native vegetation within the riparian buffer of Teatree Hollow Creek. The clearing will occur approximately 80 metres from the outside edge of the riparian buffer of Teatree Hollow Creek which is a 3rd order stream. Mitigation measures detailed in sectopm 10 would be employed to avoid indirect impacts.

The impacts to native vegetation associated with subsidence are unlikely to result in a substantial or significant impact to riparian vegetation. As discussed in section 8.3.2, the likelihood for gas emissions to result in vegetation modification is low. Furthermore, if such impacts were to occur, they would be relatively temporary and highly localised.

The Project therefore will not impact the width of native vegetation within any riparian buffers in the Study Area.

9.1.2 Impact on important wetlands

No wetlands occur within the Study Area. The Project will therefore not have an impact upon any important wetland.

9.1.3 Impact on species movement along corridors

This includes any impact of development on areas of native vegetation on land that is mapped or defined as a state significant biodiversity link, and where the impact:

1. Creates a gap greater than 100 m between two areas of moderate to good condition native vegetation with a patch size greater than 1 ha (30 m for non-woody ecosystems), or
2. Removes over-storey cover and mid-storey cover vegetation within the state significant biodiversity link to create a gap in over-storey cover and mid-storey cover vegetation greater than 100 m between two areas of moderate to good condition vegetation with a patch size greater than 1 ha (30 m for non-woody ecosystems), or
3. Creates a hostile barrier, such as a dual carriageway, wider highway, or similar hostile barrier within the state significant biodiversity link.

No regional or state biodiversity links have been mapped as occurring with the Study Area. As such, the Project will not have any impact upon any state significant biodiversity link.

9.2 Impact on native vegetation

Impacts on native vegetation that require further consideration include impacts on:

(a) any CEEC, unless the CEEC is specifically excluded by the SEARs

(b) an EEC specifically nominated in the SEARS as an EEC that is likely to become extinct or have its viability significantly reduced in the IBRA subregion if it is impacted on by development.

TECs nominated in the SEARs include:

- Shale Sandstone Transition Forest in the Sydney Basin Bioregion (CEEC)
- River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (EEC)
- Southern Highlands Shale Woodlands (CEEC)
- Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC).

Each of these TECs are discussed below in relation to the requirements of section 9.2.4.2 of the FBA.

9.2.1 Shale Sandstone Transition Forest in the Sydney Basin Bioregion

(a) the area and condition of the CEEC or EEC to be impacted directly and indirectly by the proposed development

A total of 23.57 hectares of Shale Sandstone Transition Forest (HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin) would be directly impacted by the Project. The extent of this community is shown on Figure 11.

The area of Shale Sandstone Transition Forest to be cleared consists of two different condition classes which are described in detail in Appendix 6. The two different condition classes recorded within the surface infrastructure footprint were:

- Good condition: area with minimal weeds and high resilience with stratum layers typically intact. It is the best condition of the TEC recorded on site. Approximately 17.26 hectares will be directly impacted for the surface infrastructure.
- Derived native grassland condition: area of moderate resilience which has been largely cleared of canopy and mid-storey species. Canopy trees and shrubs are relatively isolated. Regenerating eucalypts and shrubs are occasional. Weeds were recorded throughout with a low to moderate occurrence of native species. Approximately 6.31 hectares of this condition class will be directly impacted by the Project.

Indirect impacts to the remaining Shale Sandstone Transition Forest would be avoided by carrying out weed control, pest control, demarcating ‘no go’ areas, and contractor education. Details regarding these are provided in section 10.

(b) the extent and overall condition of the CEEC or EEC within an area of 1000 ha and then 10,000 ha surrounding the proposed development footprint.

The mapped occurrence of Shale Sandstone Transition Forest (based on OEH 2013) surrounding the development footprint is as follows:

- 1,000 ha = < 1 hectare (this is an error in the mapping – validated vegetation mapping by Niche indicates that approximately 43.4 hectares of the TEC occurs within the 1,000 ha circle)
- 10,000 ha = 889.6 hectares.

The condition of Shale Sandstone Transition Forest within both the 1,000 ha and 10,000 hectares circles is likely to be predominately in a low to moderate condition, given the urban and rural development and historic clearing of the area. It is highly likely that weeds would occupy portions of the lower stratums.

The largest patches of Shale Sandstone Transition Forest that have been mapped (Figure 11) include:

- A patch greater than 20 hectares within Crown Land to the east of the surface infrastructure disturbance footprint. This patch borders Dogtrap Creek and Charlies Point Road. It is known based on other field surveys by Niche to be in a relatively good condition.
- A patch within Wirrimbirra Nature Reserve which extends north along Teatree Hollow Creek. The patch is greater than 10 hectares in size.
- A large patch greater than 15 hectares occurring north of Anthony Road to the west of Dogtrap Creek.
- Nepean State Conservation Area immediately off Avon Dam Road is known to contain Shale Sandstone Transition Forest in benchmark condition. This patch is greater than 20 hectares in size.

(c) an estimate of the extant area and overall condition of the CEEC or EEC remaining in the IBRA subregion after the impact of the proposed development Project has been taken into consideration

The Project occurs in the Cumberland IBRA subregion. Approximately 1,100 hectares of Shale Sandstone Transition Forest has been mapped as occurring with the IBRA region based on OEH (2013). It is highly likely that given the extent of urban and rural development within the region, that the condition of Shale Sandstone Transition Forest is likely to be degraded, with patches of the mapped occurrence to be dominated by weeds.

The Project will reduce the extent of Shale Sandstone Transition Forest by 17.26 hectares of good condition and 6.31 hectares of the derived form of the community. This equates to about 2 per cent of the mapped occurrence of Shale Sandstone Transition Forest within the Cumberland IBRA region.

(d) the development proposal's impact on:

(i) abiotic factors critical to the long-term survival of the CEEC or EEC. For example, will the impact lead to a reduction of groundwater levels or substantial alteration of surface water patterns?

The Project will result in the loss to 23.57 hectares of Shale Sandstone Transition Forest due to direct clearing for surface infrastructure. As discussed in section 8.3.2, Shale Sandstone Transition Forest is unlikely to be impacted by subsidence as a result of the Project. Furthermore, mitigation measures will prevent any indirect impacts to neighbouring patches of the community.

The patches of Shale Sandstone Transition Forest to be impacted is quite large in comparison to other ground-truthed patches of the community in the locality. However, the removal of the patch will not result in the loss of abiotic features that will result in the decline of the remaining patches.

(ii) characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants

The Project will not result in inappropriate fire and flooding regimes that would impact upon surrounding patches of Shale Sandstone Transition Forest. A Fire Management Plan would be developed as part of the Project to minimise any potential fire ignition from the site, and to ensure that recommended fire management is carried out. Flooding as a result of the Project is unlikely to result in an impact to Shale Sandstone Transition Forest. The community is typically located away from the lower lying areas of the landscape. As discussed previously, subsidence is unlikely to result in an impact to the community.

(iii) the quality and integrity of an occurrence of the CEEC or EEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the CEEC or EEC.

The removal of 23.57 hectares of Shale Sandstone Transition Forest opens the surrounding patches to edge effects. Edge effects include the invasion of weeds, erosion and sedimentation. Mitigation measures to be undertaken as part of the Project include: weed control, pest control, demarcating 'no go' areas, and contractor education. Details regarding these are provided in section 10.

(e) direct or indirect fragmentation and isolation of an important area of the CEEC or EEC

Given Shale Sandstone Transition Forest is listed as Critically Endangered, all areas containing this community are considered important, particularly larger patches.

The removal of Shale Sandstone Transition Forest within the surface infrastructure development footprint will result in fragmentation of the broader community surrounding it.

The clearing associated with REA includes areas along the western and southern extents of previously cleared mining areas (Figure 11). It will reduce the extent of Shale Sandstone Transition Forest adjacent to this area, but will not further fragment the community.

The construction of the ventilation shaft sites would also fragment portions of good quality SSTF and also an area of the derived form of the community along Charlies Point Road.

(f) the measures proposed to contribute to the recovery of the CEEC or EEC in the IBRA subregion.

The Project will require a like-for-like offset to satisfy the requirements of the FBA and EPBC Act. As such, this will result in the establishment of a conservation area that will protect and enhance Shale Sandstone Transition Forest. Given Shale Sandstone Transition Forest is quite limited in its range, much of the land the community occupies is in the Cumberland IBRA region, and as such, it is likely that the conservation area would be established there, and thus contribute to the recovery of the CEEC within the IBRA subregion.

9.2.2 River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (EEC), Southern Highlands Shale Woodlands (CEEC), and Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC).

(a) the area and condition of the CEEC or EEC to be impacted directly and indirectly by the proposed development

The Project will not have a direct or indirect impact upon the following three TECs River-flat Eucalypt Forest, Southern Highlands Shale Woodlands, or Cumberland Plain Woodland. None of these vegetation communities occur within the area proposed for vegetation clearing, and are considered unlikely to be impacted by subsidence.

Mapping by OEH (2013) has indicated that approximately 2.9 hectares of River-flat Eucalypt Forest (HN526 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats) occurs just outside of and to the east of the Study Area. The patch of this community occurs at the very upstream portion of Eliza Creek surrounded by rural land. This area could not be surveyed during the field survey given it occurred within private property. When looking at this patch on the latest aerial imagery, the patch is quite open, indicating historic clearing. As such, it is highly likely the patch would be quite disturbed and contain weeds in the lower stratums.

A small patch (9.05 ha) of Cumberland Plain Woodland (HN528 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion) CEEC has been mapped by OEH (2013) within the centre of the Study Area. This area was not validated by Niche. Given the expanse of the Study Area across private properties, the field survey was limited to accessible areas. As such, it is possible that Cumberland Plain Woodland may occur within other small patches within some private properties on relatively flat terrain throughout the Study Area.

Similarly, Southern Highlands Shale Woodlands has not been mapped by OEH (2013) within the Study Area. Mapping by Tozer et al (2006) has indicated that a 6.4 hectare patch occurs toward the west of the Study Area within private property. Given access was not available, field validation was not possible. However, based on aerial interpretation, the patch has been impacted by previous clearing, and it is likely to be in a degraded condition given the surrounding cleared rural/residential land.

Subsidence could possibly cause cracks in the soil of within all three vegetation communities, however an impact upon the floristics, structure and viability as a result is likely to be negligible. There is no evidence in the Southern Coalfield to suggest that cracking of the soils within forest and woodland vegetation communities results in any impact to the flora within that community.

Vegetation die back as a result of gas emissions within each of the vegetation communities is also highly unlikely. Gas emissions are likely to occur within the lowest point of the topography as discussed in MSEC (2020). The three TECs do not occur along gullies of the Study Area and are therefore away from potential gas emission impacts. Furthermore, no changes to natural hydrology as a result of subsidence have been predicted to occur within any of the areas to which these vegetation communities have been mapped.

(b) the extent and overall condition of the CEEC or EEC within an area of 1000 ha and then 10,000 ha surrounding the proposed development footprint.

The mapped occurrence of River-flat Eucalypt Forest, Southern Highlands Shale Woodland and Cumberland Plain Woodland based on OEH (2013) and Tozer et al (2006) mapping is provided in the table below.

Table 22. Area of TECs within 100 ha and 10,000 ha of Project

Threatened Ecological Community	River-flat Eucalypt Forest	Southern Highlands Shale Woodland	Cumberland Plain Woodland
OEH (2013)			
1,000 ha	0.0	0.0	0.0
10,000 ha	2.9	0.0	0.0
Tozer et al (2006)			
1,000 ha	0.0	0.0	0.0
10,000 ha	2.2	6.4	0.0

The condition of all three vegetation communities across both the 1,000 and 10,000 hectare areas is unknown. However, it is likely to be in moderate to low condition, given extensive urban and rural development and historic clearing of the area. It is highly likely that weeds would occupy portions of the lower stratums.

(c) an estimate of the extant area and overall condition of the CEEC or EEC remaining in the IBRA subregion after the impact of the proposed development has been taken into consideration

The Project would not reduce the extent of River-flat Eucalypt Forest, Southern Highlands Shale Woodland and Cumberland Plain Woodland within the Cumberland IBRA subregion. None of the TECs would be subjected to direct or indirect impacts as a result of clearing, nor be impacted by subsidence.

(d) the development proposal's impact on:

(i) abiotic factors critical to the long-term survival of the CEEC or EEC. For example, will the impact lead to a reduction of groundwater levels or substantial alteration of surface water patterns?

The Project will not result in a change to abiotic factors that are critical to the long-term survival of River-flat Eucalypt Forest, Southern Highlands Shale Woodland or Cumberland Plain Woodland. As discussed previously, direct and indirect impacts from the vegetation clearing associated with the Project would not impact on the TECs. Furthermore, the likelihood for any subsidence related impact upon the TECs is relatively low. MSEC (2020) and HECONS (2020b) have not predicted any significant hydrology change in areas supporting these vegetation communities.

(ii) Characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants

As discussed above, the Project will not result in an impact to River-flat Eucalypt Forest, Southern Highlands Shale Woodland and Cumberland Plain Woodland.

A Fire Management Plan would be developed as part of the Project to minimise any potential fire ignition from the site, and to ensure that recommended fire management and prevention is carried out.

All three vegetation communities are mapped as occurring away from the lower lying areas of the landscape. As such, if flooding were to occur as a result of the Project, it is unlikely to result in an impact to any of the TECs.

(iii) the quality and integrity of an occurrence of the CEEC or EEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the CEEC or EEC.

The Project will not result in an impact to quality and integrity of River-flat Eucalypt Forest, Southern Highlands Shale Woodland or Cumberland Plain Woodland. Clearing associated with the Project does not occur adjacent to any of the TECs. Furthermore, a Biodiversity Management Plan would be prepared and mitigation measures employed as detailed in section 10, to further reduce the potential for any indirect impacts to adjacent native vegetation in the locality.

(e) direct or indirect fragmentation and isolation of an important area of the CEEC or EEC

The Project would not result in the fragmentation or isolation of River-flat Eucalypt Forest, Southern Highlands Shale Woodland and Cumberland Plain Woodland.

(f) the measures proposed to contribute to the recovery of the CEEC or EEC in the IBRA subregion.

The Project would not result in direct or indirect impacts toward River-flat Eucalypt Forest, Southern Highlands Shale Woodland or Cumberland Plain Woodland. As such, the Project would not result in a net loss of the TECs within the Cumberland IBRA region.

9.3 Impact on threatened species

Impacts on threatened species that require further consideration include impacts on:

(a) on any critically endangered species, unless the critically endangered species is specifically excluded in the SEARs

(b) on a threatened species or population that is specifically nominated in the SEARS as a species or population that is likely to become extinct or have its viability significantly reduced in the IBRA subregion if it is impacted on by the development, or

(c) where the survey or expert report undertaken in Section 6.6 confirms that a threatened species is present within the Project Area, and the threatened species has not previously been recorded in the IBRA subregion according to records in the NSW Wildlife Atlas.

Threatened species identified in the SEARs requiring further consideration include:

- *Persoonia bargoensis* (Bargo Geebung)
- *Persoonia glaucescens* (Mittagong Geebung)
- *Persoonia hirsuta* (Hairy Geebung)
- *Haplocephalus bungaroides* (Broad-headed Snake).

9.3.1 *Persoonia bargoensis*

Where the impacts of the Project meet these criteria, the assessor is required to provide the following further information in the BAR:

The size of the local population directly and indirectly impacted by the development

The Project would result in the loss of eight (8) known individuals as a result of the clearing required within the surface infrastructure disturbance footprint (Figure 14). The remaining known population, a further 684 plants, located mainly to the north and east of the surface infrastructure area is considered viable and not likely to decline over time as a result of the Project.

The species is unlikely to be impacted by subsidence given it is recorded away from cliffs, steep slopes and watercourses.

Mitigation measures detailed in section 10 would be employed to reduce potential impacts on the remaining population.

(b) the likely impact (including direct and indirect impacts) that the development will have on the habitat of the local population, including but not limited to:

(i) an estimate of the change in habitat available to the local population as a result of the proposed development

The Project would result in the removal of approximately 17.26 hectares of habitat.

(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population,

At present, the local known population of *Persoonia bargoensis* (containing an estimated 692 individual plants) extends around the north and east of the existing REA and to the east of Charlies Point Road as shown on Figure 14. The population is currently fragmented by Charlies Point Road and the existing REA operations. The Project would result in the removal of one outlying individual recorded in the western powerline corridor, five within the eastern powerline corridor and TSC2 and one within the REA. The majority of known and occupied habitat for this species within the Study Area will not be impacted by the Project.

(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.

The Project would result in the removal of approximately eight (8) plants within the population of around 692 individuals. This represents about 1.1 percent of the known population. The remaining 99 percent of the population would not be impacted by the Project and therefore would not result in extinction of the population. The remaining population is likely to maintain the seed capacity of the species within the surrounding area.

Based on previous mapping (Tozer et al 2006), the area of potential habitat in the locality is approximately 10,653 hectares, comprising Sydney Hinterland Transition Woodland (2,698.70 hectares) and Cumberland Shale Sandstone Transition Forest (573 hectares). The Project would result in the removal of approximately 0.2 percent of potential habitat in the locality. It must be noted that this may be an over-estimate of the area of potential habitat for this species. This is based on the lack of records for the species within potential habitat surveyed for the current Project (e.g. within TSC2). However, in lieu of any other know habitat surrogates by which potential area of occupation may be estimated, the Project will still only impact a relatively small proportion of known and potential habitat in the Study Area (1.1%) and locality (0.2 percent).

How the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available on: pollination cycle, seedbanks, recruitment and interactions with other species (e.g. pollinators, host species, mycorrhizal associations)

The remaining 99 percent of the population of *Persoonia bargoensis* is likely to remain viable despite the loss of eight individuals within the population. Information regarding pollinators is very limited, but it is likely that the species is primarily pollinated by native bees (Bernhardt and Weston 1996). Pollinators are unlikely to result in significant declines given 99 percent of the population would remain intact.

d) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

As discussed previously, the local population of *Persoonia bargoensis* extends around the existing REA and to the east of Charlies Point Road as shown on Figure 14. The population is currently fragmented by Charlies Point Road and the existing REA operations. The Project would result in the removal of eight individuals along the edge of the known populations that will not be impacted by the Project. The majority of the known population (99%) will not be impacted (isolated/fragmented) by the Project.

(e) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range

The population to be impacted is within the central range for *Persoonia bargoensis*. The species has a range which is restricted to a small area south-west of Sydney on the western edge of the Woronora Plateau and the northern edge of the Southern Highlands. The historical limits are Picton and Douglas Park (northern), Yanderra (southern), Cataract River (eastern) and Thirlmere (western). It is possible given the species relatively small range, that all smaller populations are of the same genetic make-up. Given 99 percent of the population would remain intact it is unlikely that other populations in the region, that may be dependant on the population within the Project Area to maintain genetic diversity, would be impacted by the Project.

(f) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population

The Project is likely to result in edge effects in the form of weed invasion, sedimentation and erosion within habitat for *Persoonia bargoensis* immediately adjacent to the areas being cleared. However, mitigation measures detailed in section 10 would be employed to reduce the impact of edge effects occurring on habitat for the remaining population.

(g) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.

The Project will require a like-for-like offset to satisfy the requirements of the FBA. As such, this will result in the establishment of a conservation area that will protect and enhance *Persoonia bargoensis*. Given *Persoonia bargoensis* is quite limited in its range, much of the land the community occupies is in the Cumberland IBRA region, and as such, it is likely that the conservation area would be established there, and thus contribute to the recovery within the IBRA subregion.

9.3.2 *Persoonia glaucescens* and *Persoonia hirsuta*

Where impacts of the Project meet these criteria, the assessor is required to provide the following further information in the BAR:

The size of the local population directly and indirectly impacted by the development

Persoonia glaucescens and *P. hirsuta* were not recorded during the current survey within areas proposed for surface infrastructure, nor within areas that are sensitive to subsidence related impacts. The Project would therefore not result in direct or indirect impacts to *Persoonia glaucescens* or *P. hirsuta.*

(b) the likely impact (including direct and indirect impacts) that the development will have on the habitat of the local population, including but not limited to:

(i) an estimate of the change in habitat available to the local population as a result of the proposed development

The Project would result in the removal of approximately 23.57 hectares of potential habitat for both species. However, it should be noted that neither species was recorded within the area to be impacted by the Project.

(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population,

The Project will not result in the loss or destruction of any known habitat. The Project will impact upon 23.57 hectares of potential habitat for both species.

(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.

Approximately 23.57 hectares of potential habitat for both species would be removed for the Project. However, despite targeted survey, *Persoonia glaucescens* and *P. hirsuta* were not recorded. As such the Project would not result in the removal of any known individuals.

It is therefore unlikely that any pollinators or seed bank would be impacted and result in a decline in the genetic diversity or long-term evolutionary development for both species.

How the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available on: pollination cycle, seedbanks, recruitment and interactions with other species (e.g. pollinators, host species, mycorrhizal associations)

The Project will not result in an impact to any residual *Persoonia glaucescens or P. hirsuta* population post development.

d) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

No local population of *Persoonia glaucescens or P. hirsuta* would be impacted by the Project.

(e) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range

No local population of *Persoonia glaucescens or P. hirsuta* would be impacted by the Project.

(f) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population

The Project is likely to result in edge effects in the form of weed invasion, sedimentation and erosion within area of potential habitat for *Persoonia glaucescens and P. hirsuta* immediately adjacent to the areas being cleared.

(g) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.

The Project will not result in direct or indirect impacts to *Persoonia glaucescens* or *P. hirsuta*. An offset for *Persoonia bargoensis* would be required for the Project. *Persoonia bargoensis* has similar habitat requirements to that of *Persoonia glaucescens* and *P. hirsuta*. It is quite likely that any conservation area established for *Persoonia bargoensis* would also offer protection of potential habitat for both *Persoonia glaucescens* and *P. hirsuta*.

9.3.3 Broad-headed Snake

The size of the local population directly and indirectly impacted by the development

The Broad-headed Snake has not been recorded in the Study Area during current or previous surveys, nor has the species previously been recorded within the Study Area. No known local population of the Broad-headed Snake is therefore known to occur within the Study Area.

The closest records obtained from BioNet is a record approximately 4 km to the west of the Study Area along the ridgeline of the Bargo River, and a record 6 km to the south along the Avon River. These areas differ from the Study Area as they contain extensive deep incised gullies and cliff lines. These areas are also within conservation lands managed by NSW NPWS and WaterNSW respectively.

Given the species was not detected during targeted surveys, and the absence of records, it is highly unlikely that habitat exists within the surface infrastructure area footprint. Furthermore, the habitat to be cleared is situated away from rocky outcrops which the species is known to occupy, so movement into the surface infrastructure footprint to use hollow-bearing trees is unlikely.

Potential habitat for the species is also quite limited within the Study Area. The Broad-headed Snake is known to be selective in its selection of rock outcrops for habitat. The Broad-headed Snake is known to occupy ridgelines facing north or west, as the species relies upon specific thermal conditions that are only attained in such ridgelines. These outcrops must have limited to no shading from the woodland canopy, again to allow penetration of high levels of sunlight. Finally, the outcrop must also include suitable rock exfoliations, which take the form of thin layers of rock resting directly on larger rock and without sand or debris between the layers (Pringle et al. (2003), Webb and Shine (1994) and Webb and Shine (1998a, 1998b & 1998c). Within the Study Area, suitable potential habitat is limited to a number of cliff line habitats along the valleys of the, the Bargo River, Dogtrap Creek and Hornes Creek. However, based on traverses throughout these areas during the field survey, areas of suitable rock exfoliation are quite limited.

As discussed in section 8.2, MSEC (2020) predict that a small number of cliffs may be subject to the impacts of subsidence, which are more likely to be impacted if directly mined beneath. MSEC (2020) states that any impacts to the cliffs that are directly mined beneath, are expected to affect between 3 to 5 percent of the total length of the cliffs. One cliff in the Study Area would be mined beneath. Based on this prediction, the length of the cliffs along Dogtrap Creek that may be impacted by subsidence equates to a length of approximately two (2) metres.

Whilst there is always the possibility that the rocky outcrops of the cliff could be potential habitat for the species, the likelihood of suitable exfoliating rock habitat occurring within this relatively small area of cliff line, is quite low. Furthermore, the likelihood of subsidence impacting the precise exfoliating rock habitat for which a Broad-headed Snake resides is considered to be low.

As such, it seems unlikely that the Broad-headed Snake would be impacted by subsidence related impacts or vegetation clearing as a result of the Project.

(b) the likely impact (including direct and indirect impacts) that the development will have on the habitat of the local population, including but not limited to:

(i) an estimate of the change in habitat available to the local population as a result of the proposed development

The Project would not result in an impact to a local population of the Broad-headed Snake. A local population is unlikely to occur in the Study Area. If a population was to occur, only a very small area of cliff line (detailed above) may be impacted.

(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population,

The Project will not result in the loss or destruction of any known habitat.

As discussed above, the area to be cleared does not contain any areas of rocky outcrops. Given the Broad-headed Snake was not detected during targeted surveys, and the absence of records, it is highly unlikely that habitat exists within the surface area footprint. Furthermore, the habitat to be cleared is situated away from rocky outcrops which the species is known to occupy.

Potential habitat for the species is also quite limited within the Study Area. As discussed previously, suitable potential habitat is limited to a number of cliff line habitats and areas of suitable rock exfoliation are very limited within these areas.

It is estimated that a small area of cliffs may be subject to the impacts of subsidence. Whilst there is always the possibility that the rocky outcrops of cliff habitat may provide potential habitat for the species, the likelihood of suitable exfoliating rock habitat to occur within this relatively small area of cliff line, is quite low. Furthermore, the likelihood of subsidence impacting the precise exfoliating rock habitat for which a Broad-headed Snake resides is considered also quite low.

As such, it is considered unlikely that the Project would result in the destruction, loss or isolation of available habitat for the species.

(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.

The following is known about the breeding cycle of the Broad-headed Snake (DEC 2005):

- Preferred habitat is centred on the communities occurring on the Triassic sandstone of the Sydney Basin.
- The sites where they occur are typified by exposed sandstone outcrops and benching and in these locations the vegetation is mainly woodland, open woodland and/or heath.
- Seasonally occupies distinctive microhabitats within these broader habitat types. They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer.
- Nocturnal to crepuscular (active at dusk) and is an 'ambush predator', preying predominantly on lizards, particularly Lesueurs Velvet Geckos, at least during the cooler months.
- During this time the species can be found frequenting exposed sandstone ridgetops where it refuges under exfoliating sheets of sandstone resting on naked rock or within crevices. These refuges often have a predominantly west to north westerly aspect. This aspect effect is thought to provide thermoregulatory advantage and maximises temperature levels for the peak feeding periods of early evening.
- During the warmer months of the year they become arboreal frequenting tree hollows and undergo a presumed dietary shift to small mammals, although crepuscular arboreal skinks (*Eulamprus tenuis*) have also been reported in the diet of summer captured individuals (G. Turner 1998 unpublished).
- They give birth to live young (ovoviviparous).

The Project is unlikely to disrupt the breeding cycle of an important population due to the following:

- The species has not been previously recorded in the Study Area.
- The species was not recorded during current surveys to date.
- Whilst there is always the possibility that the rocky outcrops of the cliff habitat could provide some habitat for the species, the likelihood of suitable exfoliating rock habitat to occur within this relatively small area of cliff line, is quite low.
- Not all potential habitat is likely to be impacted by the Project.
- Hollow bearing trees would not be impacted by subsidence.
- Food sources are unlikely to be impacted by the Project.

As discussed above, the Broad-headed Snake is unlikely to be present within the Study Area. The Project is unlikely to result in the modification of habitat required for the species life cycle.

(c) the likely impact on the ecology of the local population. At a minimum, address the following: breeding, foraging, roosting, and dispersal or movement pathways

As previously discussed, the Broad-headed Snake is unlikely to be present within the Study Area.

The area to be cleared for surface infrastructure is located away from rocky outcrops, and thus it is highly unlikely that foraging habitat would be impacted by the vegetation clearing associated with the Project.

The movement of the Broad-headed Snake if it were to occur within the Study Area is unlikely to be impacted by Project. Subsidence is only predicted to have minor impacts upon cliff lines. The likelihood of suitable exfoliating rock habitat to occur within this relatively small area of cliff line is quite low. Furthermore, the chances of subsidence to impact the precise exfoliating rock habitat for which a Broad-headed Snake resides is also considered to be low.

d) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

No local population of Broad-headed Snake is known to occur within the Study Area and thus would not be impacted by the Project.

(e) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range

No local population of Broad-headed Snake is known to occur within the Study Area and thus would not be impacted by the Project.

(f) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population

The Project is unlikely to result in edge effects in the form of weed invasion, sedimentation and erosion within areas of potential habitat for the Broad-headed Snake. However, mitigation measures detailed in section 10 would be employed to reduce the impact of edge effects occurring on areas of native vegetation surrounding the proposed surface infrastructure.

(g) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.

The Project will not result in direct or indirect impacts to any known population of the Broad-headed Snake. The Project will therefore not interfere with the recovery of the species within the Cumberland IBRA subregion.

9.4 Impact on Critical Habitat

The Project will not impact upon areas of land that the Minister for the Environment has declared 'critical habitat' in accordance with section 47 of the BC Act and that are listed on the Register of Critical Habitat.

10. Managing indirect impacts

10.1 Indirect Impacts

Indirect impacts will occur within and adjacent to the subject site (area of direct impact) as a result of Mine construction and operation. Such impacts will largely operate on a short to medium timeframe (i.e. the life of the Mine) and will be minimised where possible through management procedures. Indirect impacts with the potential to occur as a result of the Project include:

- Increased noise, and dust from surface infrastructure construction and operational activities
- Loss of connectivity and fragmentation of habitat through clearing of intact areas of native vegetation within the Study Area
- Erosion or sedimentation in areas adjoining construction and operational activities
- Increased spreading of weed propagules
- Increased edge-effects for surrounding vegetated areas.

The indirect impacts described above are variable in terms of the distance they may extend from the actual subject site, and quantifying the exact distance is not possible.

To account for a quantitative measure of indirect impacts, a 100 m buffer has been placed around the subject site. This buffer would likely encapsulate the potential spread of weeds, edge effects in surrounding vegetated areas, erosion, dust, intensive light spill, and sedimentation during construction and operation.

The specific indirect impacts and how they relate to the ecology of the Study Area, along with corresponding mitigation measures are discussed in detail in Table 23. The mitigation measures provided would be consistent with industry best practice to ensure that mitigation is effective and include development of a Biodiversity Management Plan (BMP). Monitoring of the effectiveness of the mitigation measures would be incorporated as part of the management actions associated with the Project.

The cost associated with the implementation of mitigation measures in relation to biodiversity, have been provided in Cadence Economics (2020) Economic Impact Assessment, which considers the cost of mitigation measures in the economic modelling of the Project.

Table 23. Indirect impacts

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
Edge effects	The establishment of surface infrastructure would result in the creation of new edges adjacent to areas of existing native vegetation, however these edges have been incorporated within the disturbance footprint. The new edges could facilitate the establishment and spread of introduced plant species, however appropriate monitoring and control measures would be implemented during and after construction, to assist in preventing weed invasion. The surface infrastructure would be progressively rehabilitated and will eventually be entirely revegetated to a native, open woodland community, which will recreate fauna habitat.	Varying distance from subject site. Potentially occurring within 50 metres of disturbance area throughout the active life of the Project.	Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the surface infrastructure areas. Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna. Weed management and pest management and monitoring to be implemented as per the BMP to be developed for the Project. Sedimentation management to be applied in areas that may result in runoff during construction and operation.	Active weed, and pest management are anticipated to be successful at managing edge effects from the Project.
Weeds	Weeds have the opportunity to establish themselves in areas of disturbed vegetation. The greatest potential for establishment of weeds is in areas already disturbed or subject to agricultural land use. This is mainly toward the south of the Study Area. The Project has the potential to increase or lead to the establishment of weed species where they do not currently exist through the operation of machinery during construction as a result of the movement of construction vehicles and materials into the Study Area. Areas more likely to be exposed to weed incursions are areas of native vegetation that occur to the east of ventilation shaft TSC2, and west of the proposed REA and ventilation shaft TSC 1. These adjacent areas are in better condition and contain fewer introduced species. To mitigate the potential for weed invasion, weeds will be controlled during and after construction in accordance with the	Variable depending on topography. However, typically would occur within close proximity to subject site given the subject site is not located adjacent to steep slopes.	Weed management and monitoring to be implemented according to the BMP. Weed management would be active in preventing the spread of weeds caused by construction and operation of the Project therefore preventing edge effects.	Active weed control methods are likely to be successful in managing the spread of weeds within adjacent areas.

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
	Biodiversity Management Plan and thus indirect impacts from weeds are likely to be minor within the adjacent woodland areas.			
Erosion and sedimentation	Erosion of soils during construction and operation of the Project may involve the following: • Alteration of soil structure beneath infrastructure items, and roads (these have been taken into consideration within the Study Area disturbance calculations). • The increase of surface water flow from the Study Area during rain events into the adjacent woodland areas • The deposition of soil particulates in drainage lines and within remnant vegetation. Mitigation measures will be put in place during the construction and operation to limit the erosion and sedimentation caused by the Project. With the mitigation measures in place, it is likely that the potential for erosion and sedimentation would be contained within the subject site.	Variable depending on topography. However, typically would occur within close proximity to subject site given the subject site is not located adjacent to steep slopes.	Stormwater management measures will be implemented in accordance with the recommendations in the Project's Water Management Plan. Adequate sediment controls will be applied where appropriate. Procedures for the management of spills throughout the Study Area will be developed including the requirements for vehicles to carry spill kits. Sediment basins are proposed to reduce sedimentation and overland flows. Details provided in the Project's specialist studies (HEC 2020) The rehabilitated landforms will be designed to shed water without causing excessive erosion or increasing downstream pollution.	Sedimentation control is known to reduce sedimentation spills.
Dust	Dust will be generated from the construction and operating activities. Through accumulation with existing dust generated from existing operations, dust generated during construction of the Project has the potential to impact upon the health of plants and vegetation particularly in those areas of dense native woodland immediately adjacent to the subject site. Research shows that the impacts of dust on vegetation can have both positive and negative impacts, however the impacts of increased levels of dust on animals are unknown (Farmer 1993). Farmer (1993) anticipated that dust may increase the susceptibility of plants and vegetation to secondary stresses, such as drought, insects and pathogens, or allow	Variable depending on wind conditions. Potential for dust emissions likely throughout life of Mine.	Dust impacts will be mitigated through the onsite use of water suppression and the progressive rehabilitation of the overburden emplacement. Further, vegetation clearing protocols for the Project will seek to minimise exposed areas with the potential to generate dust by completing vegetation clearing as close to the commencement of overburden emplacement as practical.	Successful implementation of dust control would minimise dust. Current dust suppression mitigation works are on-going at the Mine

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
	penetration of toxic metals or phytotoxic gaseous pollutants. Any potential impact from dust associated with the Project is likely to be localised and confined to the immediate vicinity of the Study Area.			
Noise	Noise will be generated from the construction and the extended in-pit operating hours. Although relevant research is limited, studies have found that traffic noise can mask the important contact calls of certain birds such as the Budgerigar, Canary, and Zebra Finch, (Lohr et al. 2003). Parris and Schneider (2008) found that it was increased volumes of noise and not increased volumes of traffic that were important. Various studies have indicated that changes in bird calls in response to traffic noise are twofold, either the birds change the characteristics of their call to avoid interaction of the sound of the call with the created sounds or they limit calling to periods when the levels of noise are reduced. The Project is unlikely to result in any additional noise impacts on local fauna as the hours of operation would be similar to that occurring at present.	Variable depending on wind conditions. Potential for noise impacts likely throughout life of Mine.	Tahmoor will continue to manage site operations in accordance with the existing noise restrictions and commitments.	Likely – given they are currently in operation at the mine.
Fire	Historically, rural bushfires tend to be associated with a proficient growth of native grasses following large rain events. During summer, following rain events, dry swards of grasses pose a bushfire hazard when placed near a source of ignition. Vehicles driven through long grass with hot exhausts may cause a fire particularly during the hotter months of the year.	Potential to be widespread in locality, though unlikely.	Tahmoor Coal will continue to manage site operations in accordance with the existing Bushfire Management Plan, updating where necessary.	The existing Mine operations have not resulted in any significant fires, thus updates of the existing Bushfire Management Plan would likely assist in further prevention of fire.
Light	Lighting within the areas proposed for surface infrastructure may consist of low intensity directional lighting. There is some night lighting at	Variable depending on the type of light source however	Tahmoor Coal will ensure lights are turned off at night if not required, and that the placement of lights for	Mitigation measures likely to be successful at reducing light spill.

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
	the REA and ventilation shafts; however this is limited to small directional lights (I,e. no flood lighting). The light that is likely to be generated by the surface works is unlikely to result in a significant change to fauna movement given the lighting would be directional toward the surface infrastructure. Furthermore, operational lighting (e.g. from vehicle movement) will be restricted to hours of operation.	will largely be contained within the Study Area.	night work will be so that they are directed internally towards the work area to avoid/minimise light spill.	

10.2 Biodiversity Management Plan

Tahmoor Coal currently has a Tahmoor Environmental Management System (EMS), which includes a series of Environmental Management Plans (EMPs) that outline the mitigation and management programs for key environmental aspects at the mine. Key commitments within the current EMPs include threatened species management, pest and weed management, native vegetation clearing protocols, fauna handling and site hygiene practices. An outline of this plan is provided in the main body of the EIS for the Project.

Operations at Tahmoor will continue to be managed in accordance with the EMS and associated EMPs, which will be revised and updated to incorporate the additional environmental management requirements as outlined in the EIS for the Tahmoor South Project. This will include biodiversity management measures associated with the construction and operation of the Project in order to protect and manage important biodiversity values.

All management plans, including the Biodiversity Management Plan (BMP) will be prepared to the satisfaction of relevant State and Commonwealth agencies and will also be prepared/updated in consultation with the relevant NSW government agency, which will be outlined in the conditions of Project Approval, should the Project be approved.

The EMPs will include updated, specific protocols dealing with any potential interaction between the Project activities and threatened flora or fauna species during the life of the Project.

The BMP will include directions for survey, monitoring and management of key threatened species known or considered to be potentially impacted by the Project and protocols for reporting and managing any unforeseen threatened species occurrences within the Project site. Measures designed to mitigate impacts on threatened species would be monitored for success.

Key components of the EMP update would include details in relation to the following:

Fencing and signposting

Fencing and/or the use of highly visible rope or tape boundaries or alternative effective markings e.g. posts with brightly coloured tops will be used to delineate the boundary of vegetation clearing at the edge of the Study Area where clearing activities occur within 5 metres of native vegetation.

Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with threatened species.

Employee Education and General Environmental Controls

Employees and contractors would be educated on and required to implement the following controls, to avoid or at least minimise potential environmental impacts associated with construction and operation of the Project:

- Minimise dust generation by minimising the extent and time that bare soil is exposed and by appropriate dust suppression
- Procedures for the management of hydrocarbon and/or chemical spills throughout the Study Area including the requirements for vehicles to carry spill kits
- Ensuring vehicles remain on designated roads and tracks and abide by site speed limits, through use of signposting and driver education during the induction process and in on-going Project discussions;
- Management and removal of all rubbish from the Study Area.

Vegetation Clearance Protocol

A vegetation clearing protocol would be included in the Biodiversity Management Plan. This Plan is to include the following:

- Prior to clearing of native vegetation, ecologists are to survey for ground-dwelling fauna and to remove any fauna/fauna habitat (nests or hollow logs) to adjacent habitat that would not be further disturbed.
- Prior to clearing all hollow-bearing trees are to be marked. Underscrubbing would then take place within the vegetation surrounding the hollow-bearing trees.
- After a 24 hour period, in the presence of an ecologist, the hollow-bearing trees would be gently felled.
- Any fauna displaced during clearing are to be captured where possible and relocated to previously identified, safe areas (fauna to be captured and handled only by personnel trained to do so).
- In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.

Pest and weed management

The BMP would include a section relating to pest and weed management activities of the Project and will include:

- Management protocols for feral animals such as foxes, goats, rabbits and cats within the rehabilitation areas.
- Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting weeds to rehabilitation areas or other parts of the site).

10.3 Rehabilitation

All surface infrastructure would be progressively rehabilitated in accordance with a Landscape and Rehabilitation Management Plan, to create a stable landform that does not result in sediment laden runoff or fugitive dust emissions, blends well with the adjacent natural landscapes and re-establishes a native bushland. It should be noted that Tahmoor Coal has demonstrated a diverse stable rehabilitation area on the current REA. Such an approach would be replicated for the rehabilitation for the Project.

10.4 Fire management

Tahmoor currently have a Bushfire Management Plan for their current operations. Fire prevention and suppression are detailed within the Plan including emergency protocols should a fire occur. This Plan would be updated to include the current Project.

10.5 Subsidence and Extraction Plans and Montioring

Management and mitigation measures for potential subsidence as a result of the project are detailed in the EIS, and include the preparation of an Extraction Plan that would be developed through consultation and approved by the relevant government agencies.

The Tahmoor Mine currently develops SMPs that incorporate each natural and built feature that would be impacted by subsidence. Existing subsidence monitoring and management at Tahmoor is in the EIS. In terms of biodiversity, this would entail the continuation of riparian and amphibian monitoring to assist in subsidence management measures for natural features.

As detailed in the EIS, the Extraction Plan would entail the follow specific to biodiversity:

- detailed pre-mining assessment of the potential impacts on surface infrastructure, including an assessment of potential impacts to biodiversity in the unlikely event that actual subsidence is greater than predicted subsidence.
- describe the biodiversity monitoring (amphibians and riparian monitoring) that occurs.
- Results of biodiversity monitoring
- Details any procedures for the implementation of planned responses if triggered by monitoring and inspections.

11. Thresholds for impacts and offsetting unavoidable impacts

11.1 Threshold impact criteria

The FBA lists threshold impact criteria for landscape features, native vegetation, and threatened species in order to determine when an offset or further consideration by consent authorities is required due to a Project's impacts. The impacts are classed according to the following criteria:

a. Impacts that the assessor is required to identify for further consideration by the consent authority
b. Impacts for which the assessor is required to determine an offset
c. Impacts for which the assessor is not required to determine an offset
d. Impacts that do not require further assessment by the assessor.

The impacts associated with biodiversity considered for further consideration has been detailed in section 9.

This offset strategy quantifies the required offsets for the Project in accordance with both the BC Act and EPBC Act, through the use of the FBA methodology.

The Project meets criteria b, *impacts for which the assessor is required to determine an offset* due to the following:

- Impacts on approximately 23.57 ha of Shale Sandstone Transition Forest TEC
- Impacts on approximately 14.20 ha of PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).
- Impacts to *Persoonia bargoensis, Pomaderris brunnea, and Grevillea parviflora* subsp*. parviflora.*
- Impacts to 17.26 ha of potential Koala, Eastern Pygmy Possum, Large-eared Pied Bat and Large-footed Myotis habitat.

11.2 Quantifying offset of impacts

The FBA identifies the BioBanking Credit Calculator (BBCC) as the appropriate tool for quantifying the precise nature of the offsets required in both ecosystem and species credit terms. The major Project function of the BBCC is used under the FBA to quantify the number of credits required for the development.

A calculation of the nature and extent of offset credits required due to the biodiversity impacts associated with the Project was undertaken using Version 4.0 of the BBCC.

Details of the BBCC inputs have been discussed in sections 4 to 8. Appendix 9 includes the full output printout of the BBCC for the Project which defines the ecosystem and species credits required to offset the impacts of the Project on biodiversity in accordance with the NSW Biodiversity Offsets Policy for Major Projects.

11.2.1 Summary of credits required

Offsets required for vegetation disturbance as a result of the Project are shown in Table 24, and offsets required for species are provided in Table 25.

Table 24. Ecosystem credits required for the Project

PC type code	Plant community type name	Management zone area (ha)	Loss in Landscape Value	Loss in site value score	EEC Offset Multiplier	Credits req for TS	TS with highest credit req	TS offset multiplier	Ecosystem credits required
HN556	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	17.26	12.20	58.21	3.0	862	Masked Owl	3.0	806
		6.31	12.20	54.59	3.0	292	Masked Owl	3.0	278
HN564	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin	14.20	12.20	33.33	1.0	398	Masked Owl	1.0	398
	TOTAL								**1,482**

Table 25. Species credits required for the Project

Threatened species	No. impacted	Credits required
Persoonia bargoensis	8	616
Grevillea parviflora subsp. *parviflora*	491	6,874
Pomaderris brunnea	1	15
Large-footed Myotis	17.26 ha	380
Koala	17.26 ha	449
Large-eared Pied Bat	17.26 ha	224
Eastern Cave Bat	17.26 ha	224
Eastern Pygmy Possum	17.26 ha	345

11.2.1 Summary of Commonwealth offset liability

Offsets required for MNES significantly impacted by the Project include Shale Sandstone Transition Forest. No other threatened biodiversity listed under the EPBC Act are likely to be significantly impacted by the Project. As discussed in section 11 Offset Strategy, the offset associated with Shale Sandstone Transition Forest can be determined using the EPBC Act Policy Calculator tool based on area and quality of impact at the development site and offset site.

12. Biodiversity offset strategy

The Biodiversity offset strategy forms Stage 3 of the FBA.

12.1 Introduction

The NSW Biodiversity Offsets Policy for Major Projects (OEH 2014) states that biodiversity offsets provide benefits to biodiversity to compensate for the adverse impacts of an action. Biodiversity offsets assist in achieving long-term conservation outcomes while providing development proponents with the ability to undertake actions that have unavoidable impacts on biodiversity.

Unavoidable impacts to biodiversity are those impacts that are residual (i.e. impacts that remain after impact avoidance, management and mitigation measures are employed to reduce the type or magnitude of biodiversity impacts). Section 7.1 of this report details the design changes that Tahmoor Coal has implemented through the preliminary stages of the Project in order to avoid and reduce impacts to biodiversity values.

Section 10 of this report outlines the management and mitigation actions that Tahmoor Coal will employ to further reduce direct and indirect impacts to biodiversity values as a result of this Project.

This section of the report describes the approach to biodiversity offsetting proposed for the Project in consideration of the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014) and Commonwealth EPBC Act Environmental Offsetting Policy.

12.1.1 Offset Liability

The Project would require a biodiversity offset in accordance with the FBA and associated associated *NSW Biodiversity Offsets Policy for Major Projects* policy for the following:

- Native vegetation clearing;
- Habitat clearing, potentially impacting Koala, Large-eared Pied Bat, Eastern Pygmy Possum, Large-footed Myotis, Eastern Cave Bat habitat;
- Loss of threatened flora, including *Pomaderris brunnea, Persoonia bargoensis,* and *Grevillea parviflora* subsp. *parviflora.*

Under the Commonwealth, only those threatened entities that may be significantly impacted by the Project are required to be offset, which have been determined by completion of EPBC Act Assessments of Significance (section 8.3.4, 8.4.3, 8.6; Appendix 8). Based on our assessment, the Project would therefore require an offset for the following potentially significant impacted Shale Sandstone Transition Forest.

12.2 Approach to the Biodiversity Offset

As documented in section 11.2 of the FBA, an offset requirement is represented as a number and type of biodiversity credits determined in accordance with Chapter 10 of the FBA. Subject to provisions in the *NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014), the conservation measures that may be used to address this offset requirement include:

1. Retirement of biodiversity credits from the biodiversity register established under Part 7A of the NSW Threatened Species Conservation Act 1995 (TSC Act) (now BC Act).
2. Ecological rehabilitation or remediation of previously disturbed land.
3. Supplementary measures as determined in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014).

4. Payment into the Biodiversity Conservation Trust (BCT) Payment Fund (noting not available for Commonwealth offset requirements).
5. A combination of the above.

Whilst, the Project is assessed under the Bilateral Agreement, the Commonwealth Offsetting Policy contains the following key considerations that must be addressed in the offset package:

- Offsets are described as measures that compensate for significant residual adverse impacts on the environment and the policy applies to all matters that are protected under the EPBC Act.
- The 'offsets assessment guide' is a tool that has been developed to help assess the suitability of offset proposals. The offsets assessment guide uses a balance sheet approach to measures impacts and offsets.
- At least 90% of a project's impact should be directly offset (subject to exceptions outlined in the EPBC Act Offsets Policy) and any offsets should be implemented prior to or at the time of the impact occurring.
- Up to 10% (or more if an appropriate exception applies) of a project's impacts may be indirectly offset through compensatory measures such as research, monitoring, education program etc.

DoEE requires biodiversity offset sites to be secured under a legally binding conservation covenant and actively managed under a fully funded plan. There are a variety of mechanisms for achieving this, including (but not limited to) Biodiversity Stewardship Sites, Voluntary Conservation Agreements or dedication of land to the National Parks Estate.

Due to a variety of factors, Tahmoor Coal proposes a biodiversity offset package that employs a combination of offsetting opportunities including the following:

1. Establishment of Stewardship sites on Tahmoor Coal landholdings;
2. Purchase BioBanking/BAM credits on the public register;
3. Payment into the BCT Payment Fund;
4. Establishment of Stewardship sites on additional landholdings.

Each component of the biodiversity offset package is detailed in the sections below.

Table 26 outlines the approach that will be taken by Tahmoor Coal to develop a suitable biodiversity offset in accordance with the key offsetting policy principles.

Table 26. Principles for Developing Biodiversity Offsets under NSW and Commonwealth Legislation

Offsetting Principle	How Principle will be addressed in the Offset Package
NSW Biodiversity Offsets Policy for Major Projects (OEH 2014)	
Principle 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.	Impacts have been avoided where possible during the design of the Project. Management and mitigation measures for biodiversity values have been proposed for the Project. Impact avoidance, management and mitigation measures have been detailed in Section 7 and section 10.

Offsetting Principle	How Principle will be addressed in the Offset Package
Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains.	The latest version of the FBA Credit Calculator has been used to determine the maximum credits required to offset the impacts of the Project on PCTs and species credits. Accredited BioBanking assessors have conducted the field surveys and offset calculations. The proposed offset will be assessed in accordance with the requirements of the FBA, to determine the suitability and quantum of offsets for the Project.
Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.	The offset proposed will be a like-for-like offset in the first instance. Variation rules are available however not proposed in the first instance.
Principle 4: Offsets must be additional to other legal requirements.	The proposed offset will be additional to other legal obligations that the Project may have.
Principle 5: Offsets must be enduring, enforceable and auditable.	The Biodiversity offset strategy has been developed with specific reference to the FBA.
Principle 6: Supplementary measures can be used in lieu of offsets.	The biodiversity offset site will be formally secured in accordance with the permissible offset mechanisms of the *NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014).
Commonwealth Offsetting Principles	
Deliver an overall conservation outcome that improves or maintains the viability of the protected matter.	The formalisation of the offset package will manage and fund actions to meet, improve and maintain offset principles for Shale Sandstone Transition Forest.
Be built around direct offsets but may include other compensatory measures.	At present, no compensatory measures have been proposed in the offset package, however will consider such options depending on the outcomes of current land acquisition negotiations.
Be in proportion to the level of statutory protection that applies to the protected matter.	The proposed offset package has proposed a like-for-like offset in the first instance. Tahmoor Coal has not proposed a variation to such offsetting at present.
Be of a size and scale proportionate to the residual impacts on the protected matter.	Under the Bilateral Agreement the offset liability for EPBC threatened fauna would meet the credit requirements. Consultation with DoEE would be undertaken to discuss the Shale Sandstone Transition Forest offset liability to ensure the offset is of proportionate to the residual impacts as per the EPBC Act Policy Calculator.
Effectively account for and manage the risks of the offset not succeeding.	Offsets would be established in a manner which is secure, auditable with management actions funded.
Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs.	The offset would be additional to any other requirements specified by Determining Authorities.
Be efficient, effective, timely, transparent, scientifically robust and reasonable.	The offset package would be discussed and negotiated with DoEE.
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	The proposed offset package would be finalised in a manner that provides an auditable and enforced offset in accordance with State and Commonwealth requirements.

12.3 Staged offset approach

The surface infrastructure is proposed to be developed over a 4+ year period, with the ventilation shaft TSC to commence construction in year 2020.

Given the vegetation clearing would be progressive and would not all occur within the first few years of project commencement, it is proposed that the offsets for the project also be progressive, to match that of the vegetation and/or species being impacted.

Tahmoor Coal proposes a three-stage offsetting approach over a 4 year period. The credits associated with each of the two stages based on the area impacted, has been provided in Table 27 below.

Table 27. Staged offset approach – credits required.

Project stage	PCT1395 (good condition)	PCT1395 (derived condition)	PCT1081	Persoonia bargoensis	Grevillea parviflora subsp. parviflora	Pomaderris brunnea	Large-footed Myotis	Koala	Large-eared Pied Bat	Eastern Cave Bat	Eastern Pygmy Possum
Stage 1 Offset liability (Year 1)											
Ventilation Shaft TSC 1	31	237	0	231	700	0	14	17	9	9	13
Total – Stage 1	31	237	0	231	700	0	14	17	9	9	13
Stage 2 Offset liability (Year 2)											
Ventilation Shaft TSC 2	163	0	0	308	2737	0	76	90	45	45	69
Powerline	96	41	0	0	2737	15	47	53	28	28	41
REA	0	0	398	0	0	0	0	0	0	0	0
Total – Stage 2	259	41	398	308	2737	15	123	143	73	73	110
Stage 3 Offset liability (Year 4+)											
REA	516	0	0	77	700	0	243	289	142	142	222
Total – Stage 3	516	0	0	77	700	0	243	289	142	142	222
Total Offset liability for Project	**806**	**278**	**398**	**616**	**6874**	**15**	**380**	**449**	**224**	**224**	**345**

12.4 Addressing the Offset Liability for the Project

To address the NSW offset requirement, a biodiversity offset is required for the impacts to those threatened entities listed in section 11.2.

Tahmoor has a number of options available to address the biodiversity offsets associated with the impacts to clearing of native vegetation.

The options available include the following:

1. The establishment of Stewardship sites on Tahmoor Coal Landholdings (Figure 22),
2. Purchase the required credits on the current market
3. Payment in the BCT Payment Fund (noting that this would not be accepted for Commonwealth listed threatened entities).
4. Establish Stewardship Sites on additional landholdings (purchase or agree with landholders).

12.4.1 Establishment of Stewardship Sites on Tahmoor Coal landholdings

Tahmoor Coal proposed to use areas of native vegetation within their existing landholdings which have been assessed by Niche as potential Stewardship Sites for the Project.

Each of the proposed offset sites are listed in Table 28 and would be officially established as Biodiversity Stewardship Agreement sites in accordance with the OEH (2016) Biodiversity Assessment Methodology (BAM). The location of each of the sites are included on Figure 22.

Table 28. Overview of proposed Stewardship Sites

Offset site	Property Description	Address	Lot/ DP	Total native vegetation (ha)
1	Bargo Colliery land	Ashby Close & 76 Gwynn Hughes Street, Bargo	Lot 170 DP751250 and Lot 35 DP751250	275.0
2	185 Charlies Point Road	185 Charlies Point Road	Lot 2232 DP787222; Lot 216 DP751250	13.9
3	220 Charlies Point Road	220 Charlies Point Road	Lot 222 DP751250	8.5
4	Pit Top	2975 Remembrance Driveway, Bargo	Lot 162 DP1054184	57.9
5	Rockford Road	260 & 270 Rockford Road, Tahmoor	Lot 1 and Lot 2 DP1037712	25.8

To date, field surveys have not been completed on each of the proposed Stewardship Sites in accordance with the BAM, however, vegetation validation, habitat assessments, and the collection of FBA plot data has been completed at each of the sites as detailed in Table 29. The survey effort has assisted in determining the indicative ecosystem and species credits available at each site. The surveys would need to be completed again using the BAM prior to establishment of a Stewardship Site, however there is confidence that the sites contain the vegetation communities and threatened biodiversity present.

Table 29. Survey effort at proposed Stewardship Sites

Offset site	Property Description	Survey effort completed to date
1	Bargo Colliery land	The vegetation was validated during a field survey from the 19th to 21st of September 2017. A habitat assessment for threatened biodiversity, collection of FBA plots, threatened flora habitat search targeting *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis*.
2	185 Charlies Point Road	Vegetation mapping, habitat assessment for threatened biodiversity, collection of FBA plots, threatened flora habitat search targeted *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis.*
3	220 Charlies Point Road	Vegetation mapping, habitat assessment for threatened biodiversity, threatened flora habitat search targeted *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis.*
4	Pit Top	Vegetation mapping, habitat assessment for threatened biodiversity, threatened flora habitat search targeted *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis*.
5	Rockford Road	Vegetation mapping, habitat assessment for threatened biodiversity, collection of FBA plots, threatened flora habitat search targeted *Grevillea parviflora* subsp. *parviflora* and *Persoonia bargoensis.*

Given the Project has been assessed using the FBA calculator, and the establishment of the Stewardship Sites are to be assessed using the BAM calculator, this presents a degree of difficulty when determining the credit offset ratios between the impact site (as determined in this report using the FBA), and the establishment of Stewardship Sites (as determined using the BAM). Given there is no publicly available tool to convert FBA credits to BAM credits, Niche has provided an estimate of the BioBanking credits generated at each of the proposed offset sites so a comparison can be made to the FBA credits required for the Project. Whilst we acknowledge that the credits may differ following a 'credit conversion' following the Conditions of Consent, the comparison provided in this report provides a high level of confidence in regards to how the proposed offset sites, would meet the offset liability.

The indicative FBA credits for each of the proposed offset sites are presented in Table 30. The indicative FBA credit yield at each site was assessed by running offset scenarios in the BioBanking Credit Calculator (BBCC). This has entailed the following core tasks:

- Area of native vegetation as mapped by Niche (Figure 23, Figure 24)
- Inputting plot data collected during previous surveys into the BBCC, noting that the minimum plot requirements have not been met for each site. In the absence of plots, averages from existing plot attributes have been utilised.
- Inputting the number of individuals of threatened flora recorded (noting that in the case of the Bargo Colliery Landholding, the number of individuals of Grevillea parviflora subsp. parviflora was so extensive, that population counts could not be undertaken at the time of survey. We therefore have included a conservative estimate).
- Providing an estimate of habitat occupancy for threatened fauna based on previous records, and a habitat-based assessment.

Table 30. BioBanking credit estimates for proposed offset sites

Proposed Stewardship Site	Justification for presence of threatened entity	Area	FBA credit estimate	Is the credit type required for Project offset liability?
Offset 1	Decription			
Persoonia bargoensis	Recorded by Niche as shown in Figure 23	168 plants	1,193	Yes
Pomaderris brunnea	Recorded by Niche as shown in Figure 23	45 plants	320	Yes
Acacia bynoeana	Recorded by Niche as shown in Figure 23	23 plants	227	Not required
Persoonia hirsuta	Recorded by Niche and BioNet as shown in Figure 23	145 plants	1,030	Not required
Persoonia glaucescens	Recorded by Niche and BioNet as shown in Figure 23	56 plants	398	Not required
Grevillea parviflora subsp. *parviflora*	Recorded by Niche and BioNet as shown in Figure 23	25,000 plants	200,000	Yes
Koala	Koala has been recorded as per BioNet	267.5 ha	1,870	Yes
Red-crowned Toadlet	Red-crowned Toadlet recorded along Hornes Creek by Niche during amphibian monitoring. Hornes Creek occupies a length of over 1.5 kilometres throughout the site. We have nominally attributed 2.7 ha of habitat along this creek line, which would need to be amended during further survey.	2.7 ha	19	Not required
Large-footed Myotis	No records on bionet within site, however records exist approximately 500 metres according to Bionet. It is highly likely that the Large-footed Myotis would occur given the presence of steep cliff lines, hollow-bearing trees and Hornes Creek. For this assessment, we have assumed habitat along Hornes Creek within the proposed offset site. However, we note that the area of habitat is likely to occupy the entire site which would be determined during detailed survey.	Large-footed Myotis (based on 30 hectares of habitat – 200 metres buffer along Hornes Creek)	213	Yes
Large-eared Pied Bat	No records on bionet, however it is highly like that the Large-eared Pied Bat would occur given the presence within 2km of steep cliff lines, hollow-bearing trees and Hornes Creek. For this assessment, we have assumed habitat along Hornes Creek within the proposed offset site. However, we note that the area of habitat is likely to occupy the entire site which would be determined during detailed survey.	Large-footed Myotis (based on 30 hectares of habitat – 200 metres buffer along Hornes Creek)	213	Yes
Eastern Cave Bat	No records on bionet within site, however records exist along the Bargo River and Nepean River according to BioNet. It is highly likely that the Eastern Cave Bat would occur given the presence of steep cliff lines, hollow-bearing trees and Hornes Creek.	Large-footed Myotis (based on 30 hectares of habitat – 200	213	Yes

Proposed Stewardship Site	Justification for presence of threatened entity	Area	FBA credit estimate	Is the credit type required for Project offset liability?
	For this assessment, we have assumed habitat along Hornes Creek within the proposed offset site. However, we note that the area of habitat is likely to occupy the entire site which would be determined during detailed survey.	metres buffer along Hornes Creek)		
Eastern Pygmy Possum	No records on BioNet, with closest record 1 km (BioNet) to the north. The site contains suitable habitat – eg. Eucalypt shrubby forest with hollow-bearing trees. It is likely that the species would occupy the entire site. However, would need to be confirmed during targeted survey.	248.0	1,761	Yes
1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (HN566)	Mapped by Niche as occurring at the site.	248.0	3,873	Not required
1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies (HN586)	Mapped by Niche as occurring at the site.	19.8	242	Not required
Offset 2				
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	Mapped by Niche as occurring at the site.	13.9	140	Yes
Koala	No targeted surveys completed to date within the site, however the site occurs adjacent to the Study Area, which has been attributed 'potential Koala habitat' and has subsequently offset for the Koala. OEH has stated in their response to the original EIS (OEH 2019) that they recorded Koala scratches on Eucalyptus punctata in the area.	13.9	99	Yes
Large-eared Pied Bat	Not recorded during anabat analysis near the Study Area, however OEH has regarded the study area as foraging habitat (OEH 2019). Given the site is immediately adjacent to the Study Area, it is highly likely the site would generate credits.	13.9	99	Yes
Eastern Cave Bat	Recorded during anabat analysis near the Study Area. Given the site is immediately adjacent to the Study Area, it is highly likely the site would generate credits.	13.9	99	Yes
Large-footed Myotis	The Large-footed Myotis was recorded approximately 100 m to the north-east of the site during the current survey. It is therefore highly likely the species would utilise the site.	13.9	99	Yes
Offset 3				
1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies (HN586)	Mapped by Niche as occurring at the site.	0.6	10	Not required

Proposed Stewardship Site	Justification for presence of threatened entity	Area	FBA credit estimate	Is the credit type required for Project offset liability?
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	Mapped by Niche as occurring at the site.	7.9	80	Yes
Koala	Not recorded during targeted surveys completed to date within the site, however the site occurs adjacent to the Study Area, which has been attributed 'potential Koala habitat' and has subsequently offset for the Koala. OEH has stated in their response to the original EIS (OEH 2019) that they recorded Koala scratches on Eucalyptus punctata in the area.	8.5	60	Yes
Large-eared Pied Bat	Not recorded during anabat analysis near the Study Area, however OEH has regarded the study area as foraging habitat (OEH 2019). Given the site is immediately adjacent to the Study Area, it is highly likely the site would generate credits.	8.5	60	Yes
Eastern Cave Bat	Recorded during anabat analysis near the Study Area. Given the site is immediately adjacent to the Study Area, it is highly likely the site would generate credits.	8.5	60	Yes
Large-footed Myotis	The Large-footed Myotis was recorded approximately 100 m to the north of the site during the current survey. It is therefore highly likely the species would utilise the site.	8.5	60	Yes
Offset 4				
1081 - Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain Sydney Basin Bioregion (HN564)	Mapped by Niche as occurring at the site.	25.7	256	Yes
1081 - Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain Sydney Basin Bioregion (HN564) Shrub	Mapped by Niche as occurring at the site.	6.0	60	Yes
1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies (HN586)	Mapped by Niche as occurring at the site.	15.1	152	Not required
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	Mapped by Niche as occurring at the site.	11.2	113	Yes
Persoonia bargoensis	Recorded by Niche.	77 plants	547	Yes
Epacris purpurescens var. purpurescens	Recorded by Niche.	5 plants	36	Not required
Pomaderris brunnea	Recorded by Niche.	141 plants	1,001	Yes
Grevillea parviflora subsp. parviflora	Recorded by Niche.	21 plants	149	Yes

Proposed Stewardship Site	Justification for presence of threatened entity	Area	FBA credit estimate	Is the credit type required for Project offset liability?
Koala	Not recorded during targeted surveys completed to date within the site, however the site occurs adjacent to the Study Area, which has been attributed 'potential Koala habitat' and has subsequently offset for the Koala. OEH has stated in their response to the original EIS (OEH 2019) that they recorded Koala scratches on Eucalyptus punctata in the area.	58.0	412	Yes
Large-eared Pied Bat	Not recorded during anabat analysis near the Study Area, however OEH has regarded the study area as foraging habitat (OEH 2019). Given the site is immediately adjacent to the Study Area, it is highly likely the site would generate credits.	58.0	412	Yes
Eastern Cave Bat	Recorded during anabat analysis near the Study Area. Given the site is immediately adjacent to the Study Area, it is highly likely the site would generate credits.	58.0	412	Yes
Large-footed Myotis	The Large-footed Myotis was recorded approximately 500 m to the east of the site during the current survey. It is therefore highly likely the species would utilise the site.	58.0	412	Yes
Offset 5				
1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies (HN586)	Recorded by Niche.	5.8	64	Not required
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	Recorded by Niche.	18.1	199	Yes
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)_derived	Recorded by Niche.	2.0	20	Yes
Large-eared Pied Bat	The site occurs immediately adjacent to the Bargo River, encompassing steep sandstone clifflines. It is likely the species may occur within these areas, however would need to be confirmed during targeted survey.	24.5	174	Yes
Large-eared Pied Bat	The site occurs immediately adjacent to the Bargo River, encompassing steep sandstone clifflines. It is likely the species may occur within these areas, however would need to be confirmed during targeted survey.	24.5	174	Yes
Large-footed Myotis	The site occurs immediately adjacent to the Bargo River, encompassing steep sandstone clifflines. It is likely the species may occur within these areas, however would need to be confirmed during targeted survey.	24.5	174	Yes

The combined total for the offset sites in comparison to the Project's offset liability has been provided in Table 31. Based on the results, the proposed offsets would satisfy the offset liability for the following:

- *Grevillea parviflora* subsp. *parviflora*;
- *Persoonia bargoensis;*
- *Pomaderris brunnea;*
- Koala;
- Large-eared Pied Bat;
- Large-footed Myotis;
- Eastern Cave Bat;
- Eastern Pygmy Possum.

Whilst the offset sites would need to be established as Stewardship Site using the BAM and updated survey requirements, the credit calculation at the proposed offset sites indicate that there would be residual credits for many of the threatened fauna being offset for the Project.

The proposed offset sites would satisfy the credit offset liability for Stage 1 of the staged offset.

A short-fall would occur for the overall Project liability in relation to the following:

- Shortfall of approximately 532 x PCT1395 credits using the FBA would occur for the entire Project offset liability.
- Shortfall of approximately 82 x PCT1081 credits using the FBA would occur for the entire Project offset liability.

Table 31. Credits available at proposed offset sites compared to Project offset liability

Vegetation type	Offset liability for Stage 1	Total Project offset liability	Proposed offset sites – with FBA credits generated					Total FBA credits generated	Credit shortfall for Stage 1	Credit shortfall for Project offset liability
			1	2	3	4	5			
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	268	1,084	0	140	80	113	219	552	**0**	**532**
PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).	0	398	0	0	0	316	0	316	**0**	**82**
Grevillea parviflora subsp. *parviflora*	700	6,874	>200,00	0	0	149	0	200,149	**0**	**0**
Persoonia bargoensis	231	616	1193	0	0	547	0	1,740	**0**	**0**
Pomaderris brunnea	0	15	320	0	0	1,001	0	1,321	**0**	**0**
Koala	17	449	1,870	99	60	412	0	2,615	**0**	**0**
Large-eared Pied Bat	9	224	213	99	60	412	174	958	**0**	**0**
Large-footed Myotis	14	380	213	99	60	412	174	958	**0**	**0**
Eastern Cave Bat	9	224	213	99	60	412	174	958	**0**	**0**
Eastern Pygmy Possum	13	345	1,761	99	60	412	174	958	**0**	**0**

12.4.2 Purchase credits on public register

Tahmoor Coal may purchase the shortfall of credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) on the public register. In order to satisfy the Commonwealth offset requirement for Shale Sandstone Transition Forest, only credits that meet the threshold criteria for the TEC as defined in the EPBC Act Approved Conservation Advice (including listing advice) for Shale Sandstone Transition Forest of the Sydney Basin Bioregion, would be purchased.

To date, 3,710 BioBanking credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) are available on the public register. It is highly likely that with the establishment of the Cumberland Plain Conservation Plan (envisaged for approval in 2020), large areas of Stewardship Sites would be established within Western Sydney which would increase the credit availability in the next few years.

12.4.3 Establishing further Stewardship Sites

Tahmoor Coal is also undertaking investigations in regards purchasing landholdings, or working with landholders to establish Stewardship Sites. The aim would be to establish Stewardship Sites as per the requirements of the FBA to retire the shortfall of credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556). To date, it is also noted that there are 8 properties on the BioBanking Public Register that have an Expression of Interest (EOI) for establishing a Stewardship Site, and which contain Shale Sandstone Transition Forest.

12.4.4 Payment into the Biodiversity Conservation Trust Fund (BCT)

Whilst the proposed Stewardship Sites would satisfy the threatened species offset liability, Tahmoor Coal also has the option to pay into the Biodiversity Conservation Trust Fund (BCT Fund) for these species. Given no Commonwealth offset is proposed for any threatened species, this option is permissible to Tahmoor Coal, and may be considered if during targeted surveys the threatened species are not detected at the proposed Stewardship Sites.

It is noted that given the impact to Shale Sandstone Transition Forest (PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)) has a Commonwealth offset requirement, payment into the BCT Fund is not yet recognised by the Commonwealth as a suitable offset mechanism.

Tahmoor Coal may also wish to pay into the BCT Payment Fund for PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).

12.5 The final Biodiversity Offset Package

The current investigation demonstrates the ecosystem credit availability within Tahmoor Coal's landholdings, and the process by which Tahmoor Coal would satisfy the offset liability.

The formalisation of the proposed sites to a Biodiversity Stewardship Agreement site, and the purchasing of credits and/or payment into the BCT Fund would occur following approval, and would be progressive in two stages to match the impact to vegetation and threatened flora throughout the life of the mine.

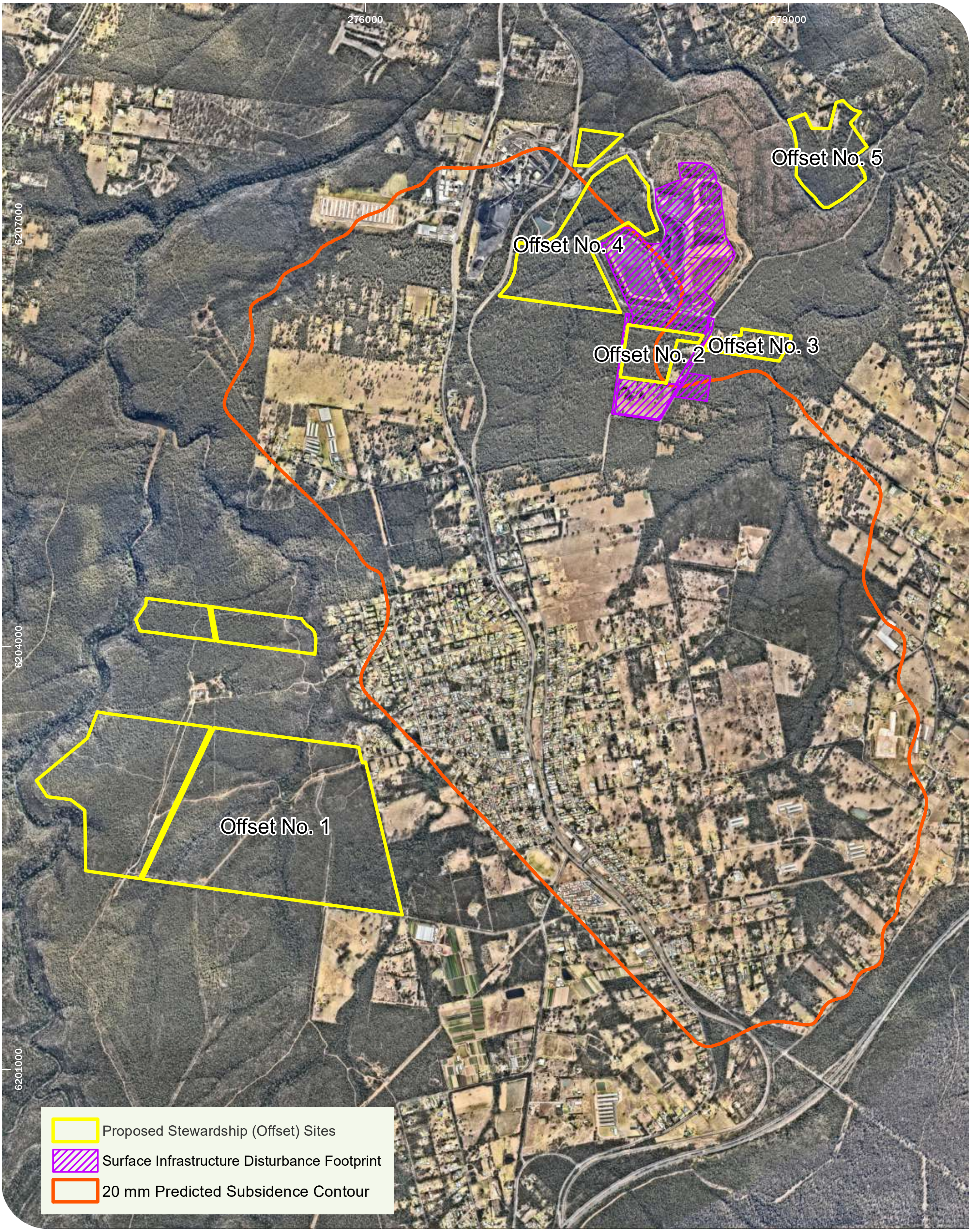
Following Project approval, the following tasks would be completed by Tahmoor Coal:

1. Formal establishment of the proposed Stewardship Sites (this includes detailed surveys, reporting management plan etc. as per the requirements of the BAM).
2. Retirement of the required credits generated from the Stewardship Sites.
3. Purchase and retire credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) which are available on the public register. Note that the credits

purchased to satisfy the Shale Sandstone Transition Forest requirement would meet the EPBC listing criteria.

4. Payment into the BCT Fund for outstanding PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).
5. Purchase/establish Stewardship Sites within landholdings that contain PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556).

Although not proposed at this stage, Tahmoor Coal may also pay into the BCT Fund for the threatened species offset requirement.



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Proposed Stewardship Sites on Tahmoor Coal Landholdings

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 22

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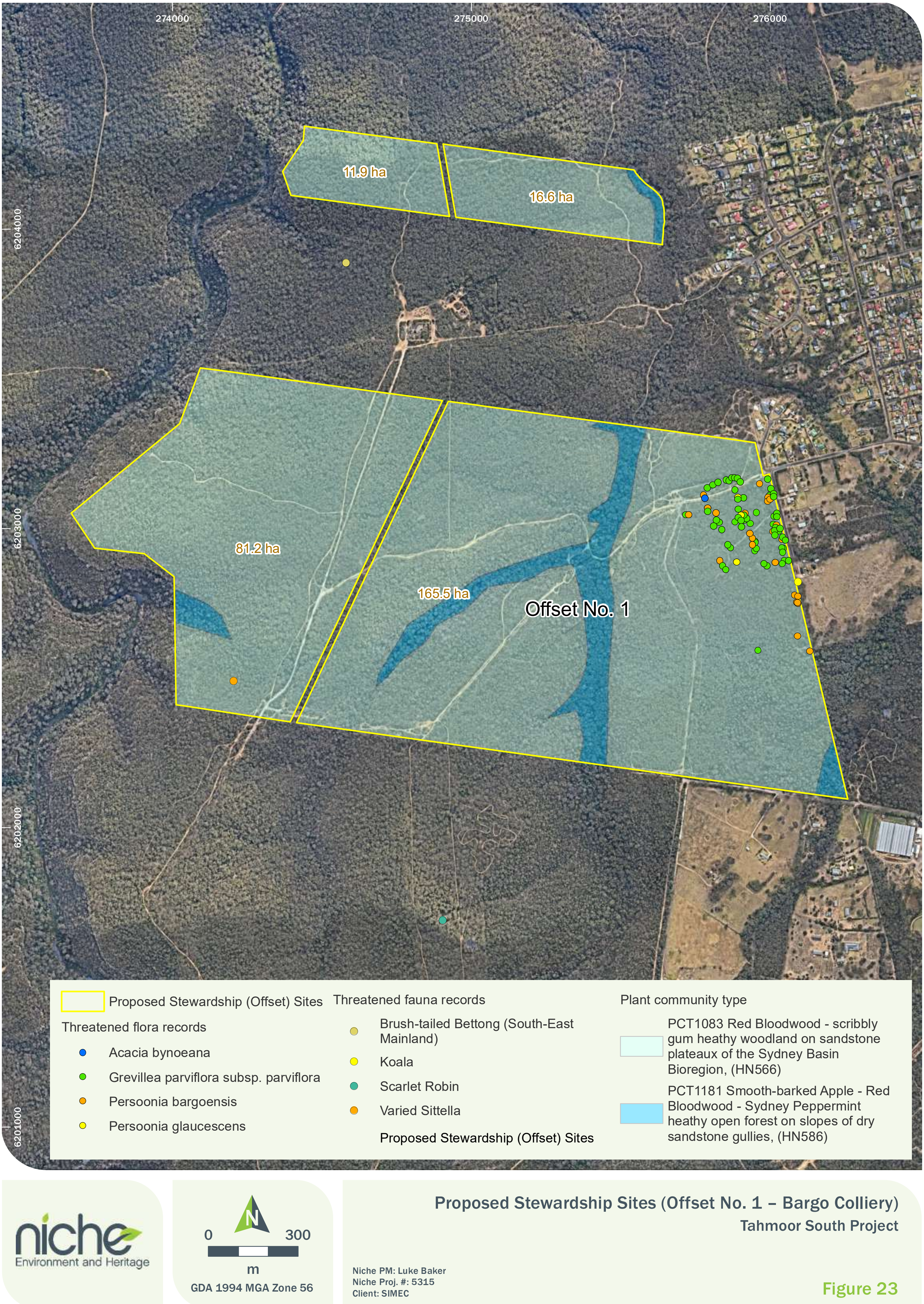
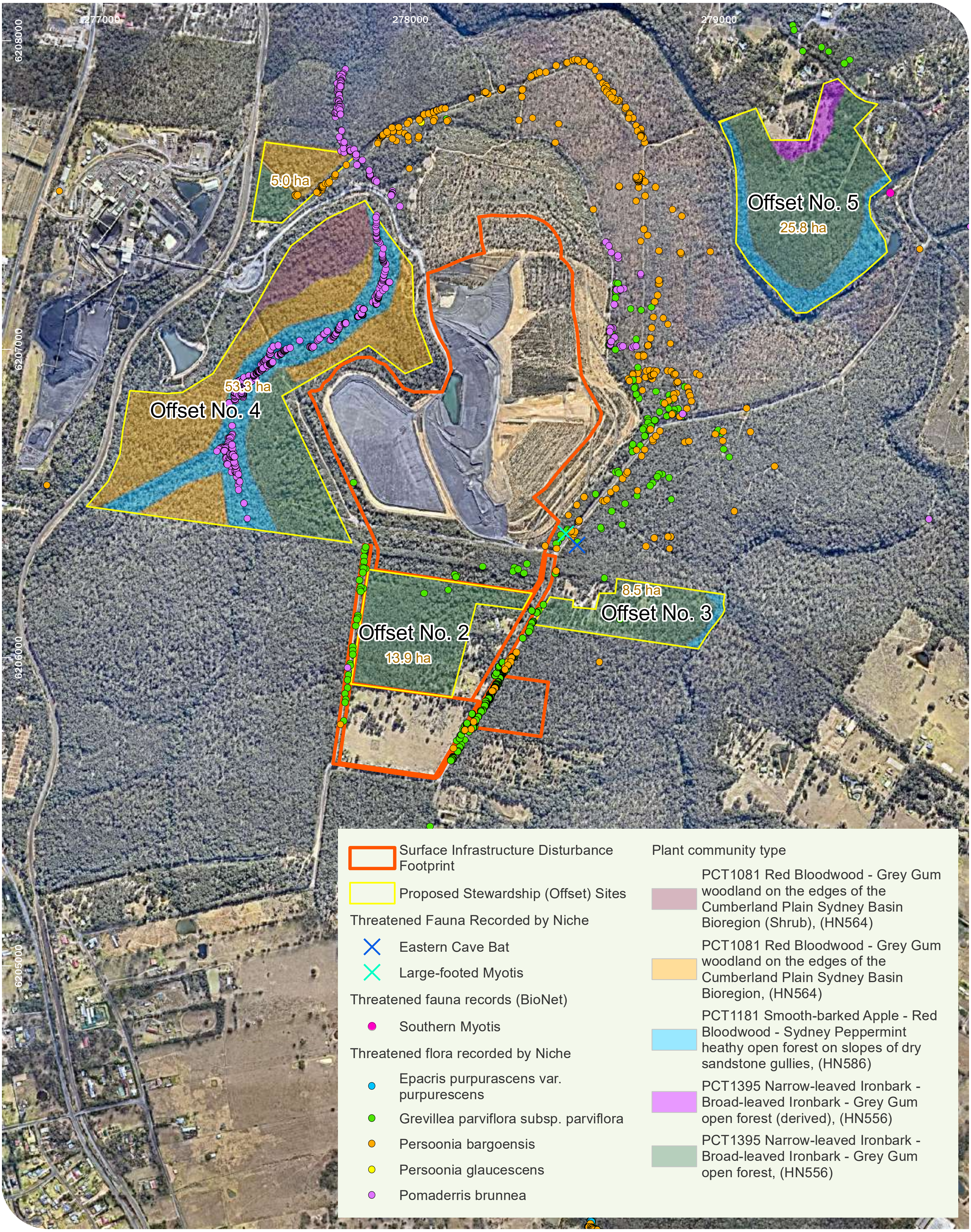


Proposed Stewardship Sites (Offset No. 1 – Bargo Colliery)

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 23



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Proposed Stewardship Sites (Offset No. 2 – 5)

Tahmoor South Project

Niche PM: Luke Baker
Niche Proj. #: 5315
Client: SIMEC

Figure 24

13. Conclusion

This report provides a biodiversity assessment to address the potential impacts associated with the Project.

The Project will result in the disturbance of 37.77 ha of native vegetation with the potential for subsidence related impacts. Indirect impacts may include dust, noise, erosion and sedimentation which will be mitigated by measures provided in section 10 of this report.

During the field survey one TEC – Shale Sandstone Transition Forest was found to occur within the Study Area. Two condition classes were attributed to the TEC; good (17.26 ha) and derived native grassland (6.31 ha). The Project will result in disturbance to approximately 23.57 hectares of the TEC listed under the BC Act and EPBC Act. This TEC would be offset according to the requirements of the FBA.

The Project would result in the following impacts to threatened flora as a result of vegetation clearance in the surface infrastructure area:

- Removal of eight individuals of *Persoonia bargoensis*
- Removal of an estimated 491 individuals of *Grevillea parviflora* subsp. *parviflora*
- Removal of one individual *Pomaderris brunnea*.

In terms of species credit fauna, this assessment has identified impacts to the following:

- Removal of 17.26 ha of known habitat for the Large-footed Myotis
- Removal of 17.26 ha of potential habitat for the Koala, Large-eared Pied Bat, Eastern Cave Bat and Eastern Pygmy-possum.

This assessment concludes that native vegetation, threatened flora or species credit fauna are unlikely to be impacted by subsidence associated with the Project.

Mitigation measures associated with indirect impacts have been proposed through the revision and implementation of new and existing management plans.

The credits as determined by the BBCC required to offset the Project equate to the following:

Threatened species	Area/ No. impacted	Credits required
Shale Sandstone Transition Forest /PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	23.57	1,084
Native mine rehabilitation/ PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).	14.20	398
Persoonia bargoensis	8	616
Grevillea parviflora subsp. *parviflora*	491	6,874
Pomaderris brunnea	1	15
Large-footed Myotis	17.26 ha	380
Koala	17.26 ha	449
Large-eared Pied Bat	17.26 ha	224

Threatened species	Area/ No. impacted	Credits required
Eastern Cave Bat	17.26 ha	224
Eastern Pygmy Possum	17.26 ha	345

Following Project approval, the following tasks would be completed by Tahmoor Coal:

1. Formal establishment of the proposed Stewardship Sites (this includes detailed surveys, reporting management plan etc. as per the requirements of the BAM).
2. Retirement of the required credits generated from the Stewardship Sites.
3. Purchase and retire credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) which are available on the public register. Note that the credits purchased to satisfy the Shale Sandstone Transition Forest requirement would meet the EPBC listing criteria.
4. Payment into the BCT Fund for outstanding PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).
5. Purchase/establish Stewardship Sites within landholdings that contain PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556).

Given vegetation clearing would be progressive, and would not all occur within the first few years of Project commencement, Tahmoor Coal has proposed that the offsets for the Project be in three stages, to match the timing of the vegetation clearing and/or threatened biodiversity being impacted.

Tahmoor Coal has enough Biodiversity credits generated within the proposed Stewardship Sites to satisfy Stage 1 of the staged offset, and all the threatened species credits required for the Project.

References

AECOM (2020) Tahmoor South Project, Amended Project, Environmental Impact Assessment, prepared for SIMEC Mining Pty Ltd Tahmoor Coal

Aitkins Acoustics (2014) Tahmoor South Project – Noise and Vibration Assessment – Final Report

APCRC (1997) Geochemical and isotopic analysis of soil, water and gas samples from Cataract Gorge. George, S.C Pallasser, R and Quezada, R.A. June 1997. APCRC Confidential Report No. 282

Benson, D. & L. McDougall (2000) Ecology of Sydney plant species: part 7b Dicotyledon families Proteaceae to Rubiaceae. Cunninghamia. 6(4):1016-1202.

Bernhardt, P. & Weston, P.H. (1996) The pollination ecology of *Persoonia* (Proteaceae) in eastern Australia. Telopea 6: 775-804.

Blombery, A.M. & B. Maloney (1992) The Proteaceae of the Sydney Region. Kenthurst, NSW: Kangaroo Press.

Churchill S (2008) 'Australian Bats. Second Edition.' Allen & Unwin, Sydney.

Craig S.A. (1985) Social organisation, reproduction and feeding behaviour of a population of Yellow-bellied Glider *Petaurus australis* (Marsupalia: Petauridae). Australian Wildlife Research 12: 1-18.

Crane MJ, Montague-Drake RM, Cunningham RB, Lindenmayer DB (2008) The characteristics of den trees used by the Squirrel Glider (*Petaurus norfolcensis*) in temperate Australian woodlands. Wildlife Research 35, 663-675.

Department of Environment and Conservation (2004a) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft. NSW Department of Environment and Conservation.

Department of Environment and Conservation (2004b) The Native Vegetation of the Nattai and Bargo Reserves. Unpublished Report. Department of Environment and Conservation, Hurstville.

Department of Environment and Conservation (2004c) “The Vertebrate Fauna of the Nattai and Bargo Reserves.” Unpublished report funded by the Central Directorate Parks and Wildlife Division Biodiversity Survey Priorities Program by NSW Department of Environment and Conservation, Conservation Assessment and Data Unit Conservation Programs and Planning Branch; Metropolitan, Environment Protection and Regulation Division.

Department of Environment and Conservation (2006) Southern Brown Bandicoot (*Isoodon obesulus*) Recovery Plan. NSW DEC, Hurstville NSW.

Department of Environment and Conservation (2006) NSW Recovery Plan for the Large Forest Owls: Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*). Department of Environment and Conservation (NSW), Sydney.

Department of Environment and Climate Change (2007a) Threatened species assessment guidelines, The assessment of significance, Department of Environment and Climate Change.

Department of Environment and Climate Change (2007b) Flying Fox Camp management, Department of Environment and Climate Change Sydney.

Department of Environment and Climate Change (2008) Threatened Species Profiles Database, NSW Department of Environment and Climate Change.

Department of Environment and Climate Change (2008b) BioBanking Assessment Methodology and Credit Calculator Operational Manual

Department of Environment, Climate Change and Water (NSW) (2010) Cumberland Plain Recovery Plan, Department of Environment, Climate Change and Water (NSW), Sydney.

Department of Environment, Climate Change and Water NSW (2013) Bargo River State Conservation Area Draft Plan of Management February 2013, Department of Environment, Climate Change and Water NSW.

Department of Environment, Climate Change and Water NSW. (2009) Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.

Department of Environment, Climate Change and Water NSW. (2008) Recovery Plan for the Koala (*Phascolarctos cinereus*). Dated November 2008. Department of Environment and Climate Change NSW, Sydney.

Department of Environment, Climate Change and Water (NSW) (2010) Cumberland Plain Recovery Plan, Department of Environment, Climate Change and Water (NSW), Sydney.

Department of Environment and Energy (2018) Referral Decision and Designated Proponent – controlled action EPBC 2017/8084 Tahmoor South Project - dated 12th January 2018.

Department of Environment and Heritage (DEH) (2001) Threat Abatement Plan For Dieback Caused By The Root-Rot Fungus *Phytophthora cinnamomi*.

Department of Environment and Resource Management (2011) National recovery plan for the large-eared pied bat *Chalinolobus dwyeri*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Department of Environment Water Heritage and the Arts (2009) Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999

Department of Planning (2008) Impacts of underground coal mining on natural features in the Southern Coalfield: strategic review State of New South Wales through the NSW Department of Planning, 2008

D.J. Sharpe (2009) Ecology of the Squirrel Glider (*Petaurus norfolceniss*) in subtropical Australia. PhD Thesis, Southern Cross University.

Eby, P., Richards, G.C., Collins, L. and Parry-Jones, K. (1999) The distribution, abundance and vulnerability to population reduction of a nomadic nectarivore, the Grey-headed flying fox *Pteropus poliocephalus* in New South Wales, during a period of resource concentration. Australian Zoologist 31:240-253.

Eco Logical Australia (2004) The Impacts of Longwall Mining on the Upper Georges River Catchment: Report to Total Environment Centre, 2004.

Garry Daly, Ben Owers, and Andrew Horton (2015) The distribution of the Red-crowned Toadlet *Pseudophryne australis* in the Nepean-Burragorang region of the Sydney Basin. Australian Zoologist: 2015, Vol. 37, No. 4, pp. 535-540.

Gibbons P (1999) Habitat-tree retention in wood production forests. PhD thesis. Australian National University, Canberra

Gibbons P, Lindenmayer D (2000) 'Tree Hollows and Wildlife Conservation in Australia'. (CSIRO Publishing: Canberra)

Gippel, C.J. (2013) Tahmoor South Project, Environmental Impact Statement, Technical Specialists Report, Geomorphology. Fluvial Systems Pty Ltd, Stockton. Tahmoor Coal Pty Ltd Tahmoor Coal, Tahmoor, December.

Goldingay R.L. and Kavanagh R.P. (1991) The Yellow-bellied Glider: a review of its ecology, and management considerations, in D. Lunney (Ed.) Conservation of Australia’s Forest Fauna. Royal Zoological Society of NSW, Mosman.

Hydro Engineering & Consulting Pty Ltd (2020a) Tahmoor South Project: Surface Water Baseline Study. Prepared for Tahmoor Coal Pty Ltd.

Hydro Engineering & Consulting Pty Ltd (2020b) Tahmoor South Project: Surface Water Impact Assessment. Prepared for Tahmoor Coal Pty Ltd.

HC (2007) Helensburgh Coal Submission to Independent expert panel – Inquiry into the NSW Southern Coalfield July 2007, Helensburgh Coal Pty Ltd.

Higgins PJ (1999) 'Handbook of Australian, New Zealand and Antarctic Birds. Oxford University Press, Melbourne. Higgins PJ and Davies SJJF (1996)

Hocking, G.J. (1990) Status of bandicoots in Tasmania. In 'Bandicoots and Bilbies' (Seebeck, J.H., Brown, P.R., Wallis, R.L. and Kemper, C.M. eds), pp 61-66. Surrey Beatty and Sons, Sydney.

Holland GJ, Bennett AF, van der Ree R (2007) Time-budget and feeding behaviour of the Squirrel Glider (*Petaurus norfolcensis*) in remnant linear habitat. Wildlife Research 34, 288-295.

HydroSimulations (2020) Tahmoor South Project EIS Groundwater Assessment, Prepared for Tahmoor Coal.

Kavanagh, R.P. and Jackson, R. (1997) Home-range, movements and diet of the Sooty Owl *Tyto tenebricosa* near Royal National Park, Sydney. In Czechura, G. and Debus, S. (Eds), Australian Raptor Studies II, Birds Australia Monograph 3, Birds Australia, Melbourne.

Kemper, C.M. (1990) Status of bandicoots in South Australia. In 'Bandicoots and Bilbies' (Seebeck, J.H., Brown, P.R., Wallis, R.L. and Kemper, C.M. eds), pp 67-72. Surrey Beatty and Sons, Sydney.

Loyn, R.H., Traill, B.J. & Triggs, B. (1986) Prey of Sooty Owls in East Gippsland before and after fire. Vict. Nat. 103(5): 147-149.

Lundie-Jenkins, G. (1993) The diet of the Sooty Owl *Tyto tenebricosa* in the Blue Mountains, N.S.W. Emu 93: 124–127.

Menkhorst P., Schedvin N., and Geering D. (1999) Regent Honeyeater Recovery Plan 1999 – 2003. Dated May 1999. Parks, Flora and Fauna Division, Department of Natural Resources and Environment, East Melbourne Vic.

Menkhorst, P.W. and Seebeck, J.H. (1990) Distribution and conservation status of bandicoots in Victoria. In 'Bandicoots and Bilbies' (Seebeck, J.H., Brown, P.R., Wallis, R.L. and Kemper, C.M. eds), pp 51-60. Surrey Beatty and Sons, Sydney.

MSEC (2020) Tahmoor South Project Subsidence Constraints Assessment: Assessment of potential constraints on the proposed Tahmoor South Project due to surface subsidence impacts resulting from the proposed longwall mining – amendment Report for Longwalls 101A . Prepared by Mine Subsidence Engineering Consultants (MSEC) for Tahmoor Coal Tahmoor Mine.

Niche (2014a) Tahmoor South Project Biodiversity Offset Strategy.

Niche (2014b) Tahmoor South Project Terrestrial Monitoring Project Year 2013-2014.

Niche (2014c) Tahmoor South Aquatic Ecology Impact Assessment, Prepared for Tahmoor Coal 2014.

Niche (2013) Tahmoor South Project Terrestrial Monitoring Project Year 2012-2013.

Niche (2013) Tahmoor South Terrestrial Monitoring Project Year 2012-2013.

Niche (2012) Tahmoor South Project Pilot Study, Prepared for Tahmoor Coal.

Niche (2010a) Bargo Exploration Program Surveys 1 Review of Environmental Factors.

Niche (2010b) Bargo Exploration Program Surveys 2 Review of Environmental Factors.

Niche (2010c) Bargo Exploration Program Surveys 3 Review of Environmental Factors.

Niche (2010d) Bargo Exploration Program Surveys 4 Review of Environmental Factors.

Niche (2011a) Tahmoor Coal Ventilation Shaft Fenceline Clearing Assessment.

Niche (2011b) Bargo Project – Preliminary Offsetting Strategy.

Niche (2011c) Tahmoor South Project Pilot Study.

Niche (2011d) Bargo Exploration Program Surveys 6 Review of Environmental Factors.

Niche (2011e) Bargo Exploration Program Surveys 7 Review of Environmental Factors.

Niche (2011f) Bargo Exploration Program Surveys 8 Review of Environmental Factors.

Niche (2011g) Bargo Exploration Program Surveys 9 Review of Environmental Factors.

Niche (2020) Tahmoor South Project, Aquatic Ecology Assessment, Prepared for SIMEC

NSW National Parks and Wildlife Service (2003a). NSW Threat Abatement Plan. Predation by *Gambusia holbrooki* – The Plague Minnow. NPWS. Hurstville, NSW.

NSW National Parks and Wildlife Service (2003b) Draft Recovery Plan for the Barking Owl. New South Wales National Parks and Wildlife Service, Hurstville, NSW.

NSW National Parks and Wildlife Service (2003c) Native Vegetation of the Woronora, O'Hares and Metropolitan Catchments, National Parks and Wildlife Service, 2003.

NSW National Parks and Wildlife Service (2002) Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney, Final Edition NSW NPWS, Hurstville.

NPWS (2002a) Environmental Impact Assessment Guidelines: *Grevillea parviflora* subsp. *parviflora*, NSW NPWS, Hurstville.

NPWS (2001a) Threatened Species Information: Red-crowned Toadlet *Pseudophryne australis* (Gray, 1835). Dated May 2001. Threatened Species Unit, Central Directorate, NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service (2001b) Environmental Impact Assessment Guideline: Red-crowned Toadlet *Pseudophryne australis* (Gray, 1835). Dated May 2001. Threatened Species Unit, Central Directorate, NSW NPWS, Hurstville.

NPWS (1999) Threatened species profiles, NPWS Hurstville NSW.

NSW Scientific Committee (2008a) Gang-gang Cockatoo *Callocephalon fimbriatum* Review of Current Information in NSW. Dated December 2008. Established under the Threatened Species Conservation Act 1995, Hurstville NSW.

NSW Scientific Committee (2008b) Sooty Owl *Tyto tenebricosa* Review of Current Information in NSW. Dated September 2008. NSW Scientific Committee established under the Threatened Species Conservation Act 1995.

NSW Scientific Committee (2008c) Powerful Owl *Ninox strenua* Review of Current Information in NSW. Dated September 2008. NSW Scientific Committee established under the Threatened Species Conservation Act 1995.

Office of Environment and Heritage (2011) BioMetric Vegetation Types Database. Available online at: http://www.environment.nsw.gov.au/resources/nature/BioMetric_Vegetation_Type_CMA.xls

Office of Environment and Heritage (2012) NSW Threatened Species Information. http://www.environment.nsw.gov.au/threatenedspecies/. NSW Office of Environment and Heritage.

Office of Environment and Heritage (2012) Assessors' guide to using the BioBanking Credit Calculator v.2. NSW Office of Environment and Heritage.

Office of Environment and Heritage (2013) Remnant Vegetation of the western Cumberland subregion, 2013 Update

Office of Environment and Heritage (2014) Threatened Species Profiles. http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx

Office of Environment and Heritage (2014a) Framework for Biodiversity Assessment - NSW Biodiversity Offsets Policy for Major Projects.

Office of Environment and Heritage (2014b) NSW Biodiversity Offsets Policy for Major Projects. State of NSW and Office of Environment and Heritage.

Office of Environment and Heritage (2016) NSW Guide to Surveying Threatened Plants.

Office of Environment and Heritage (2018a) BioNet Atlas of Wildlife. Available online: http://www.bionet.nsw.gov.au/

Office of Environment and Heritage (2018b) Koala corridors in south-west Sydney. Available online: https://datasets.seed.nsw.gov.au/dataset/koala-corridors-in-south-west-sydney

PAC (2009) The Metropolitan Coal Project Review Report. State of NSW through the NSW Planning Assessment Commission, 2009

PAC (2010) The PAC Review of the Bulli Seam Operations Project. State of New South Wales through the NSW Planning Assessment Commission, 2010

Penman, T.D, Lemckert, F.L. & Mahony, M.J. (2008) Spatial ecology of the giant burrowing frog (*Heleioporus australiacus*): implications for conservation prescriptions. Australian Journal of Zoology 56:179–186.

Palaris (2020) Tahmoor South Project Rejects Management Options, Prepared for SIMEC

Pizzey, G. and F. Knight (2007) Field Guide to the Birds of Australia; Eighth Edition. Harper Collins, Sydney.

Pringle, R.M., J.K. Webb & R. Shine (2003) Canopy structure, microclimate, and habitat selection by a nocturnal snake, *Hoplocephalus bungaroides*. Ecology. 84(10):2668-2679.

Queensland Department of Environment and Resource Management (Qld DERM) (2011) National recovery plan for the Large-eared Pied Bat *Chalinolobus dwyeri*. Draft. Report to the Department of Environment and Water Rources, Canberra. Brisbane: Queensland Parks and Wildlife Services.

Saunders, D.L. and Tzaros, C.L. (2011) National Recovery Plan for the Swift Parrot *Lathamus discolor*, Birds Australia, Melbourne.

Scientific Committee (1998) *Persoonia hirsuta* (a spreading to decumbant shrub) - endangered species listing NSW Scientific Committee - final determination.

SKM (2014) Tahmoor South Project Rejects Management Options, Prepared for Tahmoor Coal

Smith, P. (1984) Prey items of the Sooty Owl and the Barn Owl at Bega, New South Wales. Corella 8(3): 71-72.

Tahmoor Coal (2013) Bushfire Management Plan – updated 2015.

TEC (1997) Impacts of longwall Coal mining on the environment in New South Wales, Total Environment Centre, January 2007, South Sydney.

Tozer, M.G et al. (2006) Native vegetation of South eastern NSW: a revised classification and map for the coast and eastern tablelands. Cunninghamia vol 11(3):1-48.

Tozer, M.G (2003) The native vegetation of the Cumberland Plain, western Sydney: a systematic classification and field identification of communities. Cunninghamia 8: 1-75.

Webb, J.K. & R. Shine (1994) Habitat use by the broad-headed snake, *Hoplocephalus bungaroides*. Page(s) 7-24. NSW NPWS. NSW NPWS, Sydney.

Webb, J.K. & R. Shine (1998a) Thermoregulation by a nocturnal elapid snake (*Hoplocephalus bungaroides*) in southeastern Australia. Physiological Zoology. 71 (6):680-692.

Webb, J.K. & R. Shine (1998b) Using thermal ecology to predict retreat-site selection by an endangered snake species. Biological Conservation. 86:233-242.

Webb, J.K. & R. Shine (1998c) Ecological characteristics of a threatened snake species, *Hoplocephalus bungaroides* (Serpentes, Elapidae). Animal Conservation. 1:185-193

Weston, P.H. (1995) Subfam. 1. Persoonioideae. In: Flora of Australia. 16:47-125. Melbourne, Victoria: CSIRO.

Weston, P.H. & L.A.S. Johnson (1991) Taxonomic changes in Persoonia (Proteaceae) in New South Wales. Telopea. 4(2):269-306.

Western, P & Johnson (2000) Environmental Impact Assessment Guidelines for *Persoonia bargoensis*, National Parks and Wildlife Service.

White, A. (1993) Ecological and behavioural obser- vations on populations of the toadlets *Pseudophryne coriacea* and *Pseudophryne bibroni* on the Central Coast of New South Wales. Pp. 139-50 in Herpetology in Australia: a diverse discipline ed by D. Lunney and D. Ayers. Transactions of the Royal Zoological Society of New South Wales: Mosman

Wollondilly Shire Council (2011) Growth Management Strategy Final 2011, Prepared by Wollondilly Shire Council.

Appendix 1. Likelihood of occurrence of threatened flora and fauna within the Study Area

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Flora						
Acacia bynoeana Bynoe's Wattle	*A. bynoeana* occurs mainly in heath and dry sclerophyll forest (Morrison & Davies 1991). The substrate is typically sand and sandy clay, often with ironstone gravels and is usually very infertile and well-drained. The species seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	High	Moderate	There are known records for this species within the locality and former Study Area, on the edge of Kader Road. The known record is located approximately 560 metres beyond the current Study Area. Despite extensive surveys this species was not recorded within the surface works development footprint but habitat for this species does occur within this area. This species does not occur within and/or is not likely to be reliant on the vegetation communities or habitats that may be adversely impacted by subsidence.	Species
Acacia flocktoniae	Grows in dry sclerophyll forest on sandstone. The Flockton Wattle is found only in the Southern Blue Mountains (at Mt Victoria, Megalong Valley and Yerranderie).	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Not detected during field survey. Not considered further.	Species
Acacia gordonii	Restricted to the north-west of Sydney, it has a disjunct distribution occurring in the lower Blue Mountains in the west, and in the Maroota/Glenorie area in the east. This species is known from only a few locations and current information suggests the total number of individuals may be less than 2000, with only one population supporting greater than 400 individuals. A relatively large proportion of individuals (approximately 850) occur on conservation reserve within Blue Mountains National Park. This species is found within the Hawkesbury, Blue Mountains and Baulkham Hills local government areas.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area or locality. Not detected during field survey. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Acacia pubescens	Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Not detected during field survey. Not considered further.	Species
Allocasuarina glareicola	This species is restricted to a few small populations in and around Castlereagh, north-east of Penrith, NSW.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area or locality. Not detected during field survey. Not considered further.	Species
Asterolasia elegans	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area or locality. Not detected during field survey. Not considered further.	Species
Caladenia tesselata Tessellated Spider Orchid	The Tessellated Spider Orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct.	**NSW:** Endangered **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Commersonia prostrata Dwarf Kerrawang	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow gum woodland at Rose Lagoon; Blue-leaved Stringybark open forest at Tallong; and in Brittle Gum low open woodland at Penrose; Scribbly Gum - Swamp Mahogany ecotonal forest at Tomago.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Cryptostylis hunteriana Leafless Tongue Orchid	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Cynanchum elegans White-flowered Wax Plant	Recorded from rainforest gullies scrub and steep slopes from the Gloucester district to the Wollongong area and inland to Mt Dangar.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Darwinia biflora	Recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas. The northern, southern, eastern and western limits of the range are at Maroota, North Ryde, Cowan and Kellyville, respectively. Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. The vegetation structure is usually woodland, open forest or scrub-heath.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Darwinia peduncularis	Occurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. It has been recorded from Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland. Usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	No previous records in Study Area or locality. Not detected during field survey. Not considered further.	Species
Dillwynia tenuifolia population	The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. Other populations in western Sydney are recorded from Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Disjunct localities outside the Cumberland Plain include the Bulga Mountains at Yengo in the north, and Kurrajong Heights and Woodford in the Lower Blue Mountains.	**NSW:** Endangered population **Commonwealth:** Not listed	None	None	Not considered – located outside of Study Area	Species
Epacris purpurascens var. purpurascens	Found in a range of habitat types, most of which have a strong shale soil influence. Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the south.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	None	Individuals of *Epacris purpurascens* var. *purpurascens* have been recorded within the Study Area.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Eucalyptus camfieldii Heart-leaved Stringybark	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Eucalyptus sp. cattai	Occurs in the area between Colo Heights and Castle Hill, northwestern Sydney, with historical records from central Sydney. Occurs as a rare emergent tree in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small clustered groups. The sites at which it occurs are generally flat and on ridge tops. Associated soils are laterised clays overlying sandstone. There are no known populations occur in conservation reserves.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	None	None	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Genoplesium baueri	Grows in sparse sclerophyll forest and moss gardens over sandstone. The species has been recorded from locations between Ulladulla and Port Stephens.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea	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. Often occurs in open, slightly disturbed sites such as along tracks. Sporadically distributed throughout the Sydney Basin with the main occurrence centred on Picton, Appin and Bargo (and possibly further south to the Moss Vale area).	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Known	Known	There are known records for this species within the Study Area. This species does not occur within and/or is not likely to be reliant on the vegetation communities or habitats that may be adversely impacted by subsidence.	Species
Haloragis exalata subsp. *exalata* Square Raspwort	Occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the central coast, south coast and north-western slopes botanical subdivisions of NSW. The species appears to require protected and shaded damp situations in riparian habitats.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Hibbertia superans	Occurs from Baulkham Hills to South Maroota in the northern outskirts of Sydney, where there are currently 16 known sites, and at one locality at Mount Boss, inland from Kempsey. No populations are known from a formal conservation reserve.	**NSW:** Endangered **Commonwealth:** **Not listed**	None	None	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Lasiopetalum joyceae	The species has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. It is currently known from 34 sites between Berrilee and Duffys Forest. Seventeen of these are reserved, though many are situated at the reserve edge and subject to subsequent edge effects such as nutrient enrichment and weed encroachment.	**NSW:** Vulnerable **Commonwealth:** **Not listed**	None	None	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Leucopogon exolasius Woronora Beard-heath	The Woronora Beard-heath is restricted to Woronora and Grose Rivers (in the Blue Mountains), Stokes Creek and Georges River. It is found in the Holsworthy Military Reserve and in Heathcote and Royal National Parks (Commonwealth land). The species is endemic to the Sydney region and central coast of New South Wales (NSW) occurring within the Sydney Metro and Hawkesbury-Nepean Natural Resource Management Regions. The Woronora Beard-heath inhabits woodland on sandstone (and sandy alluvium) and prefers rocky hillsides along creek banks.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	Despite extensive surveys this species was not recorded within the surface facility development footprint nor along the creeklines of the Study Area.	Species
Leucopogon fletcheri subsp. *fletcheri*	Restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains. Occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs. Flowers August to September. Fruit produced October. Evidence suggests the species responds slowly to fire. The species is an obligate seeder and slow growing with a maturation period likely to exceed 5 years.	**NSW:** Endangered **Commonwealth:** Not listed	None	None	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Marsdenia viridiflora subsp. *viridiflora - endangered population*	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. Grows in vine thickets and open shale woodland.	**NSW:** Endangered population **Commonwealth:** Not listed	None	None	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Melaleuca biconvexa Biconvex Paperbark	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Melaleuca deanei Dean's Melaleuca	The species grows in heath on sandstone. Occurs in two distinct areas, in the Ku-ring-gai / Berowra and Holsworthy / Wedderburn areas respectively	**NSW:** Vulnerable **Commonwealth:** Vulnerable.	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Pelargonium sp. Striatellum	The species is known to occur in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. In New South Wales Pelargonium sp. is currently known to occur at four localities in the Southern Tablelands, at altitudes ranging from 680-1030 m a.s.l.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Persicaria elatior Tall Knotweed	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Only recorded from 8 locations in NSW. Closest record is Picton Lakes.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Persoonia acerosa Needle Geebung	Occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils. Recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Persoonia bargoensis	The Bargo Geebung occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravely soils.	**NSW:** Endangered **Commonwealth:** Vulnerable	Known	Known	There are known records for this species within the Study Area. This species does not occur within and/or is not likely to be reliant on the vegetation communities or habitats that are may be adversely impacted by subsidence. A large population of this species was recorded within the REA development footprint. It is estimated that over 96 plants will be removed as a result of the Project.	Species
Persoonia glaucescens	The Mittagong Geebung grows in woodland to dry sclerophyll forest on clayey and gravely laterite. The preferred topography is ridge-tops, plateaux and upper slopes. Aspect does not appear to be a significant factor.	**NSW:** Endangered **Commonwealth:** Vulnerable	Known	High	There are known records for this species within the Study Area. Despite extensive surveys this species was not recorded within the surface facility development footprint but habitat for this species does occur within this area. This species has been assessed on the basis of the presence of suitable habitat which will be removed for the development of the proposed surface facilities. This species does not occur within and/or is not likely to be reliant on the vegetation communities or habitats that may be adversely impacted by subsidence.	Species
Persoonia hirsuta	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	**NSW:** Endangered **Commonwealth:** Endangered	High	High	There are known records for this species within the Study Area. Despite extensive surveys this species was not recorded within the surface facilities development footprint but habitat for this species does occur within this area. This species has been assessed on the basis of the presence of suitable habitat which will be removed for the proposed surface facilities. This species does not occur within and/or is not likely to be reliant on the vegetation communities or habitats that may be adversely impacted by subsidence.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Persoonia mollis subsp. *maxima*	Highly restricted, known from the Hornsby Heights-Mt Colah area north of Sydney in the Sydney Basin Bioregion. Occurs in three populations (described on a catchment basis) located over an approximate north-south range of 5.75 km and east-west distance of 7.5 km. Additional locations may exist outside the current distribution.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Pimelea curviflora var. *curviflora*	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Occurs on shale-lateritic soils over sandstone and shale-sandstone transition soils on ridgetops and upper slopes amongst woodlands.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Pimelea spicata	Pimelea spicata has a relatively scattered distribution in two disjunct areas: the Cumberland Plain area of western Sydney; and the Illawarra Region near Wollongong, NSW. In western Sydney, the distribution extends from Camden in the south to Maraylya in the north and from Horsley Park east to Bankstown. In the Illawarra, the species is associated with coastal headlands and hill tops from Mount Warrigal to Gerroa. The western Sydney/Cumberland Plain populations occur on undulating to hilly country in remnant bushland on Wianamatta shales.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Pomaderris brunnea	The species has been found in association with *Eucalyptus amplifolia*, *Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua*. Brown Pomaderris is found in a very limited area around the Colo, 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.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Known	Known	There are known records for this species within the Study Area and one record within the surface infrastructure footprint. A large population was recorded along TeatreeHollow Creek during the field survey. It has been considered further in the impact assessment for this project.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Pterostylis saxicola Sydney Plains Greenhood	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Pultenaea glabra Smooth Bush-pea	Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Restricted to the higher Blue Mountains.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Pultenaea pedunculata	Matted Bush-pea is widespread in Victoria, Tasmania, and south-eastern South Australia. In NSW however, it is represented by just three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). The Cumberland Plain occurrences were more widespread (Yennora, Canley Vale and Cabramatta were lost to development) and is now found at Villawood and Prestons, and north-west of Appin between the Nepean River and Devines Tunnel number 2 (Upper Sydney Water Supply Canal).	**NSW:** Endangered **Commonwealth:** Not listed	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Rulingia prostrata	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) Woodland at Rose Lagoon; Blue leaved Stringybark (*E. agglomerata*) Open Forest at Tallong; and in Brittle Gum (*E. mannifera*) Low Open Woodland at Penrose; Scribbly Gum (*Eucalyptus haemastoma*)/ Swamp Mahogany (*E. robusta*) Ecotonal Forest at Tomago.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Streblus pendulinus	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest	**NSW:** Not listed **Commonwealth:** Endangered	None	None	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Syzygium paniculatum Magenta Lilly Pilly	Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State forest. On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	**NSW:** Endangered **Commonwealth** Vulnerable	Low	Low	No previous records in Study Area or locality. Unlikely to be present due to lack of potential habitat. Not considered further.	Species
Tetratheca glandulosa	Restricted to the following Local Government Areas: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. There are approximately 150 populations of this plant ranging from Sampson's Pass (Yengo NP) in the north to West Pymble (Lane Cove NP) in the south. The eastern limit is at Ingleside (Pittwater LGA) and the western limit is at East Kurrajong (Wollemi NP). There are historical collections of this species south to Manly, Willoughby and Mosman, however these populations are now extinct.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Thelymitra sp. Kangaloon Kangaloon Sun Orchid	Recorded from shallow black peaty soil in coastal heath on sandstone. *Thelymitra* sp. Kangaloon is a terrestrial orchid endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands.	**NSW:** Not listed **Commonwealth:** Critically Endangered	None	None	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Thesium australe Austral Toadflax	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Wahlenbergia multicaulis - endangered population	In NSW, W. *multicaulis* grows mainly in the coastal and tableland districts south from Sydney and the Blue Mountains, and west along the Murray River to Mathoura. This includes the following botanical subdivisions: the Central Coast, South Coast, Central Tablelands, Southern Tablelands, South Western Slopes, and South Western Plains. There are very few records from the Central Coast botanical subdivision. Early collections from Hornsby, Ashfield, and Punchbowl, may now be extinct. The occurrence in the local government areas of Auburn, Bankstown, Strathfield and Canterbury, is likely to be the only known population remaining in the Sydney area and in the Central Coast botanical subdivision	**NSW:** Endangered population **Commonwealth:** Not listed	None	None	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Zieria involucrata	Disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains local government areas. Recent records for the species come from 22 populations in the catchments of the Macdonald, Colo and Hawkesbury Rivers between Melon Creek and Mogo Creek in the north to Little Cattai Creek (Hillside) and Wheeny Creek (Colo) in the south and from a single population in the upper Blue Mountains north of Katoomba. In addition, historical records exist for at least two other localities in the eastern Blue Mountains: south of Springwood Valley Heights and north-west of Kurrajong.	**NSW:** Endangered **Commonwealth:** Vulnerable	None	None	No previous records in Study Area. Not detected during field survey. Study Area not within known habitat. Not considered further.	Species
Fauna						
Birds						
Actitis hypoleucos Common Sandpiper	Utilises a wide range of coastal wetlands and some inland wetlands, mostly found around muddy margins or rocky shores. Forages in shallow water and on soft mud, roosts on rocks or vegetation such as mangroves. Northern hemisphere breeding.	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	The species may occur from time to time in the Study Area but is not likely to be reliant on the Study Area for breeding or foraging. No wetlands occur within the Study Area. Habitat is unlikely to be impacted by subsidence. The species was not detected in the surface infrastructure disturbance area.	-

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Apus pacificus Fork-tailed Swift	The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. It occurs over various inland habitats. There are no significant threats to the Fork-tailed Swift in Australia. Potential threats include habitat destruction and predation by feral animals.	**NSW:** Not listed **Commonwealth:** Migratory	Moderate	Moderate	Due to the wide range of the species and its aerial habits, the species may occur on occasion in the Study Area. The species was not detected during the field survey and is unlikely to be present within the surface infrastructure area.	-
Ardea alba Great Egret	Terrestrial wetlands, estuarine and littoral habitats and moist grasslands. Inland, prefer permanent waterbodies on floodplains; shallows of deep permanent lakes (either open or vegetated), semi-permanent swamps with tall emergent vegetation and herb dominated seasonal swamps with abundant aquatic flora. Also regularly use saline habitats including mangrove forests, estuarine mudflats, saltmarshes, bare saltpans, shallows of salt lakes, salt fields and offshore reefs. Breeding requires wetlands with fringing trees in which to build nests including mangrove forest, freshwater lakes or swamps and rivers.	**NSW:** Not listed **Commonwealth:** Migratory	Low - moderate	Low	The species may occur from time to time in the Study Area but is not likely to be reliant on the Study Area for breeding or foraging. Habitat is unlikely to be impacted by subsidence. The species was not detected in the surface infrastructure disturbance area.	-
Ardea ibis Cattle Egret	The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59542	**NSW:** Not listed **Commonwealth:** Migratory	Low/moderate	Low	The species may occur from time to time in the Study Area but is not likely to be reliant on the Study Area for breeding or foraging. Habitat is unlikely to be impacted by subsidence. The species was not detected in the surface infrastructure disturbance area.	-

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Artamus cyanopterus cyanopterus Dusky Woodswallow	Often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	Margin habitat occurs in the Study Area. There are no records within the locality.	Ecosystem
Botaurus poiciloptilus Australasian Bittern	The species is widespread in NSW and Victoria. In NSW, it occurs along the coast and is frequently recorded in the Murray-Darling Basin, notably in floodplain wetlands of the Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers.	**NSW**: Endangered **Commonwealth:** Endangered	Low	Low	Marginal habitat occurs in the Study Area. There are no records within the locality.	Ecosystem
Burhinus grallarius Bush Stone-curlew	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber.	**NSW**: Vulnerable **Commonwealth:** Not listed	Low	Low	Marginal habitat occurs in the Study Area. There are no records within the locality. Not detected during field surveys. Unlikely to be present in surface infrastructure disturbance area.	Species
Calidris acuminata Sharp-tailed Sandpiper	Prefers muddy edges of shallow or brackish wetlands, with inundated or emergent sedges, saltmarsh or other low vegetation. Also found foraging in sewage ponds and flooded paddocks. Northern hemisphere breeding.	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	Marginal habitat occurs in the Study Area. There are no records within the locality. Not detected during field surveys. Unlikely to be present in surface infrastructure disturbance area.	-
Calidris ferruginea Curlew Sandpiper	It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland. Northern hemisphere breeding.	**NSW:** Endangered **Commonwealth:** Critically endangered, Migratory	Low	Low	Marginal habitat occurs in the Study Area. There are no records within the locality. Not detected during field surveys. Unlikely to be present in surface infrastructure disturbance area.	Ecosystem & Species
Calidris melanotos Pectoral Sandpiper	Prefers shallow fresh to saline wetlands, found at coastal lagoons, estuaries, bays, swamps, inundated grasslands, saltmarshes and artificial wetlands. Northern hemisphere breeding.	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	Marginal habitat occurs in the Study Area. There are no records within the locality. Not detected during field surveys. Unlikely to be present in surface infrastructure disturbance area.	-

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Callocephalon fimbriatum Gang-gang Cockatoo	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	**NSW:** Vulnerable **Commonwealth:** Not listed	High	Moderate	The species has a high likelihood of occurrence within the Study Area. Its habitat is unlikely to be impacted by subsidence. It was not detected during the survey within the surface infrastructure areas.	Ecosystem & Species
Calyptorhynchus lathami Glossy Black Cockatoo	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur.	**NSW:** Vulnerable **Commonwealth:** Endangered only in South Australia Population	Known	Known	Recorded immediately adjacent to the REA during surveys and is almost certain to be present as suitable feed trees are present, although large hollow-bearing trees suitable for nesting are not present within the disturbance areas for surface infrastructure.	Ecosystem & Species
Climacteris picumnus victoriae Brown Treecreeper	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	**NSW:** Vulnerable **Commonwealth:** Not listed	High (Previously recorded by OEH).	High	A record for this species occurs within the Study Area. It may use the surface infrastructure on occasion. Habitat types are unlikely to be impacted by subsidence.	Ecosystem
Cuculus optatus Oriental Cuckoo	Mainly inhabits coniferous, deciduous and mixed forests. Breeds in northern hemisphere. Brood parasite, laying eggs in nests of other birds.	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	Marginal habitat occurs in the Study Area. There are no records within the locality. Not detected during field surveys. Unlikely to be present in surface infrastructure disturbance area.	-

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Daphoenositta chrysoptera Varied Sittella	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	This species was recorded within the Study Area during this assessment.	Ecosystem
Dasyomis brachypterus Eastern Bristlebird	The Eastern Bristlebird inhabits low dense vegetation in a broad range of habitat types including sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest. Within NSW, populations of Eastern Bristlebirds are isolated, fragmented and small. Disjunct populations occur in the north-east, the Illawarra region and the south-east of the state.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. No known populations in Study Area. Not recorded during field surveys. Not considered further.	Species
Erythrotriorchris radiatus Red Goshawk	The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia. Riverine forests are also used frequently. Such habitats typically support high bird numbers and biodiversity, especially medium to large species which the goshawk requires for prey. The Red Goshawk nests in large trees, frequently the tallest and most massive in a tall stand, and nest trees are invariably within one km of permanent water. In NSW favoured habitat is mixed subtropical rainforest and Melaleuca forest along coastal rivers, often in rugged terrain. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=942	**NSW:** Critically Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. No known populations in Study Area. Not recorded during field surveys. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Falco subniger Black Falcon	Widely, but sparsely, distributed in NSW, mostly occurring in inland regions. In NSW there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres. The Black Falcon inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	Marginal habitat occurs in the Study Area. There are no records within the locality. Not detected during field surveys. Unlikely to be present in surface infrastructure disturbance area.	Ecosystem
Gallinago hardwickii Latham's Snipe	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=863	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	No previous records in Study Area. No known populations in Study Area. Not recorded during field surveys. Not considered further.	-
Glossopsitta pusilla Little Lorikeet	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet al.so finds food in Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	**NSW:** Vulnerable **Commonwealth:** Not listed	Moderate	Moderate	The habitat present in the Study Area is suitable for use by this species. The species may also use the habitat of the surface infrastructure disturbance footprint on occasion. Habitat features of the Study Area are unlikely to be impacted by subsidence.	Ecosystem
Grantiella picta Painted Honeyeater	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	The habitat present in the Study Area is unlikely to be suitable for use by this species on a regular basis given the lack of potential habitat.	Ecosystem

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Haliaeetus leucogaster White-bellied Sea-eagle	A migratory species that is resident to Australia. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and salt marshes.	**NSW:** Vulnerable **Commonwealth:** Migratory	Low	Low	Not considered further.	Ecosystem & Species
Hieraaetus morphnoides Little Eagle	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	This species was observed immediately adjacent to the REA and the habitat in the REA is suitable for foraging and nesting.	Ecosystem & Species
Hirundapus caudacutus White-throated Needletail	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges). There appear to be few threats to the populations of White-throated Needletails. When in Australia, there is the constant threat of collision with overhead wires, windows and lighthouses, though, as this affects only a few individuals, it is not a threat to the species overall.	**NSW:** Not listed **Commonwealth:** Vulnerable Migratory	Low	Low	No previous records in Study Area. No known populations in Study Area. Not recorded during field surveys. Not considered further.	-
Lathamus discolor Swift Parrot	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*.	**NSW:** Endangered **Commonwealth:** Endangered	High	Low	The habitat present in the Study Area is suitable for use by this species. The species has marginal habitat within the surface infrastructure disturbance footprint. Habitat features of the Study Area are unlikely to be impacted by subsidence.	Ecosystem & Species
Leipoa ocellata Malleefowl	In New South Wales, it typically occurs west of the Great Dividing Range. Its distribution extends from Pilliga south-west to the districts of Griffith and Wentworth, although the species is absent from the southern parts of the Riverina region.	**NSW**: Vulnerable **Commonwealth:** Vulnerable, Migratory	None	None	No previous records in Study Area. No known populations in Study Area. Not recorded during field surveys. Not considered further.	Ecosystem

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Lophoictinia isura Square-tailed Kite	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by woollybutt, spotted gum, river peppermint or gully gum. Individuals appear to occupy large hunting ranges of more than $100km^2$. They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Ecosystem & Species
Melanodryas cucullata cucullata Hooded Robin	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	**NSW**: Vulnerable **Commonwealth:** Not listed	Moderate	Moderate	The habitat present in the Study Area is suitable for use by this species. The species may also use the habitat of the surface infrastructure disturbance footprint on occasion. Habitat features of the Study Area are unlikely to be impacted by subsidence.	Ecosystem
Melithreptus gularis gularis Black-chinned Honeyeater	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	**NSW:** Vulnerable **Commonwealth:** Not listed	High (Previously recorded by OEH).	High	Previously recorded in Study Area.	Ecosystem
Merops ornatus Rainbow Bee-eater	Usually occurs in open or lightly timbered areas, often near water (Higgins, 1999). The species occurs in a variety of habitat types throughout Australia. In Australia the nest is located in an enlarged chamber at the end of long burrow or tunnel that is excavated, by both sexes, in flat or sloping ground, in the banks of rivers, creeks or dams, in roadside cuttings, in the walls of gravel pits or quarries, in mounds of gravel, or in cliff-faces. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=670	**NSW:** Not listed **Commonwealth:** Migratory	Moderate	Moderate	This species could occasionally be present in the Study Area.	-

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Monarcha melanopsis Black-faced Monarch	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland. The Black-faced Monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=609	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	-
Motacilla flava Yellow Wagtail	Breeds in temperate Europe and Asia. The Yellow Wagtail is a regular wet season visitor to northern Australia. Increasing records in NSW suggest this species is an occasional but regular summer visitor to the Hunter River region. The species is considered a vagrant to Victoria, South Australia and southern Western Australia. Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves.	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	-

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Myiagra cyanoleuca Satin Flycatcher	Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies. Satin Flycatchers are mainly recorded in eucalypt forests, especially wet sclerophyll forest, often dominated by eucalypts such as Brown Barrel, *Eucalypt fastigata*, Mountain Gum, *E. dalrympleana*, Mountain Grey Gum, Narrow-leaved Peppermint, Messmate or Manna Gum, or occasionally Mountain Ash, *E. regnans*. Such forests usually have a tall shrubby understorey of tall acacias, for example Blackwood, *Acacia melanoxylon*. In higher altitude Black Sallee, *E. stellulata*, woodlands, they are often associated with tea-trees and tree-ferns. They sometimes also occur in dry sclerophyll forests and woodlands, usually dominated by eucalypts such as Blakely's Red Gum, *E. blakelyi*, Mugga Ironbark, *E. sideroxylon*, Yellow Box, White Box, *E. albens*, Manna Gum or stringybarks, including Red Stringybark, *E. macrorhyncha* and Broad-leaved Stringybark, usually with open understorey. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=612	**NSW:** Not listed **Commonwealth:** Migratory	Moderate	Moderate	The habitat present in the Study Area may be suitable for this species.	-
Neophema pulchella Turquoise Parrot	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	**NSW:** Vulnerable **Commonwealth:** Not listed	Moderate	Moderate	The habitats present in the Study Area may be suitable for this species. Limiting resources for this species are unlikely to be impacted by the Project. This species is generally highly mobile and are likely to utilise potential habitat immediately adjacent to the proposed surface infrastructure.	Ecosystem
Ninox connivens Barking Owl	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.	**NSW:** Vulnerable **Commonwealth:** Not listed	High	High	The habitat present in the Study Area may be suitable for this species.	Ecosystem & Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Ninox strenua Powerful Owl	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl 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 comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Balart *Exocarpus cupressiformis* and a number of eucalypt species.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	Previously recorded in Study Area and recorded during surveys.	Ecosystem & Species
Petroica boodang Scarlet Robin	The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	Previously recorded in Study Area and the habitat in the surface infrastructure footprint is suitable for the species.	Ecosystem
Pyrrholaemus saggitatus Speckled Warbler	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	**NSW:** Vulnerable **Commonwealth:** Not listed	Moderate	Moderate	The woodlands present represent relatively suitable habitat for this species although the Study Area contains large areas of disturbed habitat. Limiting resources for this species are unlikely to be impacted by the Project.	Ecosystem

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Rhipidura rufifrons Rufous Fantail	In east and south-east Australia, mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests; for example near Bega in south-east NSW, where they are recorded in temperate Lilly Pilly (*Acmena smithii*) rainforest, with Grey Myrtle (*Backhousia myrtifolia*), Sassafras (*Doryphora sassafras*) and Sweet Pittosporum (*Pittosporum undulatum*) subdominants. They occasionally occur in secondary regrowth, following logging or disturbance in forests or rainforests. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including Spotted Gum (*Eucalyptus maculata*), Yellow Box (*E. melliodora*), ironbarks or stringybarks, often with a shrubby or heath understorey. They are also recorded from parks and gardens when on passage. In north and north-east Australia, they often occur in tropical rainforest and monsoon rainforests, including semi-evergreen mesophyll vine forests, semi-deciduous vine thickets or thickets of Paperbarks (*Melaleuca* spp.)	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	-
Rostratula australis Australian Painted Snipe	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains (DoEE).	**NSW**: Endangered **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Ecosystem

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Stagonopleura guttata Diamond Firetail	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	**NSW:** Vulnerable **Commonwealth:** Not listed	High (Previously recorded by OEH).	High	Previously recorded in Study Area. Likely to use the Study Area on occasion.	Ecosystem
Sterna fuscata Sooty Tern	Flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	**NSW:** Vulnerable **Commonwealth:** Not listed	None	None	Previously recorded however was an isolated incident of a lost vagrant individual and the Study Area contains no suitable habitat for this marine species. It is not considered further.	Species
Tringa nebularia Common Greenshank	Variety of inland wetlands and sheltered coastal habitats of varying salinity. Found on mudflats, saltmarsh, mangroves in embayments, harbours, deltas and lagoons. Breeds in northern hemisphere.	**NSW:** Not listed **Commonwealth:** Migratory	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	-
Tyto novaehollandiae Masked Owl	Pairs have a large home-range of 500 to 1000 hectares. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	**NSW:** Vulnerable **Commonwealth:** Not listed	High	High	The habitat present in the Study Area is suitable for this species.	Ecosystem & Species
Tyto tenebricosa Sooty Owl	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (*Pseudocheirus peregrinus*) or Sugar Glider (*Petaurus breviceps*). Nests in very large tree-hollows.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	Recorded during the field survey.	Ecosystem & Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Anthomyza phrygia Regent Honeyeater	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests (NPWS, 1999) (Pizzey, 1997).	**NSW**: Endangered **Commonwealth:** Endangered, Migratory	Moderate	Low	As state in the OEH Bionet description, 'the species is a dual credit species, mapped important areas are a species credit, these areas do not require survey and any impact from development could be potentially serious and irreversible. Ecosystem credit are areas that are unlikely to be potential serious and irreversible impacts.' The habitats present in the Study Area may be suitable for this species on an occasional basis (fly in or over the Study Area). The survey did not detect the species, nor have there been any previous records or and known breeding populations in the Study Area. Limiting resources for this species are unlikely to be impacted by the Project. This species is generally highly mobile. Furhtermore, subsidence is unlikely to impact the dry sclerophyll forest and woodand habitat that the species may occasionally use.	Ecosystem
Fish						
Macquaria australasica Macquarie Perch	Macquarie perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries.	**NSW:** Endangered **Commonwealth:** Endangered	None	None	No habitat present in the Study Area.	-
Amphibians						

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Heleioporus australiacus Giant Burrowing Frog	Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water. Around the Sydney Basin they are associated with Triassic Sandstones. South of the Sydney Basin they have been recorded from a wide range of habitat including heath, woodlands and dry and wet sclerophyll forests, but not cleared lands. Adults move 50-200m from the breeding site during non-breeding times.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No known populations in Study Area. Habitat marginal. Lack of deep pools and suitable habitat. Not recorded during field surveys or amphibian monitoring within the Study Area. Some habitat potential occurs within Cow Creek which occurs outside of the Stuyd Area. As discussed in section 8.7, potential impacts to baseflow within Cow Creek are so minimal, that it highly unlikely to impact any breeding pools or limiting habitat. For this reason, the Giant Burrowing Frog has not been assessed further.	Species
Litoria aurea Green and Golden Bell Frog	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. This frog is also a "pioneering" species that invades newly disturbed habitats and most of the sites it remains extant at are highly disturbed human created environments.	**NSW:** Endangered **Commonwealth:** Vulnerable	Low. Habitat is of low quality only (no open shallow water bodies with emergent vegetation) and the species is probably extinct in region.	Low	No known populations in Study Area. Habitat marginal. Not recorded during field surveys or amphibian monitoring. Not considered further.	Species

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Litoria littlejohni Littlejohn's Tree Frog	Occurs in wet and dry sclerophyll forests associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range. The species has been located calling around a range of water bodies including rocky flowing streams, semi-permanent and permanent dams, upland swamps and temporary pools. Individuals forage and shelter both in the tree canopy and on the ground. It is not known from coastal or completely cleared habitats.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No known populations in Study Area. Habitat marginal at best. Not recorded during field surveys or amphibian monitoring. Not considered further.	Species
Mixophyes balbus Stuttering Frog	This species is associated with mountain streams in wet mountain forests and rainforests. Adults and juveniles are regularly recorded hundreds of metres from the banks of the permanent forest streams that form their breeding sites. Eggs are deposited in leaf litter or gravel/sand within the stream bed in nests hollowed out by the female. The tadpoles enter the stream proper when they are large enough to break free of the nesting hollow or when they are washed out by rains.	**NSW:** Endangered **Commonwealth:** Vulnerable	Low. Habitat is poor and species is almost certainly extinct in region	Low	No known populations in Study Area. Lack of suitable habitat in Study Area. Not recorded during field surveys or amphibian monitoring. Not considered further.	Species
Pseudophryne australis Red-crowned Toadlet	Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Red-crowned Toadlets are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites. Due to this tendency for discrete populations to concentrate at particular sites, a relatively small localised disturbance may have a significant impact on a local population if it occurs on a favoured breeding or refuge site. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Low	Recorded at Hornes Creek within the Study Area. Unlikely to be present within the area proposed for surface infrastructure and thus unlikely to be impacted by works in that area. There is the potential for subsidence impacts to results in loss of pools which could support a population of the species along Hornes Creek. This species is considered further in the impact assessment of this report.	Species
Reptiles						

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Hoplocephalus bungaroides Broad-headed Snake	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring, requiring very specific types of rock shelters that may be used year after year. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	**NSW:** Endangered **Commonwealth:** Vulnerable	Low	Low	The Broad-headed Snake is unlikely to occur within the Study Area due to the following: - It was not detected during targeted field survey - No known records occur within the Study Area. - Most of the records occur greater than 3.5 km to the south of the Study Area within land managed by WaterNSW. - The broad-headed snake is known to occur sandstone ridgetops to which the snakes are known to prefer sites with a west to north-west aspect. Such habitat features are quite restricted in the Proejct Area, occurring along the portions of Dogtrap Creek, TeatreeHollow Creek, Dry Creek, Eliza Creek and the Nepean River. The restricted habitat, coupled with the lack of records and distance from known populations, indicates a low likelihood fo the species to occur within the Study Area.	Ecosystem & Species
Varanus rosenbergi Rosenberg's Goanna	Found in heath, open forest and woodland. Terrestrial termite mounds are a critical habitat component for this species as is uses them as nesting sites. Rock outcrops are also important as shelter sites.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	The species is unlikely to occur within the Study Area due to the following: - It was not detected during targeted field survey despite targeted trapping - No known records occur within the Study Area. - Records occur greater than 3.5 km to the south of the Study Area within land managed by WaterNSW.	Ecosystem
Invertebrates						

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Meridolum corneovirens Cumberland Plain Land Snail	Lives in a very small area on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. Primarily inhabits Cumberland Plain Woodland. This community is a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	**NSW:** Endangered **Commonwealth:** Not listed	Low	Low	Not detected during target surveys within area proposed for surface disturbance. Lack of Cumberland Plain Woodland throughout the Study Area.	Species
Mammals						
Cercartetus nanus Eastern Pygmy-possum	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows but can also construct its own nest. Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5 ha area over a 5 month period.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Moderate	No previous records in Study Area. No known populations in Study Area. The species was not recorded during the field survey. Potential foraging and nesting habitat occurs within the surface infrastructure area. Recorded within close proximity (3km) of the Study Area. Considered further in impact assessmentand offsets provided.	Species
Chalinolobus dwyeri Large-eared Pied Bat	Roosts in caves (near their entrances) and overhangs, crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They will return to the same cave over many years.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Moderate	Moderate	One record within the Study Area and also along the Bargo River within 2 km of Study Area There are no known caves within the Study Area, however sandstone overhangs and cliffs do occur. There is also suitable foraging habitat present. Considered further in impact assessment.	Species
Dasyurus maculatus Spotted-tailed Quoll	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.	**NSW:** Vulnerable **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Ecosystem
Falsistrellus tasmaniensis Eastern False Pipistrelle	Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Occurs at higher altitudes.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	Previously recorded in Study Area.	Ecosystem

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Isoodon obesulus Southern Brown Bandicoot	Prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	**NSW:** Endangered **Commonwealth:** Endangered	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Species
Miniopterus schreibersii oceanensis Eastern Bent-wing Bat	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Critical habitat are its maternity roosts where very large numbers of female bats congregate. These are scattered throughout Australia.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	Previously recorded in Study Area.	Ecosystem & Species
Miniopterus australis Little Bent-wing Bat	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Critical habitat are its maternity roosts where very large numbers of female bats congregate. These are scattered throughout Australia.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	This species is at very edge of possible range and is unlikely to be present. It is also a cave-roosting bat and would not be reliant on any habitats within the Study Area. It is not considered further.	Ecosystem & Species
Mormopterus norfolkensis Eastern Freetail-Bat	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in man-made structures.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	Previously recorded in Study Area.	Ecosystem
Myotis macropus Large-footed Myotis	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Uses water courses as primary foraging habitat.	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	Recorded in the Study Area.	Species
Pseudomys novaehollandiae New Holland Mouse	Coastal heath and dry sclerophyll forest and woodland. Across the species' range, the New Holland Mouse is known to inhabit the following types of habitat; open heathland; open woodland with a heathland understorey; vegetated sand dunes.	**NSW:** Not listed **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Ecosystem
Petaurus australis Yellow-bellied Glider	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.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Ecosystem

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Petaurus norfolcensis Squirrel Glider	Inhabits 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.	**NSW:** Vulnerable **Commonwealth:** Not listed	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Species
Petrogale penicillata Brush-tailed Rock-wallaby	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north.	**NSW:** Endangered **Commonwealth:** Vulnerable	None	None	No previous records in Study Area. No known populations in Study Area. Not recorded during field surveys. Not considered further.	Species
Phascolarctos cinereus Koala	Inhabit eucalypt woodlands and forests.	**NSW:** Vulnerable **Commonwealth:** Vulnerable	High (Previously recorded by OEH).	Moderate	Previously been recorded in the Study Area, however was not recorded within the surface infrastructure area during targeted surveys. It is therefore unlikely the species would use the area proposed for surface infrastructure for important foraging habitat. Considered further in impact assessment.	Ecosystem & Species
Potorous tridactylus Long-nosed Potoroo	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy (Johnston, 1995).	**NSW:** Vulnerable **Commonwealth:** Vulnerable	Low	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Not considered further.	Ecosystem
Pteropus poliocephalus Grey-headed Flying-fox	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost (Tidemann 1995) although some individuals may travel up to 70 km (Augee 1999).	**NSW:** Vulnerable **Commonwealth:** Vulnerable	High	High	Habitat for this species occurs within the Study Area. Considered further in impact assessment.	Ecosystem & Species
Scoteanax rueppellii Greater Broad-nosed Bat	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. Although this species usually roosts in tree hollows, it has also been found in buildings. This species tends to occur at lower altitudes.	**NSW:** Vulnerable **Commonwealth:** Not listed	High (Previously recorded by OEH).	High	Likely present within the Study Area. The species may utilise the disturbance footprint for surface infrastructure for foraging.	Ecosystem

Threatened species	Habitat requirements	Conservation status	Likelihood of occurrence in Study Area	Likelihood of occurrence in surface works area	Consideration in this assessment	Species Credit or Ecosystem Credit species
Vespadelus troughtoni Eastern Cave Bat	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. Little is understood of its feeding or breeding requirements or behaviour. The Study Area is the southern edge of the species range	**NSW:** Vulnerable **Commonwealth:** Not listed	Known	Known	This species is known to occur within the Study Area.	Species
Petauroidies volans Greater Glider	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria. Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha.	**NSW:** Vulnerable **Commonwealth:** Not listed	Moderate	Low	No previous records in Study Area. No known populations in Study Area. Habitat marginal. Not recorded during field surveys. Records approximately 300 metres to the north of the Study Area along Bargo River.	Species

Appendix 2. Threatened Ecological Community likelihood of occurrence

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	Bangalay Sand Forest typically comprises a relatively dense or open tree canopy, an understorey of mesophyllous or sclerophyllous small trees and shrubs, and a variable groundcover dominated by sedges, grasses or ferns. The most common tree species include *Eucalyptus botryoides* (Bangalay) and *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia). It occurs on deep, freely draining to damp sandy soils on flat to moderate slopes within a few km of the sea and at altitudes below 100 m. It is currently known from parts of the Local Government Areas of Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions.	Endangered	-	None – out of distribution range for this community.
Blue Gum High Forest in the Sydney Basin Bioregion	A moist, tall open forest community, with dominant canopy trees of Sydney Blue Gum (*Eucalyptus saligna*) and Blackbutt (*E. pilularis*). Forest Oak (*Allocasuarina torulosa*) and Sydney Red Gum (*Angophora costata*) also occur. Species adapted to moist habitat such as Lilly Pilly (*Acmena smithii*), Sandpaper Fig (*Ficus coronata*), Rainbow Fern (*Calochleana dubia*) and Common Maidenhair (*Adiantum aethiopicum*) may also occur. The remnants mainly occur in the Lane Cove, Willoughby, Ku-ring-gai, Hornsby, Baulkham Hills, Ryde and Parramatta local government areas. An example of Blue Gum High Forest can be seen at the Dalrymple-Hay Nature Reserve, St Ives.	Endangered	Critically Endangered	None – out of distribution range for this community.
Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion	Characteristic tree species of this ecological community are Mountain Blue Gum (*Eucalyptus deanei*), Monkey Gum (*E. cypellocarpa*) and Turpentine (*Syncarpia glomulifera*). Other tree species include Sydney Red Gum (*Angophora costata*), Rough-barked Apple (*A. floribunda*), Mountain Mahogany (*E. notabilis*), Sydney Peppermint (*E. piperita*) and Grey Gum (*E. punctata*). Tree species composition varies between sites depending on geographical location and local conditions (e.g. topography, rainfall exposure). Known from the local government areas of Blue Mountains and Hawkesbury, both within the Sydney Basin Bioregion. It may occur elsewhere in the Bioregion, and communities within Wollondilly LGA certainly show similarities to this community.	Endangered	Critically Endangered	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) within the Study Area.
Castlereagh Scribbly Gum and Agnes Banks Woodland in the Sydney Basin Bioregion	Agnes Banks Woodland is a low woodland dominated by *Eucalyptus sclerophylla* and *Angophora bakeri* with a diverse understorey of sclerophyllous shrubs species including *Banksia oblongifolia*, *Conospermum taxifolium, Leptospermum trinervium, Dillwynia sericea, Monotoca scoparia,Persoonia nutans*, and ground stratum species including *Lepidosperma urophorum, Platysace ericiodes, Pimelea linifolia, Mitrasacme polymorpha, Trachymene incisa* and *Stylidium graminifolium.* Agnes Banks Woodland is restricted to small areas of sand dunes overlying Tertiary Alluvium at Agnes Banks on the east bank of the Hawkesbury River. In low-lying, poorly drained areas it grades into Castlereagh Ironbark Forest.	Vulnerable/ Critically Endangered	Endangered	None – out of distribution range for this community.
Coastal Saltmarsh in the New South Wales North Coast, Sydney	Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands. Characteristic plants include *Baumea juncea*, Sea Rush (*Juncus krausii* subsp. *australiensis*), Samphire	Endangered	Vulnerable	None – out of distribution range

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
Basin and South East Corner Bioregions	(*Sarcocornia quinqueflora* subsp. *quinqueflora*), Marine Couch (*Sporobolus virginicus*), Streaked Arrowgrass (*Triglochin striata*), Knobby Club-rush (*Ficinia nodosa*), Creeping Brookweed (*Samolus repens*), Swamp Weed (*Selliera radicans*), Seablite (*Suaeda australis*) and Prickly Couch (*Zoysia macrantha*). Occasionally mangroves are scattered through the saltmarsh. Tall reeds may also occur, as well as salt pans. This community occurs in the intertidal zone along the NSW coast.			for this community.
Coastal Upland Swamp in the Sydney Basin Bioregion	The Coastal Upland Swamp in the Sydney Basin Bioregion includes open graminiod heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. The vegetation of the Coastal Upland Swamp may include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands. Larger examples may include a complex of these structural forms. The flora comprising the upland swamp is diverse there are 73 plant species listed as characterising the ecological community. The total species list is much greater and is likely to exceed 200 species of vascular plants.	Endangered	Endangered	None – no upland swamps previously mapped within the Study Area. Furthermore, aerial photography interpretation has not identified any potential upland swamps.
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Ranges from open forest to low woodland, with a canopy dominated by Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Paperbark (*Melaleuca decora*). The canopy may also include other eucalypts such as Woolybutt (*E. longifolia*). The dense shrubby understorey consists of Prickly-leaved Paperbark (*Melaleuca nodosa*) and Peach Heath (*Lissanthe strigosa*), with a range of 'pea' flower shrubs, such as *Dillwynia tenuifolia*, Hairy Bush-pea (*Pultenaea villosa*) and Gorse Bitter Pea (*Daviesia ulicifolia*) (can be locally abundant). The sparse ground layer contains a range of grasses and herbs. Contains many more species and other references should be consulted to identify these. Occurs in western Sydney, and the extent of intact remnants is now reduced to 1011 hectares, with the most extensive stands occurring in the Castlereagh and Holsworthy areas.	Endangered	Critically Endangered	Low – not recorded during surveys, nor previously mapped as occurring in Study Area.
Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest	Has an open forest structure with a canopy dominated by Broad-leaved Ironbark *Eucalyptus fibrosa*, with Grey Box *E. moluccana* and Forest Red Gum *E. tereticornis* occurring less frequently. Paperbark *Melaleuca decora* is common in the small tree layer. A sparse shrub layer is usually present which includes Blackthorn *Bursaria spinosa, Daviesia ulicifolia* and Peach Heath *Lissanthe strigosa*. Contains many more species and other references should be consulted to identify these. Mainly found in the northern section of the Cumberland Plain, western Sydney, in the Richmond, Marsden Park and Windsor districts. Also appears in the Liverpool/ Holsworthy area, and there are small occurrences at Bankstown, Yennora and Villawood and the Kemps Creek area.	Critically Endangered	Critically Endangered	Possible however detailed vegetation mapping by Niche did not record this TEC during field surveys, nor has vegetation mapping by Tozer et al. (2006) mapped any within the study Area.

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	A scrub community dominated by Coastal Banksia *Banksia integrifolia* subsp. *integrifolia*. Other canopy species include Broad-leaved Apple *Angophora subvelutina*. The shrubby understorey is diverse and includes species that usually occur in sandstone areas, such as Wedding Bush *Ricinocarpus pinifolius,* Riceflower *Pimelea linifolia* subsp. *linifolia* and Daphne Heath *Brachyloma daphnoides*. Contains many more species and other references should be consulted to identify these. Occurs only in the Elderslie area, near Camden, in Sydney's south-west. Remaining remnants are 15 ha in total.	Endangered	-	None – out of range for this TEC.
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime: Those that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum* (water couch), *Leersia hexandra* (swamp rice-grass), *Pseudoraphis spinescens* (mud grass) and *Carex appressa* (tussock sedge). Known from along the majority of the NSW coast. However, it is distinct from Sydney Freshwater Wetlands which are associated with sandplains in the Sydney Basin bioregion. Extensively cleared and modified.	Endangered	-	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) or OEH (2013) within the Study Area.
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest is generally a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species. Several species have compound leaves, and vines may be a major component of the canopy. These features differentiate littoral rainforest from forest or scrub, but while the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *Eucalyptus tereticornis* occur in many stands. There is considerable floristic variation between stands and in particular areas, localised variants may be recognised. The Sutherland Shire Littoral Rainforest Endangered Ecological Community which was listed previously as an endangered ecological community is included within this community.	Endangered	Critically Endangered	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) or by OEH (2013) within the Study Area.
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and	Montane Peatlands and Swamps comprises a dense, open or sparse layer of shrubs with soft-leaved sedges, grasses and forbs. It is the only type of wetland that may contain more than trace amounts of Sphagnum spp., the hummock peat-forming mosses. Small trees may be present as scattered emergents or absent. The community typically has an open to very sparse layer of shrubs, 1-5 m tall, (eg. *Baeckea gunnian*a, *B. utilis, Callistemon pityoides, Leptospermum juniperinum, L. lanigerum, L. myrtifolium, L. obovatum, L. polygalifolium).* Species of *Epacris (*eg. *E. breviflora, E. microphylla, E. paludosa)* and *Hakea microcarpa* are also common shrubs. In some peatlands and swamps, particularly those with a history of disturbance to vegetation, soils or hydrology, the shrub layer comprises dense thickets of Leptospermum species. In other peatlands and swamps with a history of grazing by domestic livestock, the shrub layer may be very sparse or absent.	Endangered	Endangered	None – not recorded during vegetation survey, Study Area out of known range and not previously mapped by within the Study Area.

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
Australian Alps bioregions				
O'Hares Creek Shale Forest	Occurs on small outcrops of Hawkesbury shale in the Darkes Forest area of the Woronora Plateau. The community is dominated by *Eucalyptus piperita* (Sydney Peppermint), *E. globoidea* (White Stringybark) and *Angophora costata* (Smooth-barked Apple), with the latter species sometimes being the dominant canopy species. The shrub layer is variable in density and height but is characterised by *Acacia binervata, A. longifolia* subsp. *longifolia, Leucopogon lanceolatus var. lanceolatus* and *Banksia spinulosa* var. *spinulosa*. The groundcover is often the distinguishing feature of the community with an impressive cushion of ferns, lilies, grasses and rushes that include species such as *Calochlaena dubia, Pteridium esculentum, Doryanthes excelsa, Dianella caerulea, Lomandra longifolia, Blechnum cartilagineum, Entolasia stricta* and *Imperata cylindrica* var. *major*. O'Hares Creek Shale Forest is a component of Red Bloodwood - Smooth Barked Apple shrubby forest on shale or ironstone of coastal plateau, Sydney Basin. The community occupies approximately 286 ha within the local government areas of Campbelltown, Wollondilly and Wollongong between the Cataract Special Area and Appin Road to Helensburgh.	Endangered	-	None – not recorded during vegetation survey, Study Area out of known range and not previously mapped by within the Study Area.
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	As the name suggests, this EEC is found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. amplifolia* (cabbage gum), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). *Eucalyptus baueriana* (blue box), *E. botryoides* (bangalay) and *E. elata* (river peppermint) may be common south from Sydney, *E. ovata* (swamp gum) occurs on the far south coast, *E. saligna* (Sydney blue gum) and *E. grandis* (flooded gum) may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury	Endangered	-	Moderate – previously mapped occurred on the far upper reaches of Eliza Creek. The existing mapping could be incorrect. Validated of the mapping could not be undertaken given location within private property.
Shale Sandstone Transition Forest	Occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include Forest Red Gum (*Eucalyptus tereticornis*), Grey Gum (*E. punctata*), stringybarks (*E. globoidea, E. eugenioides*) and ironbarks (*E. fibrosa* and *E. crebra*). Areas of low sandstone influence (more clay-loam soil texture) have an understorey that is closer to Cumberland Plain Woodland. Shale Sandstone Transition Forest in the Sydney Basin Bioregion contains many more species than described for the canopy (above) and other references should be consulted to identify these.	Critically Endangered	Critically Endangered	Known – vegetation validation has confirmed the presence of the TEC within area proposed for

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
	Only 9,950 ha remains intact (22.6% of its original extent) and the bulk of this occurs in the Hawkesbury, Baulkham Hills, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly local government areas. Good examples can be seen at Gulguer Nature Reserve, in the Wilton area and in the Sackville - Maroota area.			surface infrastructure.
Southern Highlands Shale Woodlands in the Sydney Basin Bioregion	Southern Highlands Shale Woodland is confined to a small area in the Southern Highlands. It occurs roughly within an area bounded by the Illawarra Escarpment in the east, Burrawang and Bundanoon in the south, Canyonleigh in the west and Berrima and Colo Vale in the north. Occurs in the Wingecarribee local government area, but may occur elsewhere in the Sydney Basin Bioregion. Southern Highlands Shale Woodland is a variable community in terms of both structure and composition. The community may exist as tall open forest, grassy woodland or scrub; though it originally existed as woodland. The dominant canopy species vary across the distribution of the community. Common species throughout much of the community's range are Mountain Grey Gum *Eucalyptus cypellocarpa*, Sydney Peppermint *E. piperita*, Swamp Gum *E. ovata*, Narrow-leafed Peppermint *E. radiata* and White Stringybark *E. globoidea*. Brittle Gum *E. mannifera*, Snow Gum *E. pauciflora*, Cabbage Gum *E. amplifolia* and Rough-barked Apple *Angophora floribunda* are less common.	Endangered	Critically Endangered	Low – not recorded during vegetation survey. More likely to occur south of Study Area near Colo Vale.
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion has an open forest structure, although disturbance may result in local manifestations as woodland or scrub. The community is typically associated with sheltered heads and upper slopes of gullies on transitional zones where sandstone outcrops may exist, but where soils are influenced by lateral movement of moisture, nutrients and sediment from more fertile substrates, such as shale/ironstone caps or dolerite dykes, in adjacent areas. Southern Sydney sheltered forest on transitional sandstone soils is an open forest dominated by eucalypts with scattered subcanopy trees, a diverse shrub layer and well-developed groundcover of ferns, herbs and graminoids. Some stands may take on structural forms of woodland or scrub, as disturbance associated with past clearing has resulted in reduced density and/or dense regrowth of the tree stratum. The dominant trees include *Angophora costata*, *Eucalyptus piperita* and occasionally *E. pilularis*, particularly around Helensburgh. *Corymbia gummifera* occurs frequently within the community, although generally at lower abundance than the other eucalypts. An open subcanopy includes *Allocasuarina littoralis, Ceratopetalum gummiferum* and occasionally *Elaeocarpus reticulatus* and *Pittosporum undulatum*.	Endangered	-	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) within the Study Area.
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui. The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica* var. *discolor*, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.	Endangered	-	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) within the Study Area.

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	This swamp community has an open to dense tree layer of eucalypts and paperbarks although some remnants now only have scattered trees as a result of partial clearing. The trees may exceed 25 m in height but can be considerably shorter in regrowth stands or under conditions of lower site quality where the tree stratum is low and dense. For example, stands dominated by *Melaleuca ericifolia* typically do not exceed 8 m in height. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. The most widespread and abundant dominant trees include *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (paperbark) and, south from Sydney, *Eucalyptus botryoides* (bangalay) and Eucalyptus longifolia (woollybutt). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including *Callistemon salignus* (sweet willow bottlebrush), *Casuarina glauca* (swamp oak) and *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), *Livistona australis* (cabbage palm) and *Lophostemon suaveolens* (swamp turpentine).	Endangered	-	Low – not recorded during vegetation survey, or previously mapped.
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	A complex of vegetation types largely restricted to freshwater swamps in coastal areas. These also vary considerably due to fluctuating water levels and seasonal conditions. Characteristic species include sedges and aquatic plants such as Baumea species, *Eleocharis sphacelata*, Gahnia species, *Ludwigia peploides* subsp. *montevidensis* and Persicaria species. Areas of open water may occur where drainage conditions have been altered and there may also be patches of emergent trees and shrubs. Characteristic species are listed in the final determination - see links box. Occurs on sand dunes and low-nutrient sandplains along coastal areas in the Sydney Basin bioregion. It is known from the Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverley, Botany, Rockdale, Randwick, Sutherland and Wollongong local government areas, but is likely to occur elsewhere within the bioregion. Has been extensively cleared and filled and remnants are often small and disturbed.	Endangered	-	Low – no freshwater wetlands are known to occur within the Study Area
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions	Tableland Basalt Forest is dominated by an open eucalypt canopy of variable composition. *Eucalyptus viminalis, E. radiata, E. dalrympleana subsp. dalrympleana* and *E. pauciflora* may occur in the community in pure stands or in varying combinations. The community typically has an open canopy of eucalypts with sparse mid-story shrubs (e.g. *Acacia melanoxylon* and *A. dealbata*) and understory shrubs (e.g. *Rubus parvifolius*) and a dense groundcover of herbs and grasses, although disturbed stands may lack either or both of the woody strata. The structure of the community varies depending on past and current disturbances, particularly fire history, clearing and grazing. Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy groundcover. At some sites, mature trees may exceed 30 m tall, although regrowth stands may be shorter than 10 m tall. Tableland Basalt Forest is currently found in the Eastern Highlands and Southern and Central Tablelands, covering the local government areas of Bathurst Regional, Goulburn Mulwaree, Oberon, Palerang, Shoalhaven,	Endangered	-	Low – not recorded during vegetation survey, or previously mapped.

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
	Upper Lachlan and Wingecarribee. The community, however, may be found elsewhere within the designated bioregions.			
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	This community, commonly referred to as Tablelands Snow Gum Grassy Woodland, occurs as an open-forest, woodland or open woodland. This community may also occur as a secondary grassland where the trees have been removed, but the groundlayer remains. The main tree species are *Eucalyptus pauciflora* (Snow Gum), *E. rubida* (Candlebark), *E. stellulata* (Back Sallee) and *E. viminalis* (Ribbon Gum), either alone or in various combinations. Other eucalypt species may occur. A shrub layer may be present and sub-shrubs are common. The most common shrubs include *Melicytus* sp. 'Snowfileds' (Gruggly-bush) and *Melichrus urceolatus* (Urn Heath). The ground layer is grassy, with the most common species including *Themeda australis* (Kangaroo Grass), *Poa* spp. (snow-grasses), *Austrostipa* spp. (spear-grasses) and *Rytidosperma* spp. (wallaby-grasses). Sites in high condition have a range of forb (wildlfower) species, including *Leptorhynchos squamatus* (Scaly-buttons), *Chrysocephalum apiculatum* (Common Everlastings) and *Asperula conferta* (Native Woodlruff). Many threatened flora and fauna species have been recorded in this community.	Endangered	Critically Endangered	None – out of distribution range for this community.
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Themeda Grassland on seacliffs and coastal headlands is found on a range of substrates in the NSW North Coast, Sydney Basin and South East Corner bioregions. Stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, as for example at Cape Banks and Henry Head in Botany Bay National Park, and on metasedimentary headlands, as for example at McCauleys Headland in Coffs Coast Regional Park, Look-at-me-now Headland, Dammerels Head and Bare Bluff in Moonee Beach Nature Reserve and Wilson's Headland in Yuraygir National Park. Individual stands of the community are often very small, a few square metres, but at some sites larger stands of up to several hectares or tens of hectares occur. Overall, the community has a highly restricted geographic distribution comprising small, but widely scattered patches.	Endangered	-	None – out of distribution range for this community.
Turpentine Ironbark Forest in the Sydney Basin Bioregion	Open forest, with dominant canopy trees including Turpentine *Syncarpia glomulifera*, Grey Gum *Eucalyptus punctata*, Grey Ironbark *E. paniculata* and Thin-leaved Stringybark *E. eugenoides*. In areas of high rainfall (over 1050 mm per annum) Sydney Blue Gum *E. saligna* is more dominant. The shrub stratum is usually sparse and may contain mesic species such as Sweet Pittosporum *Pittosporum undulatum* and Elderberry Panax *Polyscias sambucifolia*. Contains many more species and other references should be consulted to identify these. A similar form of the community occurs more widely (particularly in the Wollondilly and Hawkesbury areas) but this is outside the nominated councils that are included in the determination (Ashfield, Auburn, Canterbury, Concord, Drummoyne, Leichhardt, Marrickville, Bankstown, Ryde, Hunters Hill, Baulkham Hills, Ku-ring-gai, Hornsby, Parramatta, Bankstown, Rockdale, Kogarah, Hurstville and Sutherland). This form could be equated to Blue Mountains Shale Cap Forest, although the correlation is less strong for Wollondilly (which is not mentioned in that determination).	Endangered	Critically Endangered	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) or OEH (2013) within the Study Area.

Threatened Ecological Community	Description	NSW Status	Commonwealth Status	Likelihood of occurrence within Study Area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	The ecological community typically occurs as an open to tall open forest with a sparse to dense layer of shrubs and vines, and a diverse understorey of native grasses, forbs, twiners and ferns (Keith, 2004). However, the structure of the ecological community may vary from tall open forest with trees up to and above 30 m tall with a projected foliage cover of 30–70% (e.g. *Eucalyptus fastigata* forest on basalt near Sassafras in and around Morton National Park) to woodland with trees 10–30 m tall, with a projected foliage cover of 10–30% (e.g. exposed woodland on rocky microsyenite at Mt Jellore) depending on aspect, slope, soil conditions, soil depth, and previous clearing and disturbance (Fisher et al., 1995; NPWS & SCA, 2003; Eco Logical Australia, 2003; NSW Scientific Committee, 2001a, 2001b).	Endangered	Endangered	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) within the Study Area.
Western Sydney Dry Rainforest and Moist Woodland on Shale	The canopy of the Moist Shale Woodland generally has trees of *Eucalyptus tereticornis* and *Eucalyptus moluccana,* with *Eucalyptus crebra* and *Corymbia maculata* occurring occasionally. There is often a small tree stratum including species such as *Acacia implexa* or *Acacia parramattensis* subsp. *parramattensis.* A sparse shrub stratum is usually present, and commonly *includes Breynia oblongifolia, Clerodendrum tomentosum, Bursaria spinosa* and *Olearia viscidula.* Ground layer species include *Desmodium varian, Cyperus gracilis, Galium propinquum, Cayratia clematidea, Glycine clandestina, Brunoniella australis, Desmodium brachypodum, Dichondra repens, Microlaena stipoides* var. *stipoides, Sigesbeckia orientalis* subsp. *orientalis* and *Solanum prinophyllum.* Moist Shale Woodland usually occurs on soils derived from Wianamatta Shale on higher country in the southern half of the Cumberland Plain. Moist Shale Woodland is found in very similar environments to Western Sydney Dry Rainforest, but tends to occupy upper slopes while Western Sydney Dry Rainforest is often found on lower slopes and in gullies.	Endangered	Critically Endangered	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) within the Study Area.
White Box Yellow Box Blakely's Red Gum Woodland	Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW. White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box *Eucalyptus albens*, Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi*. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species.	Endangered	Critically Endangered	None – out of distribution range for this community.

Appendix 3. Vegetation and threatened flora survey effort

Site	Activity	Date	Total hours threatened flora survey	Staff
Surface infrastructure (2019)	Five BioBanking quadrats, threatened flora survey.	10/09/19 – 13/09/19, 24/09/19	32 hours	Cairo Forrest, Sarah Hart
Surface infrastructure (2018)	Seven BioBanking quadrats, threatened flora survey.	12/09/18 – 15/09/18, 18/09/18	32 hours	Cairo Forrest, Alex Christie
Surface infrastructure (2017)	Four quadrats, threatened flora survey, *Grevillea parviflora* subsp. *parviflora* population count	13/09/17, 14/09/17, 15/09/17, 16/09/17, 17/09/17	24 hours	Luke Baker, Matthew Stanton, Cairo Forrest
REA Survey (2013)	43 quadrats, Threatened flora targeted survey, population counts for *Grevillea parviflora* subsp. *parviflora*, *Persoonia bargoensis* and *Pomaderris brunnea*.	15/9/12, 16/9/12, 20/9/12, 22/9/12, 16/10/12, 17/10/12, 18/10/12, 22/10/12, 23/10/12, 15/11/12, 18/6/13	100 hours	Luke Baker, Nathan Smith, Anna Senior
Ventilation shaft TSC1 (2013) – site no longer part of Project.	One quadrat, random meander, rapid data points	6/09/13	10 hours	Luke Baker, Anna Senior
Ventilation shaft TSC2 (2013) site no longer part of Project.	Seven quadrats, random meander	18/6/13	10 hours	Luke Baker, Anna Senior
Ventilation shaft TSC3 (2013) site no longer part of Project.	Seven quadrats, random meander	19/6/13	10 hours	Luke Baker, Anna Senior
Powerline (2013) site no longer part of Project.	Two quadrats, random meander, threatened species counts	21/6/13	10 hours	Luke Baker, Anna Senior, Frank Lemckert
Haul Road (2013) site no longer part of Project.	Random meander, threatened flora counts	20/6/13	6 hours	Anna Senior, Chris McEvoy

Site	Activity	Date	Total hours threatened flora survey	Staff
Riparian vegetation monitoring (2012-2013) (Niche 2013)	30 quadrats and threatened flora random meanders	18/6/12, 19/6/12, 20/6/12, 21/6/12, 22/6/12, 5/12/12, 6/12/12, 7/12/12, 10/12/12, 11/12/12, 12/12/12, 13/12/12.	80 hours	Luke Baker, Anna Senior, Simon Tweed, Daniella Binder
Riparian vegetation monitoring (2013-2014) (Niche 2014)	30 quadrats and threatened flora random meanders	3/6/13, 4/6/13, 5/6/13, 6/6/13, 10/6/13, 11/6/13, 12/6/13, 13,6/13, 14/6/13, 15/6/13	80 hours	Luke Baker, Anna Senior.
Tahmoor South Pilot study (Niche 2012)	Habitat assessment. Rapid data points and random meander	5/12/11, 6/12/11, 7/12/12, 8/12/11, 11/4/12, 16/4/12	6 hours	Luke Baker, Frank Lemckert, Kristy McQueen

Appendix 4. Fauna survey effort

Table 32. Former surface infrastructure footprint survey effort

Area (Surface infrastructure)	Method	Survey effort (hours/trap nights)	Total hours	Dates	Staff
Ventilation shaft sites	Camera traps	10 traps over 10 nights	2,400 hours	12/09/18 to 22/09/2018	Cairo Forrest and Alex Christie
Ventilation shaft sites	Call play-back	3 hours over three nights	3 hours	12/09/18, 13/09/18,	Cairo Forrest and Alex Christie
Ventilation shaft sites	Spotlighting	12 hours over 2 nights	12 hours	12/09/18, 13/09/18,	Cairo Forrest and Alex Christie
Ventilation shaft sites	Bird surveys (morning)	Three mornings	2.5 hours	13/09/18, 17/09/18, 18/09/18	Cairo Forrest and Alex Christie
Ventilation shaft sites	Koala SAT searches	6 hours total	6 hours	18/09/18	Cairo Forrest and Alex Christie
Ventilation shaft sites	Cumberland Plain Land Snail Searches	24 hours total	24 hours	13/09/18, 17/09/18, 18/09/18	Cairo Forrest and Alex Christie
Ventilation shaft sites	Songmeter	3 nights one location	68 hours	14/09/18, 15/09/18, 16/09/18	Cairo Forrest and Alex Christie
Hornes Creek	Songmeter	3 nights one location	72 hours	14/09/18, 15/09/18, 16/09/18	Cairo Forrest and Alex Christie
REA	Camera traps	29 traps over 10 nights	6,980 hours	13/09/17	Matthew Stanton, Cairo Forrest
REA	Call play-back	3 hours over three nights	3 hours	13/09/17, 14/09/17, 15/09/17, 16/09/17, 17/09/17	Matthew Stanton, Cairo Forrest
REA	Spotlighting	24 hours over three nights	24 hours	13/09/17, 14/09/17, 16/09/17,	Matthew Stanton, Cairo Forrest

Area (Surface infrastructure)	Method	Survey effort (hours/trap nights)	Total hours	Dates	Staff
REA	Koala scat searches	6 hours	6 hours	17/09/17	Luke Baker, Cairo Forrest
REA	Frog searches (Dogtrap Creek, Tea Tree Hollow Creek, Eliza Creek)	3 days and 2 nights	24 hours	13/09/17, 14/09/17	Matthew Stanton, Cairo Forrest, Frank Lemckert
REA	Camera traps	7 nights (3 traps)	252 hours	20th -27th March, 2013	Matthew Stanton, Frank Lemckert
REA	Koala scat searches	10 hours (2 day)	10 hours	26th-27th March, 2013	Matthew Stanton, Anna Senior
REA	Spotlighting/stag watch	4 hours	4 hours	20th -27th March, 2013	Matthew Stanton, Frank Lemckert, Anna Senior
REA	Call playback	8 hours	8 hours	20th -27th March, 2013	Matthew Stanton, Frank Lemckert, Anna Senior
REA	Frog searches	6 hours	6 hours	20th -27th March, 2013	Matthew Stanton, Frank Lemckert, Anna Senior
REA	Songmeters	5 days (one location)	60 hours	20th -27th March, 2013	Matthew Stanton, Frank Lemckert
REA	Harp traps	2 nights in two locations	48 hours	20th -27th March, 2013	Matthew Stanton, Frank Lemckert
REA	Songmeters	9 nights (in three locations)	324 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Camera traps	9 nights (3 locations)	1620 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Call playback	16 hours	16 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Spotlighting/stag watch	12 hours	12 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Frog searches	6 hours	6 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Arboreal cage traps	150 trap nights	1800 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Harp traps	3 nights in 2 locations	72 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Hair tubes	9 nights	6480 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Reptile spotlighting	4 hours	4 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Reptile habitat search	4 hours	4 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert

Area (Surface infrastructure)	Method	Survey effort (hours/trap nights)	Total hours	Dates	Staff
REA	Diurnal Bird searches	20 minutes each site (6) with two people + opportunistic	5 hours	5th - 14th Nov, 2013	Simon Tweed, Anna Senior, Frank Lemckert
REA	Habitat search	2 hours	2 hours	16th Oct, 2012	Simon Tweed, Anna Senior
REA	Koala scat searches	2 hours	2 hours	16th Oct, 2012	Simon Tweed, Anna Senior
Ventilation shaft TSC1	Habitat assessment	4 hours	4 hours	6/09/13	Luke Baker, Anna Senior
Ventilation shaft TSC2	Habitat assessment	8 hours	8 hours	18/6/13	Luke Baker, Anna Senior
Original ventilation shaft TSC3	Habitat assessment	8 hours	8 hours	19/6/13	Luke Baker, Anna Senior

Table 33. Amphibian monitoring survey effort 2012 season

Site	Activity	Autumn 2012				Spring 2012			
		Date	Staff	Time	Effort (mins/per person)	Date	Staff	Time	Effort (mins/per person)
Dogtrap Creek 1	Transect	3/7	LB, ST	17.00	45	4/12	LB, FL	20.00	25
Dogtrap Creek 1	Day tadpole search	20/6	LB, ST	9.00	15	-	LB, FL	-	-
Dogtrap Creek 1	Songmeter	-	LB, ST	-	-	4/12	LB, FL	-	4nights
Dogtrap Creek 2	Transect	3/7	LB, ST	18.05	40	4/12	LB, FL	20.45	30
Dogtrap Creek 3	Transect	3/7	LB, ST	19.00	45	4/12	LB, FL	21.30	30
Cow Creek 1	Transect	28/6	LB, ST	16.20	40	26/11	LB, FL	19.30	50
Cow Creek 1	Day tadpole search	28/6	LB, ST	16.00	20	-	LB, FL	-	-
Cow Creek 1	Songmeter	-	LB, ST	-	-	26/11	LB, FL	-	8nights
Cow Creek 2	Transect	28/6	LB, ST	17.10	55	26/11	LB, FL	20.20	40
Cow Creek 3	Transect	28/6	LB, ST	18.20	45	26/11	LB, FL	21.15	35
Carter Creek 1	Transect	3/7	LB, ST	16.30	20	11/12	LB, FL	11.15	20
Carter Creek 1	Tadpole search	13/6	LB, ST	10.3	10	-	LB, FL	-	-
Carter Creek 2	Transect	3/7	LB, ST	17.00	25	11/12	LB, FL	12.10	20
Carter Creek 3	Transect	3/7	LB, ST	17.3	20	11/12	LB, FL	12.50	22
Tea Tree Hollow 1	Transect	4/7	LB, ST	16.00	45	4/12	LB, FL	22.15	30
Tea Tree Hollow 1	Day tadpole search	21/6	LB, ST	15.30	25	5/12	LB, FL	9.30	10
Tea Tree Hollow 1	Songmeter	21/6	LB, ST	-	3nights	-	LB, FL	-	-
Tea Tree Hollow 2	Transect	4/7	LB, ST	17.10	50	4/12	LB, FL	22.45	30
Tea Tree Hollow 3	Transect	4/7	LB, ST	18.05	40	4/12	LB, FL	23.20	30
Washhouse Gully 1	Transect	28/6	LB, ST	19.45	30	26/11	LB, FL	22.00	35
Washhouse Gully 2	Transect	28/6	LB, ST	20.25	40	26/11	LB, FL	22.45	35

Site	Activity	Autumn 2012				Spring 2012			
		Date	Staff	Time	Effort (mins/per person)	Date	Staff	Time	Effort (mins/per person)
Washhouse Gully 3	Transect	28/6	LB, ST	21.00	40	26/11	LB, FL	23.25	35
Hornes Creek D 1	Transect	5/7	LB, ST	17.00	55	28/11	LB, FL	20.00	40
Hornes Creek D 1	Songmeter	5/7	LB, ST	-	3nights	-	LB, FL	-	-
Hornes Creek D 2	Transect	5/7	LB, ST	18.00	30	28/11	LB, FL	21.00	25
Hornes Creek D 3	Transect	5/7	LB, ST	19.00	45	28/11	LB, FL	21.35	30
Hornes Creek U 1	Transect	5/7	LB, ST	10.30	45	28/11	LB, FL	22.25	30
Hornes Creek U 2	Transect	5/7	LB, ST	9.30	40	28/11	LB, FL	23.00	20
Hornes Creek U 3	Transect	5/7	LB, ST	20.30	30	28/11	LB, FL	23.30	20
Moore Creek 1	Transect	29/6	LB, ST	16.15	50	27/11	LB, FL	-	-
Moore Creek 1	Songmeter	-	LB, ST	-	-	27/11	LB, FL	-	4nights
Moore Creek 1	Day tadpole search	29/6	LB, ST	15.30	20	27/11	LB, FL	8.30	10
Moore Creek 2	Transect	29/6	LB, ST	17.30	40	-	LB, FL	-	-
Moore Creek 2	Day tadpole search	-	LB, ST	-	-	27/11	LB, FL	9.10	13
Moore Creek 2	Songmeter	-	LB, ST	-	-	-	LB, FL	-	4nights
Moore Creek 3	Transect	29/6	LB, ST	18.55	40	-	LB, FL	-	-
Moore Creek 3	Songmeter	-	LB, ST	-	-	27/11	LB, FL	-	4nights
Moore Creek 3	Day tadpole search	-	LB, ST	-	-	13/12	LB, FL	-	14
Unnamed Bargo Tributary 1	Transect	29/6	LB, ST	20.00	45	-	LB, FL	-	-
Unnamed Bargo Tributary 1	Day tadpole search	5/7	LB, ST	13.00	10	13/12	LB, FL	12.00	15
Unnamed Bargo Tributary 2	Transect	29/6	LB, ST	20.55	40	-	LB, FL	-	-
Unnamed Bargo Tributary 2	Day tadpole search	5/7	LB, ST	14.00	15	13/12	LB, FL	13.00	15
Unnamed Bargo Tributary 3	Transect	29/6	LB, ST	-	-	-	LB, FL	-	-

Site	Activity	Autumn 2012				Spring 2012			
		Date	Staff	Time	Effort (mins/per person)	Date	Staff	Time	Effort (mins/per person)
Unnamed Bargo Tributary 2	Day tadpole search	5/7	LB, ST	15.20	20	13/12	LB, FL	13.40	15
Eliza Creek 1	Transect	3/7	LB, ST	20.30	45	27/11	LB, FL	22.00	30
Eliza Creek 1	Day tadpole search	19/6	LB, ST	11.30	20	-	LB, FL	-	-
Eliza Creek 2	Transect	3/7	LB, ST	21.30	40	27/11	LB, FL	22.45	30
Eliza Creek 3	Transect	3/7	LB, ST	22.20	45	27/11	LB, FL	23.20	30
Dry Creek 1	Transect	4/7	LB, ST	19.30	45	27/11	LB, FL	19.30	30
Dry Creek 2	Transect	4/7	LB, ST	20.15	45	27/11	LB, FL	20.00	45
Dry Creek 3	Transect	4/7	LB, ST	21.10	45	27/11	LB, FL	20.55	35
Woodhouse Creek 1	Transect	6-Jul	LB, ST	10.30	20	7/12	LB, AS	9.30	22
Woodhouse Creek 2	Transect	6-Jul	LB, ST	11.30	22	7/12	LB, AS	10.15	19
Woodhouse Creek 3	Transect	6-Jul	LB, ST	12.40	18	7/12	LB, AS	11	25
Bargo River 1	Transect	21-June	LB, ST	15.00	20	7/12	LB, AS	14.25	12
Bargo River 2	Transect	21-June	LB, ST	15.30	25	7/12	LB, AS	14.55	15
Bargo River 3	Transect	21-June	LB, ST	16.10	18	7/12	LB, AS	15.20	13

Table 34. Amphibian monitoring 2013 season

Site	Activity	Autumn 2013			Spring 2013		
		Date	Time	Effort (mins/per person)	Date	Time	Effort (mins/per person)
Dogtrap Creek 1	Transect	30-Apr	18:30	60	11-Sep	17:25	30
Dogtrap Creek 2	Transect	30-Apr	19:49	46	11-Sep	18:00	40
Dogtrap Creek 3	Transect	30-Apr	20:57	31	11-Sep	18:45	30
Cow Creek 1	Transect	2-May	18:03	52	12-Sep	17:25	18
Cow Creek 2	Transect	2-May	19:12	40	12-Sep	18:00	20
Cow Creek 3	Transect	2-May	20:49	35	12-Sep	18:45	32
Carter Creek 1	Transect	30-May	18:30	45	29-Oct	19:50	18
Carter Creek 2	Transect	30-May	19:12	36	29-Oct	20:30	16
Carter Creek 3	Transect	30-May	20:05	32	29-Oct	20:55	20
Tea Tree Hollow 1	Transect	30-Apr	22:26	63	11-Sep	19:40	15
Tea Tree Hollow 2	Transect	30-Apr	23:32	30	11-Sep	20:00	25
Tea Tree Hollow 3	Transect	30-Apr	0:10	49	11-Sep	20:30	26
Washhouse Gully 1	Transect	2-May	22:24	24	12-Sep	19:40	15
Washhouse Gully 2	Transect	2-May	22:54	28	12-Sep	20:00	18
Washhouse Gully 3	Transect	2-May	23:29	46	12-Sep	20:30	16
Hornes Creek D 1	Transect	1-May	17:32	32	30-Oct	19:45	32
Hornes Creek D 2	Transect	1-May	18:15	45min	30-Oct	20:55	25
Hornes Creek D 3	Transect	1-May	19:52	80	30-Oct	21:35	18
Hornes Creek U 1	Transect	1-May	22:19	51	30-Oct	22:30	18
Hornes Creek U 2	Transect	1-May	23:10	26	30-Oct	23:05	18
Hornes Creek U 3	Transect	1-May	0:34	62	30-Oct	23:35	18
Moore Creek 1	Transect	23-May	18:30	26	31-Oct	19:50	25

Moore Creek 2	Transect	23-May	19:08	48	31-Oct	20:40	20
Moore Creek 3	Transect	23-May	20:36	37	31-Oct	21:18	18
Unnamed Bargo Tributary 1	Transect	23-May	22:10	26	31-Oct	22:10	16
Unnamed Bargo Tributary 2	Transect	23-May	22:58	19	31-Oct	22:38	17
Unnamed Bargo Tributary 3	Transect	23-May	23:35	25	31-Oct	23:00	15
Eliza Creek 1	Transect	8-May	18:30	23	28-Oct	19:00	25
Eliza Creek 2	Transect	8-May	19:05	31	28-Oct	19:30	27
Eliza Creek 3	Transect	8-May	19:55	23	28-Oct	20:15	21
Dry Creek 1	Transect	8-May	21:00	23	28-Oct	21:15	22
Dry Creek 2	Transect	8-May	21:42	20	28-Oct	21:55	18
Dry Creek 3	Transect	8-May	22:16	40	28-Oct	22:17	16

Table 35. Weather condition during current field survey

Date	Min temp	Max temp	Rainfall	Max wind speed km/h	Direction
13-Sep-17	4.2	33.3	0mm	74	WNW
14-Sep-17	9.9	17.4	0mm	76	W
15-Sep-17	10.7	20.9	0mm	61	SW
16-Sep-17	8	22.8	0mm	69	WNW
17-Sep-17	0.4	20	0mm	31	ENE
18-Sep-17	0.2	27.2	0mm	31	NNW
19-Sep-17	3.8	22.2	0mm	52	WSW
20-Sep-17	2.4	21.2	0mm	28	NNW
21-Sep-17	3.2	26.9	0mm	22	NE
22-Sep-17	3.8	30	0mm	20	NNE

Table 36. Weather conditions during 2012/2013 field survey

Date	Min temp	Max temp	Rainfall	Max wind speed km/h	Direction
16-Oct-12	9	32	24.5mm in preceding 4 days	39	NW
5-Nov-12	11.7	33.6	1.2mm in preceding 2 days	54	N
6-Nov-12	17.1	33.6	0mm	35	ENE
7-Nov-12	18.4	25.3	0.8mm	20	ENE
8-Nov-12	16.1	29.8	1.8mm	35	ENE
9-Nov-12	16.2	30.7	0.6mm	41	WSW
10-Nov-12	13.2	19.9	0mm	35	S
11-Nov-12	9.3	23.3	0mm	37	ESE
12-Nov-12	6.3	29.1	0mm	37	NNE
13-Nov-12	10.5	24.3	0mm	35	SSE
14-Nov-12	13.4	21.1	1.0mm	30	NE
20-Mar-13	10.3	26.3	0mm	31	NE
21-Mar-13	11.7	28.7	0mm	37	NNE
22-Mar-13	14.8	31.7	0mm	35	NNW
23-Mar-13	19.6	30.2	0mm	33	ENE
24-Mar-13	17.2	31.2	0mm	22	N
25-Mar-13	10.9	29.5	0mm	24	SE
26-Mar-13	13.8	28.4	0mm	24	NNE
27-Mar-13	17.8	30.1	0mm	28	NE
28-Mar-13	16.5	32	0mm	44	SW

Appendix 5. Flora species list and plot data

Table 37. Flora species list 2012 - 2018

Score: 1 = present but common, 2 = <5% and common, 3 = 6-20%, 4 = 21-50%, 5 = 51-75%, 6 = >75

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Acacia baileyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia brownii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	0
Acacia decurrens	0	0	0	0	0	2	0	0	0	1	0	3	0	0	1	1	0	2	3	0	0	0	0	2	5	2	0	0	0	0	0	0	0	0	0	2	2	0	3	3	3
Acacia falcata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia fimbriata	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia linifolia	2	1	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	4	0	3	0	2	0	0	0	0	0	0	0	0	0
Acacia longifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	0
Acacia obtusifolia	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia terminalis	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	2	0	0	0
Acacia ulicifolia	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	2	0	0	0	0
Acianthus fornicatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0
Allocasuarina littoralis	0	0	1	0	0	2	0	3	0	0	3	3	0	2	0	0	0	0	0	1	3	2	0	0	0	0	2	2	3	0	2	2	0	0	0	2	0	0	5	2	2
Anisopogon avenaceus	4	4	4	3	4	2	0	5	4	3	0	0	4	4	0	0	0	0	0	0	2	3	0	0	0	0	3	2	2	4	4	4	2	2	2	3	0	0	0	0	2
Aristida ramosa	3	0	3	0	0	0	4	2	0	3	0	4	4	3	3	3	2	2	0	0	0	2	2	0	0	0	3	2	0	0	0	0	3	2	0	0	0	0	0	0	2
Aristida vagans	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	2	0	2	2	2
Aristida warburgii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	0
Astroloma humifusum	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Austrodanthonia racemosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Austrodanthonia spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austrodanthonia tenuior	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Austrostipa pubescens	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Axonopus compressus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Banksia serrata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Banksia spinulosa	0	1	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	0	0	0	2	3	3	0	0	0	0	2	2	3	3	3	3	0	2	3	3	0	0	0	0
Bauera rubioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bidens pilosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Billardiera scandens	2	1	2	0	0	1	0	3	2	0	0	0	0	3	2	0	0	0	0	1	2	2	2	2	0	0	2	0	2	0	0	0	2	0	1	0	2	0	2	0	0
Blechnum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Boronia ledifolia	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boronia polygalifolia	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bossiaea obcordata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0
Bossiaea prostrata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Brachyloma daphnoides	0	0	2	0	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachyscome angustifolia	3	2	2	0	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromus catharticus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brunoniella australis	0	1	0	1	0	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Burchardia umbellata	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Callistemon linearifolius	0	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Callistemon linearis	0	0	0	0	0	0	0	0	0	0	0	1	2	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Calochilus paludosus	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calytrix tetragona	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Cassinia aculeata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassytha glabella	1	0	0	0	0	0	0	2	0	0	1	0	0	2	0	0	0	0	0	2	1	0	0	0	0	0	0	1	1	2	2	0	2	0	0	0	0	0	1	1	0
Cassytha pubescens	0	2	2	1	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	2	0	1	0	0	1	0	0	0
Centaurium tenuiflorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centella asiatica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilanthes sieberi	0	0	0	0	2	2	0	0	0	1	0	2	2	2	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2	2
Cirsium vulgare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Clematis aristata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0
Conyza bonariensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conyza sumatrensis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Coronidium scorpioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0
Correa reflexa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Corymbia gummifera	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0	2	0	3	2	0	0	0	0	2	2	2	2	3	0	0	3	2	3	0	0	0	0
Cyanicula caerulea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Cyathochaeta diandra	4	3	5	2	5	0	4	5	3	0	2	0	2	4	2	0	0	1	0	3	3	4	2	2	0	0	3	3	3	3	4	4	0	3	3	0	0	3	0	2	3
Cymbopogon refractus	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Cynodon dactylon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Daviesia acicularis	0	0	2	2	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Daviesia corymbosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Daviesia squarrosa	1	0	0	0	2	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Daviesia ulicifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Desmodium brachypodum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dianella caerulea	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	1	1	0	0	1	2	0	0	0	0	0	0	2	1	0	2	0	0	0	0
Dianella revoluta	1	4	2	3	2	2	1	0	2	2	2	3	3	2	3	0	0	0	0	0	0	1	0	2	2	0	0	1	0	0	0	1	2	1	0	1	0	0	2	1	2
Dichelachne micrantha	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Dichondra repens	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dillwynia retorta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Dillwynia rudis	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dillwynia sieberi	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diuris arenaria	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diuris sulphurea	0	0	1	1	0	0	1	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Drosera peltata	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Echinopogon caespitosus	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	1
Einadia hastata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Entolasia marginata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Entolasia stricta	2	4	3	3	3	3	3	4	3	4	3	4	4	4	4	0	0	0	0	2	4	3	3	3	0	2	4	3	3	0	3	3	3	2	0	2	2	3	3	2	3
Epacris microphylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Eragrostis brownii	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	2	0
Eragrostis leptocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eragrostis leptostachya	0	4	1	2	0	0	0	0	0	0	0	0	3	2	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eriostemon australasius	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	3	2	3	3	0	0	0	3	0	2	3	0	0	3	3	2	2	2	3	0	0	0
Eucalyptus crebra	0	3	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Eucalyptus eugenioides	0	0	0	3	5	3	4	0	0	4	2	3	4	4	4	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus fibrosa	3	0	3	4	2	4	4	0	0	5	0	5	4	1	4	0	0	0	0	0	2	0	0	3	0	1	0	0	0	3	3	3	0	0	0	0	0	0	2	3	3
Eucalyptus globoidea	3	3	3	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	3	3	3	2	2	2	0	0	0	0	0	3
Eucalyptus piperita	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	3	0	3	3	4	0	0	0	0
Eucalyptus punctata	3	2	4	0	3	3	0	2	0	3	2	0	3	3	0	0	2	0	0	1	0	3	0	0	0	2	2	3	2	2	3	2	0	2	0	2	0	0	2	0	0
Eucalyptus racemosa	0	3	0	0	0	0	0	4	4	0	0	0	0	0	0	0	3	0	0	3	3	4	2	0	0	0	5	2	3	0	0	0	3	3	2	3	3	4	0	3	2
Eucalyptus saligna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus seeana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euryomyrtus ramosissima	0	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eustrephus latifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Exocarpos cupressiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Facelis retusa	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gahnia aspera	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium propinquum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Glycine clandestina	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Glycine tabacina	0	0	0	0	0	0	0	0	0	2	0	0	0	1	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Gompholobium glabratum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Gompholobium minus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0
Gonocarpus tetragynus	1	2	2	1	2	0	0	0	0	0	0	0	2	3	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	2	2	2	2	0	0	2	0	0	1
Goodenia bellidifolia	2	0	1	0	3	0	0	0	0	0	0	0	2	2	2	2	0	2	0	2	2	1	0	0	0	0	0	0	2	2	2	2	2	0	0	2	0	2	0	2	2
Goodenia hederacea	0	2	0	1	3	2	2	2	0	3	0	2	2	3	1	0	0	0	0	0	0	2	0	0	0	0	0	1	1	1	1	2	3	2	1	0	0	2	0	0	1

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Goodenia stelligera	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea mucronulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea parviflora	2	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea robusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea sphacelata	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	1	0	0	0	0	0	0	3	0	0	0
Hakea dactyloides	2	1	0	0	2	1	0	3	3	0	0	0	0	3	0	0	0	0	0	1	1	3	2	0	0	0	0	2	2	3	2	2	0	0	0	0	0	0	0	0	0
Hakea sericea	2	0	3	0	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	1	1	0	2	0	0	0	0	2	1	3	0	0	2	2	0	2	0	0	1	1	0
Hardenbergia violacea	2	1	1	1	0	1	1	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	2	0	0	0	2	0	1	0
Hibbertia aspera	0	0	0	0	0	2	3	0	0	3	0	0	3	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0
Hibbertia bracteata	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibbertia cistiflora subsp. cistiflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibbertia diffusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Hibbertia empetrifolia subsp. empetrifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Hibbertia fasciculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Hibbertia obtusifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Hibbertia riparia	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibbertia spp.	2	1	0	0	0	0	0	3	1	0	0	2	1	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	2	1	1	0	0	0	0	0	0
Hovea linearis	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	2	0	0	0	0	0	2	0	0	1	1	0	0	0	0	2	0	0	0	0
Hovea longifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hovea purpurea	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1	0	1	0	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Hybanthus monopetalus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrocotyle pedicellosa	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypericum gramineum	0	0	0	0	0	0	0	0	0	1	0	0	2	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypochaeris radicata	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Imperata cylindrica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	2	0	0	3	0	3	2	0
Isopogon anemonifolius	0	0	2	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	1	2	2	1	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Joycea pallida	0	0	0	4	0	3	4	0	0	3	3	0	2	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Juncus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kunzea ambigua	0	0	2	0	3	0	4	0	0	2	3	3	0	2	0	1	0	0	2	0	3	0	2	0	0	0	0	3	0	0	0	0	0	2	0	3	0	0	4	1	3
Lagenophora stipitata	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	2	0	1	0	0	0	0	0	0	0
Lambertia formosa	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	4	3	1	0	0	0	0	0	0	0	0	0	2	2	0	0	2	3	0	0	0
Lasiopetalum ferrugineum	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	2	2	0	0	0	0	0	0	1	2	1	0	0	0	0	1	0	0	0	0	0
Laxmannia gracilis	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidosperma forsythii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Lepidosperma laterale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidosperma spp.	2	0	3	3	3	3	5	4	0	4	3	4	5	4	4	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	4	4	0	0	2	0	0	2	1	2	3
Leptomeria acida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Leptospermum continentale	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum parvifolium	0	3	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Leptospermum polyanthum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Leptospermum polygalifolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	2	3	2	3	2	0	2	0	0	0	2	0	0	0
Leptospermum trinervium	0	3	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	3	0	0	0	0	0	0	0	1	0
Lepyrodia scariosa	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Leucopogon appressus	1	2	2	2	0	1	0	0	0	0	2	2	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Leucopogon ericoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Leucopogon lanceolatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	1	0
Ligustrum sinense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Lindsaea linearis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	1	1	1	2	0	0	0
Lissanthe strigosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	2	0	0	2	2	0	0	2	2	1
Lomandra cylindrica	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	2	0	0	2	0	0	0	0	2	1	2	2	2	0	0	0	0	0	0	0	0	2
Lomandra filiformis	2	0	2	3	0	1	1	3	0	2	3	1	3	3	3	0	0	0	0	0	2	0	0	0	0	0	3	1	0	0	0	0	3	0	0	2	3	2	0	2	2
Lomandra fluviatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Lomandra gracilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Lomandra longifolia	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	2	0	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Lomandra multiflora subsp. multiflora	2	1	2	2	2	2	3	3	0	4	2	0	0	0	0	0	0	2	0	0	2	2	0	2	0	0	2	1	0	2	2	0	2	0	0	2	2	0	2	2	1
Lomandra obliqua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Lomandra spp.	3	4	2	0	3	0	2	3	2	0	0	0	4	3	3	0	0	0	0	2	2	3	2	0	0	0	1	3	2	3	2	2	3	2	2	2	0	3	2	0	0
Lomatia silaifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	3	2	0	0	3	2	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Lycium ferocissimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca linariifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca thymifolia	0	0	0	2	0	0	0	0	0	0	0	0	1	2	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Melichrus procumbens	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melichrus urceolatus	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Microlaena stipoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Micromyrtus minutiflora	0	0	0	0	0	2	0	0	0	3	0	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	2	1	1	2	2
Mirbelia rubiifolia	4	3	3	1	3	0	0	3	1	0	0	0	3	2	0	0	0	2	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	2	0	1	0
Monotoca scoparia	2	0	0	0	0	0	0	3	1	0	1	0	0	1	0	0	0	0	0	1	0	2	2	0	0	0	2	1	1	2	2	2	0	1	1	2	2	0	0	0	0
Olearia microphylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olearia viscidula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opercularia diphylla	2	0	2	1	0	0	1	2	0	2	0	2	3	2	2	1	0	0	0	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Opercularia hispida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Oplismenus aemulus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Oplismenus imbecillis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Ozothamnus diosmifolius	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Panicum simile	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paspalum dilatatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	2	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patersonia glabrata	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	0	0	0	0	0	0	0	0	0	0
Patersonia sericea	2	0	2	0	3	0	0	3	0	2	0	0	3	2	0	0	0	0	0	1	2	1	0	0	0	0	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
Pennisetum clandestinum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Persoonia bargoensis	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Persoonia levis	0	2	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	0	0	2	2	2	3	2	3	2	2	0	0	2	0	0	0
Persoonia linearis	2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	3	0	1	0	0	0	2	3	0	0	1	2	3	0	2	0	2	3	0	1	0
Persoonia pinifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Petrophile pulchella	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrophile sessilis	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	2	0	0	0	0	1	0	0	0	0	0	0
Phyllanthus hirtellus	2	2	2	0	2	0	3	3	2	3	1	2	0	2	2	2	0	0	0	2	2	2	1	0	0	0	0	2	0	2	2	2	2	2	0	1	2	2	2	0	0
Pimelea linifolia	2	0	2	0	2	0	2	3	2	1	1	0	0	2	0	0	0	0	0	1	2	0	0	0	0	0	0	2	2	2	3	0	0	0	0	0	0	2	0	2	2
Pittosporum undulatum	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantago lanceolata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platysace linearifolia	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	3	2	3	2	0	0	0	2	0	2	0	0	0	2	2	0	0	0	3	0	0	0
Poa sieberiana	2	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2	2	0	0	0	0	0	0
Podolobium scandens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pomaderris andromedifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Pomaderris brunnea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Pomaderris elliptica subsp. elliptica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pomaderris ferruginea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0
Pomax umbellata	2	2	2	1	2	3	2	2	1	2	1	2	2	2	1	2	0	0	0	1	2	0	2	0	0	0	2	0	2	2	2	0	2	2	2	2	0	2	2	1	1
Poranthera ericifolia	0	2	3	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Pratia purpurascens	0	0	0	1	0	2	0	1	0	2	1	2	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	1

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Pseuderanthemum variabile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0	0	1	0	1	0	0	0	0	0
Pteridium esculentum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Pterostylis concinna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	3	3	0	0	0
Pterostylis spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Ptilothrix deusta	0	0	0	0	1	2	0	0	3	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Pultenaea hispidula	0	0	0	1	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pultenaea mollis	0	0	1	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pultenaea tuberculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Pultenaea villosa	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Rhytidosporum procumbens	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	1	0	0	0	0	0	0
Rumex crispus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sannantha pluriflora	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schoenus apogon	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Schoenus brevifolius	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senecio madagascariensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Setaria parviflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida rhombifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum nigrum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum prinophyllum	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Solanum pungetium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

Botanical name	Quadrat name																																							
	003	012	017	033	034	054	056	065	088	124	134	135	136	137	138	153	157	161	163	164	174	175	176	281	384	582	591	244	245	246	247	253	255	256	257	258	259	260	263	264	280
Sphaerolobium vimineum	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Sporobolus creber	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stackhousia viminea	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stypandra glauca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thelymitra spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	1
Themeda australis	0	0	3	3	2	3	0	0	0	2	0	0	3	2	2	3	2	3	4	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	1	0	0	0	1	3	2
Trifolium repens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Verbena bonariensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viola hederacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Wahlenbergia communis	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wahlenbergia gracilis	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Xanthorrhoea minor subsp. minor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Xanthosia pilosa	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Xerochrysum bracteatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xylomelum pyriforme	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 38. Flora list (September 2019) within Study Area

Plots numbers	0	1	2	3	4	5	6	7	8	9	10	11
Acacia baileyana								0.5				
Acacia decurrens	5						3					
Acacia falcata		0.5						0.5			15	
Acacia floribunda			0.4	2								
Acacia longifolia		10						5				
Acacia mearnsii					5	3						5
Acacia myrtifolia		0.1										
Acacia obtusifolia											1	
Acacia parramattensis		25						3	0.2		0.1	
Acacia terminalis		0.5										
Acacia ulicifolia								0.1				
Acacia undulifolia			0.1									
Allocasuarina littoralis		0.1	0.1				2	0.2			10	
Anisopogon avenaceus	2	0.1					2	0.1				
Aristida ramosa	10				20	2	2	0.1		40	0.5	20
Aristida vagans							2		0.5			
Astroloma humifusum	0.1			0.1			1	0.2	0.5	0.3	0.1	
Austrodanthonia sp									0.5			
Banksia serrata											0.1	
Banksia spinulosa											0.1	
Billardiera scandens	0.1		0.1	0.1								
Bothriochloa macra								0.5				
Brassica sp		0.3						0.1				
Brunoniella australis	0.1		0.1	0.1								
Callistemon linearifolius							2					
Callistemon linearis						0.2			0.4			
Carex inversa	0.1							0.1				
Cassinia aculeata		0.1						0.1				

Plots numbers	0	1	2	3	4	5	6	7	8	9	10	11
Cassytha glabella	0.1			0.1								
Cheilanthes sieberi	0.1				0.1		2	0.1		0.1		0.1
Chloris gayana	0.2					0.1						
Cirsium vulgare	0.1							0.1				
Climber				0.1								
Conospermum spp.				0.1								
Conyza sp		0.2						0.1				
Cyathochaeta diandra	1		0.5	1			3					
Cymbopogon refractus								0.1	0.1			
Cynodon dactylon		0.5										
Daviesia genistifolia		0.2						0.2				
Daviesia squarrosa		0.1						0.2				
Daviesia ulicifolia	0.1		0.1	0.1	0.1							0.1
Dianella caerulea									0.1		0.1	
Dianella revoluta	0.1		0.2	0.1			2	0.1	0.5			
Dichelachne micrantha								0.1				
Dichondra repens								0.2	0.1			0.2
Digitaria parviflora									0.2			
Dodonaea viscosa		5						1			0.1	
Echinopogon caespitosus							1		0.2	0.1		3
Elymus scaber					30	0.5						5
Entolasia stricta	10	0.1	5	10	3	0.4	3		25		0.1	1
Eragrostis brownii					5	0.5		0.2			0.1	5
Eragrostis curvula								0.5			0.1	20
Eucalyptus crebra	5	0.5	20	5	3	10		1				
Eucalyptus fibrosa	10	1		10			3		1	30	0.5	
Eucalyptus globoidea	8	1	2	8			3	2	1			
Eucalyptus punctata	2			2					5		2	
Eucalyptus racemosa							2					
Glycine clandestina					0.1		1					0.1

Plots numbers	0	1	2	3	4	5	6	7	8	9	10	11
Glycine tabacina								0.1	0.1	0.1		
Gompholobium minus			0.1									
Gonocarpus tetragynus					0.1	0.1	1		0.1			0.1
Goodenia bellidifolia							2					
Goodenia hederacea			0.1		0.1	0.1	1					0.1
Grevillea mucronulata								0.5	40	1		
Hakea dactyloides								0.2				
Hardenbergia violacea		5						0.5				
Herb					0.1	0.1						0.2
Herb2					0.1							0.4
Hibbertia aspera subsp. aspera	0.2		0.2	0.2								
Hypericum perforatum					0.1							0.1
Hypochaeris radicata						0.1						
Imperata cylindrica									5	0.1	0.1	
Kunzea ambigua						0.2	3	0.4	40	35	1	
Lagenophora stipitata									0.1			
Laxmannia gracilis	0.1			0.1								
Lepidosperma laterale	5		15	5				0.2				
Lepidosperma spp.							3					
Leucopogon ericoides							1					
Lissanthe strigosa	0.4		0.5	0.4			1					0.2
Lomandra cylindrica							2					
Lomandra filiformis			0.1		0.1	0.1	2			1	0.1	0.1
Lomandra gracilis							2					
Lomandra multiflora subsp. multiflora	0.1		0.1	0.1	0.1	0.1	1		0.2			0.1
Melaleuca decora					0.1				40			
Melaleuca thymifolia	0.1		0.3	0.1		0.3	2					1
Microlaena stipoides					0.1	3			0.5	10		0.1
Micromyrtus minutiflora							2					
Mirbelia rubiifolia	0.1	0.1	0.1	0.1				0.1		0.1		

Plots numbers	0	1	2	3	4	5	6	7	8	9	10	11
Modiola caroliniana								0.1				
Opercularia diphylla									0.1			
Opercularia hispida							1					
Oplismenus aemulus							1					
Orchid						0.1						
Panicum maximum		0.1										
Paspalum dilatatum					25	0.2						20
Patersonia sericea	3		2	3				0.1	0.3			
Persoonia hirsuta										0.1	0.1	
Persoonia levis											0.1	
Persoonia linearis		0.1										
Phyllanthus hirtellus								0.1				
Pimelea linifolia							2					
Plantago lanceolata					0.3			0.1				0.1
Platylobium formosum		0.1										
Pomax umbellata	0.1			0.1		0.1	1	0.2				
Pratia purpurascens							1			0.1		
Pratia spp.											0.1	
Prostanthera spp.	0.1			0.1		0.1						
Ptilothrix deusta							1					
Pultenaea microphylla	0.1			0.1								
Pultenaea spinosa	0.5			0.5								
Pultenaea villosa		0.3					2	0.1				
Rhytidosporum spp.											0.1	
Rytidosperma pumilum	20		10	20								
Rytidosperma spp.	5		0.5	5	0.1	2		0.2				15
Senecio madagascariensis						0.1						
Senecio sp quad?		0.1										
Sida rhombifolia								0.1				
Solenogyne dominii					0.1							0.1

Plots numbers	0	1	2	3	4	5	6	7	8	9	10	11
Soliva sessilis					0.1							
Sporobolus creber								0.1				
Thelymitra spp.							1					
Themeda australis							2					
Themeda triandra			0.1		0.5	0.2		0.2	0.1			0.5
Verbena bonariensis								0.1				
Veronica plebeia					0.1							0.1
Vittadinia cuneata								0.2				
Wahlenbergia gracilis							2					
Wahlenbergia spp.								0.1				0.1

Table 39. Transect attribute data (outside of Study Area – not used in BBCC)

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
SSTF Good													
1311 LB017	38	32.5	2.5	88	12	78	0	1	1	6	278852	6206854	56
1311 LB054	40	23	0	82	6	66	0	0	1	3	278398	6206313	56
1311 LB056	27	21	18	80	14	58	0	2	1	11	278052	6206126	56
1311 LB124	41	27	1.5	80	2	60	0	2	1	29	277889	6206184	56
CF_ 01	20	12.5	1.5	100	22	68	0	0	1	10	278047	6206264	56
3680 CF02	21	17.4	0	45	0	43	0	0	1	17	278402	6205829	56
3690 cf03	28	15	0	38	0	37	0	0	1	18	278270	6205788	56
SSTF Med													
1311MR263	32	8	6.5	56	26	0	0	0	1	102	277705	6206713	56
1311MR264	36	12	6.5	66	4	8	0	0	1	78	277660	6206719	56
1311MR280	42	14	2	94	10	12	0	0	1	8	278114	6206347	56
CF_02	12	29	2	80	14	14	0	0	1	0	277699	6206641	56
SSTF low													
3680cf01	15	14.3	0	10	0	8	6	0	1	74	277870	6205792	56
3690cf05	12	6.5	11	44	0	0	0	0	1	0	278015	6205857	56
3690cf04	10	0	4	44	0	2	0	0	1	0	278109	6205702	56
UGRSW													
1311MR253	51	12	1	76	0	16	0	2	1	45	278821	6207051	56
1311MR246	45	8	2	76	0	14	0	2	1	43.5	278751	6207484	56
1311MR247	56	11	0	98	16	12	0	1	1	23	278804	6207216	56

Table 40. Transect attribute data (used in BBCC to determine the offset liability)

Plot Name	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
11	24	12.5	1.5	100	22	68	0	0	1	10	278047	6206264	56
2	24	17.4	0	45	0	43	0	0	1	17	278402	6205829	56
3	29	15	0	38	0	37	0	0	1	18	278270	6205788	56
6	39	14	2	94	10	12	0	0	1	8	278114	6206347	56
1	23	14.3	0	10	0	8	6	0	1	74	277870	6205792	56
5	21	6.5	11	44	0	0	0	0	1	0	278015	6205857	56
4	22	0	4	44	0	2	0	0	1	0	278109	6205702	56
8	27	15	22	99	50	52	0	0	1	50	278302	6206260	56
7	42	0	6	24	24	22	8	0	1	48	278499	6206970	56
0	31	0	7	0	50	20	12	0	1	0	278496	6206630	56
10	21	1.5	5	4	4	4	0	0	1	0	278356	6207348	56
9	14	17.7	3.5	62	12	6	0	0	1	35	277879	6206455	56

Appendix 6. Vegetation descriptions

Vegetation community descriptions and PCT alignment

PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin (HN556)

PCT1395 is the dominant vegetation community within the Study Area.

Dominant species of the community include the following:

Trees: *Eucalyptus punctata, E. fibrosa, E. eugenioides, Allocasuarina littoralis,* and *A. torulosa.*

Shrubs: *Acacia decurrens, Bursaria spinosa, Exocarpos cupressiformis, Indigofera australis, Kunzea ambigua, Melaleuca thymifolia, Pultenaea villosa, Olearia microphylla,* and *Ozothamnus diosmifolius.*

Grasses: *Anisopogon avenaceus, Aristida ramosa, Aristida vagans, Entolasia stricta, Eragrostis brownii, Microlaena stipoides* and *Themeda australis*.

Ground Covers: *Billardiera scandens, Cheilanthes sieberi, Einadia hastata, Lomandra filiformis, Lomandra obliqua, Lepidosperma laterale, Phyllanthus hirtellus, Pratia purpurascens,* and *Solanum prinophyllum.*

NSW PCT: This vegetation type is most closely aligned to PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556), as is evident from the dominant species listed above and forest structure.

Condition: Two different condition classes were recorded within the Study Area:

Good – minimal weeds with high resilience

Derived – area of moderate resilience which has been largely cleared of canopy and mid-storey species. Canopy trees and shrubs are relatively isolated. Regenerating eucalypts and shrubs are occasional. Weeds were recorded throughout with a low to moderate occurrence of native species.

Conservation status

EPBC Act status: Critically Endangered Ecological Community.

BC Act status: Critically Endangered Ecological Community.

This vegetation community in all condition classes aligns to the NSW BC Act Shale Sandstone Transition Forest TEC (CEEC) and EPBC Act listed CEEC. How the vegetation community fits the TEC listing as detailed in Scientific Determination (2014) and DoEE (2014) is provided in Table 41.

Table 41. Shale Sandstone Transition Forest TEC alignment

Condition	Description	How it meets the TSC Act Determination	How it meets the EPBC Act Determination
Good	• The presence of diagnostic mature trees including *Eucalyptus punctata, E. eugenioides, E. fibrosa* in an open woodland formation. • Presence of diagnostic groundcover plant species including some important species (excluding grasses). • Presence of regenerating over-storey species.	• Characterised by the presence or prior occurrence of *Eucalyptus eugenioides*, *E. punctata*. • A small tree stratum is present in high resilience and intact area consisting of *Eucalyptus* spp., with *Allocasuarina* littoralis and *Acacia decurrens* present. • A shrub layer dominated by *Bursaria spinosa* is present. • The understorey in intact areas is characterised by native grasses and a high diversity of herbs • Characteristic species are present as identified in the Scientific Determination • Occurs within the known range of the TEC.	• Diagnostic species present. • Predominantly native understorey. • Mature trees and natural regeneration of eucalypts is present. • Meets the moderate condition class threshold. • Patch is greater than 0.5 hectares. • Great than 30 percent of understorey is made up of native species • The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) >1ha in area • The patch has at least one tree with hollows.
Derived	• No canopy structure. • Regenerating eucalypts present in areas. • Areas of regenerating native shrubs characteristic of SSTF. • Relatively low diversity groundcover plant species. • Regenerating over storey species. • Moderate to high occurrence of exotic plant species. • A history of grazing.	• Characterised by the presence or prior occurrence of characteristic overstorey species. • Resilience is observed through regeneration of Bursaria spinosa and diagnostic native grasses including *Aristida ramosa, A. vagans, Themeda australis,* and *Entolasia stricta.* • Shrubs are generally sparse or absent, though they may be locally common. • Characteristic species are present as identified in the Scientific Determination. • Occurs within the known range of the TEC.	• Diagnostic species present. • Meets the moderate condition class threshold. • Patch is greater than 0.5 hectares. • Great than 30 percent of understorey is made up of native species • The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) >1ha in area

Photo 1. PCT 1395 Shale Sandstone Transition Forest (HN556)_good

Photo 2. PCT 1395 Shale Sandstone Transition Forest (HN556)_derived

Mine Rehabilitation – best fit PCT PCT1081 is Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564)

Mine rehabilitation has taken place on the current REA, which has entailed the seeding and planting of native tubestock. A range of native flora have been used for the rehabilitation, consisting of species that make up various PCTs within the Sydney Region.

As per the FBA, the 'best fit' PCT needs to be assigned to rehabilitation and plantings. We have assigned the vegetation to PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564) given the surrounding vegetation, and the presence of *Corymbia gummifera,* and *Eucalyptus puncata* in the tubestock mix.

Dominant species of the community include the following:

Trees: *Corymbia gummifera, Eucalyptus eugenioides, Eucalyptus punctata* and *Eucalyptus racemosa*.

Shrubs: *Acacia ulicifolia, Acacia terminalis, Acacia linifolia, Banksia spinulosa var. spinulosa, Hakea sericea, Persoonia levis, Persoonia linearis, Leptospermum trinervium.*

Grasses: *Anisopogon avenaceus, Aristida ramosa, Cyathochaeta diandra, Entolasia stricta, Microlaena stipoides, Poa sieberiana,* and *Themeda australis*.

Ground Covers: *Billardiera scandens, Cheilanthes sieberi, Goodenia hederacea, Lomandra filiformis, Lomandra obliqua, Lomandra longifolia, Lepidosperma laterale, Phyllanthus hirtellus, Pimelea linifolia subsp. linifolia* and *Xanthosia tridentata.*

NSW PCT: This vegetation type is most closely aligned to NSW PCT: HN564 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin.

Conservation status

EPBC Act status: Not listed.

BC Act status: Not listed.

Photo 3. Mine rehabilitation planting within the Study Area

Appendix 7. Fauna species list

Table 42. Fauna recorded during the surveys

Group	Scientific name	Common name	Date and time of record	No. recorded
Amphibia	*Crinia signifera*	Clicking Froglet	18/09/2017 20:07	2
Amphibia	*Crinia signifera*	Clicking Froglet	21/09/2017 10:51	3
Amphibia	*Litoria lesueurii*	Stoney Creek Frog	21/09/2017 15:23	1
Aves	*Aegotheles cristatus*	Australian Owlet-nightjar	18/09/2017 20:16	3
Aves	*Aegotheles cristatus*	Australian Owlet-nightjar	20/09/2017 19:35	1
Aves	*Artamus cyanopterus*	Dusky Woodswallow	19/09/2017 16:56	2
Aves	*Artamus cyanopterus*	Dusky Woodswallow	20/09/2017 17:28	2
Aves	*Climacteris erythrops*	Red-browed Treecreeper	14/09/2017 13:09	2
Aves	*Daphoenositta chrysoptera*	Varied Sittella	20/09/2017 15:08	2
Aves	*Daphoenositta chrysoptera*	Varied Sittella	20/09/2017 15:38	2
Aves	*Daphoenositta chrysoptera*	Varied Sittella	21/09/2017 13:40	2
Aves	*Lichenostomus melanops*	Yellow-tufted Honeyeater	20/09/2017 15:44	1
Aves	*Ninox novaeseelandiae*	Southern Boobook	20/09/2017 19:32	1
Aves	*Origma solitaria*	Rockwarbler	21/09/2017 15:40	1
Aves	*Petroica boodang*	Scarlet Robin	19/09/2017 15:34	1
Aves	*Podargus strigoides*	Tawny Frogmouth	20/09/2017 20:23	1
Mammalia	*Macropus giganteus*	Eastern Grey Kangaroo	14/09/2017 20:40	2
Mammalia	*Macropus giganteus*	Eastern Grey Kangaroo	15/09/2017 12:37	5
Mammalia	*Myotis macropus*	Large-footed Myotis	21/09/2017 16:04	15
Mammalia	*Petaurus breviceps*	Sugar Glider	14/09/2017 21:18	2
Mammalia	*Petaurus breviceps*	Sugar Glider	18/09/2017 20:53	1
Mammalia	*Petaurus breviceps*	Sugar Glider	18/09/2017 21:50	1
Mammalia	*Petaurus breviceps*	Sugar Glider	18/09/2017 23:19	1
Mammalia	*Petaurus breviceps*	Sugar Glider	18/09/2017 23:32	2
Mammalia	*Petaurus breviceps*	Sugar Glider	20/09/2017 20:10	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	14/09/2017 20:48	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	14/09/2017 20:57	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	18/09/2017 19:56	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	18/09/2017 21:05	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	18/09/2017 21:32	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	18/09/2017 22:11	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	18/09/2017 22:42	2
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	18/09/2017 23:06	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	20/09/2017 19:14	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	20/09/2017 19:15	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	20/09/2017 19:26	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	20/09/2017 19:38	2

Group	Scientific name	Common name	Date and time of record	No. recorded
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	20/09/2017 19:53	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	20/09/2017 20:05	1
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	20/09/2017 20:40	1
Mammalia	*Trichosurus vulpecula*	Common Brushtail Possum	14/09/2017 20:53	1
Mammalia	*Trichosurus vulpecula*	Common Brushtail Possum	20/09/2017 20:25	2
Mollusca	*Meridolum sheai*	Land Snail	14/09/2017 10:25	0
Aves	*Aegotheles cristatus*	Australian Owlet-nightjar	18/09/2017 20:16	3
Aves	*Aegotheles cristatus*	Australian Owlet-nightjar	20/09/2017 19:35	1
Aves	*Artamus cyanopterus*	Dusky Woodswallow	19/09/2017 16:56	2
Aves	*Artamus cyanopterus*	Dusky Woodswallow	20/09/2017 17:28	2
Aves	*Climacteris erythrops*	Red-browed Treecreeper	14/09/2017 13:09	2
Aves	*Lichenostomus melanops*	Yellow-tufted Honeyeater	20/09/2017 15:44	1
Aves	*Ninox novaeseelandiae*	Southern Boobook	20/09/2017 19:32	1
Aves	*Origma solitaria*	Rockwarbler	21/09/2017 15:40	1
Aves	*Petroica boodang*	Scarlet Robin	19/09/2017 15:34	1
Aves	*Podargus strigoides*	Tawny Frogmouth	20/09/2017 20:23	1
Aves	*Coturnix ypsilophora*	Brown Quail	17/09/2018	1
Aves	*Phaps chalcoptera*	Common Bronzewing	17/09/2018	1
Aves	*Sturnus tristis*	Common Myna	17/09/2018	1
Aves	*Platycercus eximius*	Eastern Rosella	17/09/2018	1
Aves	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	17/09/2018	1
Aves	*Lichenostomus fuscus*	Fuscous Honeyeater	17/09/2018	1
Aves	*Anthochaera chrysoptera*	Little Wattlebird	18/09/2018	1
Aves	*Anas superciliosa*	Pacific Black Duck	21/09/2018	1
Aves	*Strepera graculina*	Pied Currawong	17/09/2018	1
Aves	*Lichenostomus melanops*	Yellow-tufted Honeyeater	18/09/2018	1
Aves	*Sericornis frontalis*	White-browed Scrubwren	17/09/2018	1
Aves	*Acanthiza nana*	Yellow Thornbill	17/09/2018	1
Aves	*Aegotheles cristatus*	Australian Owlet-nightjar	17/09/2018	1
Aves	*Dacelo novaeguineae*	Laughing Kookaburra	18/09/2018	1
Mammalia	*Macropus giganteus*	Eastern Grey Kangaroo	17/09/2018	2
Mammalia	*Macropus giganteus*	Eastern Grey Kangaroo	20/09/2018	1
Mammalia	*Trichosurus vulpecula*	Common Brushtail Possum	20/09/2018	1
Mammalia	*Trichosurus vulpecula*	Common Brushtail Possum	17/09/2018	2
Mollusca	*Meridolum corneovirens*	Cumberland Plain Land Snail	21/09/2018	2

Table 43. Survey effort results during 2013 survey

Family	Species	Scientific name	Status	Survey Technique in REA 1								Survey Technique in REA 2							Survey Technique in Area surrounding REA			
				Call playback	Cage trap	Incidental	Amphibian	Spotlighting	Diurnal/bird	Hair tubes	Anabat	Amphibian	Diurnal/ bird	Spotlighting	Hair tubes	Call playback	Incidental	Anabat	Incidental	Amphibian	Hair tubes	Anabat
Amphibia																						
Hylidae	Bleating Tree Frog	*Litoria dentata*					O					H					H					
Hylidae	Lesueur's Frog	*Litoria lesueurii*						O														
Hylidae	Peron's Tree Frog	*Litoria peronii*					H (>50)					H				O				H		
Hylidae	Tyler's Tree Frog	*Litoria tyleri*					H (4)					H								H		
Myobatrachidae	Common Eastern Froglet	*Crinia signifera*				H	H (>100)	H (>20)				H				O				H		
Myobatrachidae	Eastern Banjo Frog	*Limnodynastes dumerilii*										O/H										
Myobatrachidae	Smooth Toadlet	*Uperoleia laevigata*							O			O/H			O					H	O	
Myobatrachidae	Striped Marsh Frog	*Limnodynastes peronii*						O														
Aves																						
Phasianidae	Brown Quail	*Coturnix ypsilophora*															O					
Columbidae	Common Bronzewing	*Phaps chalcoptera*				H			H				H									
Sturnidae	Common Myna	*Sturnus tristis*																	O			
Psittaculidae	Eastern Rosella	*Platycercus eximius*							O													
Cuculidae	Fan-tailed Cuckoo	*Cacomantis flabelliformis*							H													
Apodidae	Fork-tailed Swift	*Apus pacificus*							>10H													
Meliphagidae	Fuscous Honeyeater	*Lichenostomus fuscus*																	O			
Meliphagidae	Little Wattlebird	*Anthochaera chrysoptera*							H													
Accipitridae	Little Eagle	*Hieraaetus morphnoides*	BC Act: V									O										
Anatidae	Pacific Black Duck	*Anas superciliosa*							O													
Artamidae	Pied Currawong	Strepera graculina															H					
Meliphagidae	Yellow-tufted Honeyeater	Lichenostomus melanops				O			O,H													
Acanthizidae	White-browed Scrubwren	*Sericornis frontalis*											O									
Acanthizidae	Yellow Thornbill	*Acanthiza nana*											O									
Aegothelidae	Australian Owlet-nightjar	*Aegotheles cristatus*										H										
Alcedinidae	Laughing Kookaburra	*Dacelo novaeguineae*											O/H									
Alcedinidae	Sacred Kingfisher	*Todiramphus sanctus*				H			H				O									
Artamidae	Australian Magpie	*Cracticus tibicen*											H				H		O			
Artamidae	Grey Butcherbird	*Cracticus torquatus*							H				H						H			
Cacatuidae	Glossy Black-Cockatoo	*Calyptorhynchus lathami*	BC Act: *V*										H									
Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*							O, H								H					
Climacteridae	White-throated Treecreeper	*Cormobates leucophaea*							O				H									
Corvidae	Australian Raven	*Corvus coronoides*															O		O,H			
Cuculidae	Brush Cuckoo	*Cacomantis iediolosus*											H									
Cuculidae	Channel-billed Cuckoo	*Scythrops novaehollandiae*											H									
Cuculidae	Pallid Cuckoo	*Cacomantis pallidus*							H				H				O,H					
Maluridae	Variegated Fairy-wren	*Malurus lamberti*											O									
Meliphagidae	Eastern Spinebill	*Acanthorhynchus tenuirostris*				O, H			H				O									
Meliphagidae	Noisy Friarbird	*Philemon corniculatus*							H				H				O,H					

Family	Species	Scientific name	Status	Survey Technique in REA 1								Survey Technique in REA 2							Survey Technique in Area surrounding REA			
				Call playback	Cage trap	Incidental	Amphibian	Spotlighting	Diurnal/bird	Hair tubes	Anabat	Amphibian	Diurnal/ bird	Spotlighting	Hair tubes	Call playback	Incidental	Anabat	Incidental	Amphibian	Hair tubes	Anabat
Meliphagidae	Red Wattlebird	*Anthochaera carunculata*				O, H			H				O									
Meliphagidae	White-eared Honeyeater	*Lichenostomus leucotis*											O						O			
Meliphagidae	Yellow-faced Honeyeater	*Lichenostomus chrysops*							H				O				H, O					
Monarchidae	Restless Flycatcher	*Myiagra inquieta*																				
Neosittidae	Varied Sittella	*Daphoenositta chrysoptera*	BC Act: V EPBC: V										O									
Pachycephalidae	Grey Shrike-thrush	*Colluricincla harmonica*											H									
Pachycephalidae	Rufous Whistler	*Pachycephala rufiventris*				H			H				O				O,H		H			
Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*							H				IO/H									
Pardalotidae	Striated Pardalote	*Pardalotus striatus*											H									
Petroicidae	Eastern Yellow Robin	*Eopsaltria australis*				O, H			H				O				O,H		O			
Petroica	Scarlet Robin	*Petroica boodang*	BC Act: V			O																
Psittacidae	Crimson Rosella	*Platycercus elegans*				O			O				H				H					
Psophodidae	Eastern Whipbird	*Psophodes olivaceus*				O, H							H						H			
Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*							O				O				O,H		O,H			
Strigidae	Powerful Owl	*Ninox strenua*	BC Act: V	O																		
Tytonidae	Sooty owl	*Tyto tenebricosa*	BC Act: V													O						
Mammalia																						
Vespertilionidae	Gould's wattled bat	*Chalinolobus gouldii*																				
Vespertilionidae	Long-eared bat	*Nyctophilus sp.*									O											O
Vespertilionidae	Southern Myotis	*Myotis macropus*	BC Act: V															H				
Vespertilionidae	Eastern Free-tail Bat	*Mormopterus norfolkensis*	BC Act: V															H				
Vespertilionidae	Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	BC Act: V															H				
Vespertilionidae	Eastern false Pipistrelle	*Falsistrellus tasmaniensis*	BC Act: V															H				
Vespertilionidae	Eastern Cave Bat	*Vespadelus troughtoni*	BC Act: V															H				
Vespertilionidae	Southern forest bat	*Vespadelus regulus*									O											O
Molossidae	White-striped freetail bat	*Tadarida australis*																				
Macropodidae	Eastern Grey Kangaroo	*Macropus giganteus*											O									
Macropodidae	Swamp Wallaby	*Wallabia bicolor*											O									
Muridae	Bush Rat	*Rattus fuscipes*			O																	
Petauridae	Sugar Glider	*Petaurus breviceps*										O										
Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*						O	O	O					O						O	
Pseudocheiridae	Common Ringtail Possum	*Pseudocheirus peregrinus*				O		O				O		O								
Vespertilionidae	Eastern cave Bat	*Vespadelus troughtoni*																				
Vespertilionidae	White-striped Mastiff Bat	*Tadarida australis*														H						
Reptilia																						
Chelidae	Long-necked Turtle	*Chelodina longicollis*				O																
Agamidae	Jacky Lizard	*Amphibolurus muricatus*											O									
Gekkonidae	Leaf tailed gecko	*Saltuarius swaini*				O																
Gekkonidae	Stone Gecko	*Diplodactylus vittatus*				O											O					
Scincidae	Coppertail Skink	*Ctenotus taeniolatus*							O								O					

Family	Species	Scientific name	Status	Survey Technique in REA 1								Survey Technique in REA 2							Survey Technique in Area surrounding REA			
				Call playback	Cage trap	Incidental	Amphibian	Spotlighting	Diurnal/bird	Hair tubes	Anabat	Amphibian	Diurnal/ bird	Spotlighting	Hair tubes	Call playback	Incidental	Anabat	Incidental	Amphibian	Hair tubes	Anabat
Scincidae	Eastern Water Skink	*Eulamprus quoyii*							O													
Scincidae	Pale-flecked Garden Sunskink	*Lampropholis guichenoti*							O				O				O		O			
Typhlopidae	Blackish Blind Snake	*Rhamphotyphlops nigrescens*							O													

Appendix 8. MNES Assessments of Significance

Matters for Assessment

Assessments of Significance are presented for the following MNES in relation to the Project:

- Threatened Ecological Communities
  - Shale Sandstone Transition Forest.
- Threatened flora
  - *Acacia bynoeana*
  - *Grevillea parviflora* subsp. *parviflora*
  - *Leucopogon exolasius*
  - *Persoonia bargoensis*
  - *Persoonia glaucescens*
  - *Persoonia hirsuta*
  - *Pomaderris brunnea.*
- Threatened Fauna
  - Broad-headed Snake (assessment undertaken as a precautionary approach).
  - Large-eared Pied Bat
  - Koala
  - Grey-headed Flying-fox
  - Greater Glider
  - Birds (grouped): Swift Parrot, Regent Honeyeater, Cattle Egret, Great Egret, Fork-tailed Swift, Rainbow Bee-eater, and Satin Flycatcher.

Descriptions in regards to the lifecycle for the species have been taken from the relevant Commonwealth Conservation Advice unless otherwise stated.

Shale Sandstone Transition Forest	
Critically Endangered Ecological Community	**Significant Assessment Criteria**
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:	
Reduce the extent of an ecological community	The Project would involve the removal of approximately 23.57 ha of Shale Sandstone Transition Forest (SSTF) as a result of clearing required for the Project. Subsidence as a result of the Project may cause cracking of the soil within the community, however SSTF occurs within drier soils and is not solely dependent on groundwater interaction that may be impacted by surface cracking. Previous vegetation mapping by Tozer et al. (2006) has mapped approximately 2,947 ha as occurring within 10 km of the Study Area. The Project will therefore result in reducing the extent of the SSTF in the locality by less than 1 per cent.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or powerlines	Approximately 23.57 ha of SSTF would be impacted by the required clearing for the Project. Given SSTF is listed as Critically Endangered, all areas containing this community are considered important, particularly larger patches. The removal of SSTF within the surface infrastructure development footprint will result in fragmentation of the broader native vegetation community surrounding it. The clearing associated with the REA includes areas along the southern extents of previously cleared mining areas (Figure 11). It will reduce the extent of SSTF adjacent to this area, but will not further fragment the community. The clearing of SSTF within the powerline corridors would create a cleared corridor approximately 30 m wide. However, the powerline is located, for the most part, along existing cleared vehicle access tracks, including of Charlies Point Road. The construction of the ventilation shaft sites would also fragment portions of good quality SSTF and also an area of the derived form of the community along Charlies Point Road. The Project will result in the isolation of any areas of SSTF.
Adversely affect habitat critical to the survival of an ecological community	Given SSTF is listed as Critically Endangered, all areas containing this community are considered important, particularly larger patches. The habitat for SSTF that would be impacted within the Study Area consist of approximately 23.57 ha which equates to less than 1 per cent of SSTF within the locality (2,947 hectares has been mapped by Tozer et al. (2006) as occurring within 10 km of the Study Area). Much of the remaining SSTF within the locality is scattered within private lots, and Crown land that are not formally protected under conservation agreements. Within the locality, SSTF is informally protected within Upper Nepean State Conservation Area, WaterNSW Special Area, and Wirrimburra Sanctuary Bargo. None of these areas would be impacted by the Project. When compared to the amount of SSTF within the locality and priority conservation lands, the component of the CEEC that would be impacted by the Project is unlikely to adversely affect habitat critical to the survival of the community.

Shale Sandstone Transition Forest	
Critically Endangered Ecological Community	**Significant Assessment Criteria**
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The Project would involve the clearing of approximately 23.57 ha of SSTF, and therefore destroy abiotic factors necessary for the CEEC survival within the impact footprint. The Project would not result in the removal of all SSTF within the locality: over 2,947 hectares has been mapped by Tozer et al. (2006) in the locality. As such, the SSTF to be cleared, and any potential indirect impacts of the Project, would not adversely affect all abiotic factors critical to the survival of the community within the locality.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The Project would result in the clearing of approximately 23.57ha of SSTF. As stated above, the 99 percent of the community remaining in the locality will not be impacted directly by the Project.. The Project is not likely to cause changes to the remainder of the CEEC within the locality that would lead to the decline or loss of functionally of the CEEC.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to; assisting invasive species, that are harmful to the listed ecological community, to become established, or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	The Project would result in the reduction of SSTF within the Study Area through the clearing of approximately 23.57ha of the CEEC. The Project would involve the implementation of mitigation measures such as a weed management plan. Through implementing this plan it is unlikely that an increase in invasive species would occur within bushland surrounding the surface infrastructure footprint. The Project is not likely to increase the mobilisation of fertilisers, herbicides or other chemicals or pollutants into the CEEC which would impact on the species composition of the community. Any use of herbicides as part of a weed management plan would be undertaken using industry best practice.
Interfere with the recovery of an ecological community.	An approved recovery plan exists for SSTF as part of the recovery plan for the Cumberland Plain (DECCW 2010). The main recovery objectives of this recovery plan include (DECCW 2010): ▪ To build a protected area network, comprising public and private lands, focused on the priority conservation lands

Shale Sandstone Transition Forest	
Critically Endangered Ecological Community	**Significant Assessment Criteria**
	▪ To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the priority management objectives are compatible with biodiversity conservation ▪ To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management and the recovery program ▪ To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner. The Project is likely to interfere with the recovery of SSTF, as the Study Area has been identified as part of a priority conservation land in the Cumberland Plain Recovery Plan (DECW 2010). Of the 9,642 ha of SSTF remaining (as mapped by NPWS 2002, Tozer 2003 and NSW Scientific Committee and Simpson 2008, referenced in DECCW 2010), approximately 3,145 ha (33%) has been mapped as priority conservation lands (DECCW 2010). The 23.57 ha that would be removed as part of the Project represents 0.76% of the area of SSTF mapped as part of a priority conservation lands (DECCW 2010).
Conclusion	The Project is considered **likely** to result in a significant impact to SSTF due to the following: ▪ The Project would result in the direct clearing of approximately 23.57 ha identified in the Cumberland Plain Recovery Plan (DECW 2010). ▪ The Project would result in fragmentation of SSTF due to direct clearing. ▪ The Project would reduce the extent of the CEEC.

Acacia bynoeana	
Vulnerable species	**Address of Criteria**
Background	*Acacia bynoeana* occurs in heath or dry sclerophyll forest on sandy soils. The species seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches (NPWS 1999). A population of *Acacia bynoeana* was recorded during previous survey along an existing Fire Trail off Ashby Close, within Bargo. The population does not occur within the Study Area and would therefore not be impacted by the Project. Within the Study Area, no individuals for *Acacia bynoeana* were recorded despite targeted survey. Whilst no individuals were recorded, it is noted that the Project would result in impacts to approximately 23.57 hectares of potential habitat for *Acacia bynoeana* through vegetation clearing. Potential habitat to be directly impacted includes Shale Sandstone Transition Forest. Given the species occurs within heath and Dry Sclerophyll Forest habitat typically occurring away from sensitive environmental features that may be impacted by subsidence (ie. Watercourses, edges of ridges) subsidence is unlikely to impact upon the species.
Is this population an important population?	Given the species was not recorded in the Study Area despite targeted searches, the Project footprint is not likely to support an important population of the species.
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 an important population of a species	*Acacia bynoeana* occurs in heath or dry sclerophyll forest on sandy soils. The species seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and recently burnt patches (NPWS 1999). *Acacia bynoeana* was not recorded during the current survey within the disturbance footprint, as such, no important population would be impacted. Furthermore, the species is not considered likely to be impacted by subsidence, as it is unlikely that cracking of soils within areas of potential habitat would lead to vegetation die back, or significant vegetation composition changes. Given no important population was recorded in the proposed surface facility areas, and the species is unlikely to be impacted by subsidence, the Project is unlikely to result in a long-term decrease in the size of a population.
Reduce the area of occupancy of an important population	The Project would not reduce the area of occupancy of the species as no individuals were recorded in the proposed surface facility footprint. It is unlikely that subsidence would result in the modification of habitat given the species is reliant upon dry sclerophyll forest habitats that are not solely reliant or groundwater. Furthermore, no important population was recorded within the Study Area.

Acacia bynoeana	
Vulnerable species	**Address of Criteria**
Fragment an existing important population into two or more populations	There is no known population within the Study Area and so the Project would not result in the fragmentation of an existing population.
Adversely affect habitat critical to the survival of a species	The Project is unlikely to adversely affect habitat critical to the survival of the species as: ▪ No individuals are are known to occur and thus the species is not likely to be impacted by the Project. ▪ The species is relatively conspicuous and is unlikely to have remained undetected during the field survey if present. It is therefore likely the species is not present within the proposed footprint of the surface facility sites. ▪ Subsidence is unlikely to impact the species given it is reliant upon dry sclerophyll forest habitats.
Disrupt the breeding cycle of an important population	The following is known about the lifecycle of *Acacia bynoeana* (NPWS 1999): ▪ Plants are generally very small and produce few flowers. ▪ Flowers from September until March and the fruit matures November to January with the peak fruit maturation occurring in November. ▪ Seeds are shed at maturity. Seed production is considered to be minimal and seedlings are rare. There is apparently little local dispersal of seed. ▪ The plant has a woody rootstock and it is likely the species is able to re-sprout from this rootstock after fire. ▪ The species maintains a long-term soil-stored seedbank. ▪ Plants may not always be apparent and appear periodically, perhaps in response to local disturbance. The Project is unlikely to have an adverse impact on *Acacia bynoeana* such that the breeding cycle of an important population would be disrupted, due to the following: ▪ The Project would not impact upon any known individuals of *Acacia bynoeana*. ▪ The Project is unlikely to result in the loss of any known pollinators of the species. ▪ No important population was recorded within the Study Area. Given the species is relatively conspicuous, and is therefore unlikely to remain undetected during the field survey, it is likely that no individuals occur in the Study Area and none would be impacted by the Project. Furthermore, subsidence as a result of the Project is unlikely to impact the species as it occurs within dry sclerophyll vegetation.
Modify, destroy, remove or isolate or decrease the	The Project would result in the removal of approximately 23.57 ha of potential habitat.

Acacia bynoeana	
Vulnerable species	**Address of Criteria**
availability or quality of habitat to the extent that the species is likely to decline	Based on previous vegetation mapping (Tozer 2006), the area of potential habitat in the locality is approximately >20,000 hectares, comprising of Sydney Hinterland Transition Woodland (7,705 hectares), Coastal Sandstone Ridgetop Woodland (11,239 hectares), and Cumberland Shale Sandstone Transition Forest (2,947 hectares). This vegetation would not be impacted by the Project. Given the species was not recorded during the current survey, and given the large extent of potential habitat, it is unlikely the Project would modify, destroy, remove or isolate the availability of quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is the potential for the Project to result in an increase in invasive species that may occur within areas of potential habitat. However, mitigation measures such as the implementation of a weed management plan would be undertaken as part of the Project. This would reduce the potential for any impacts on the habitat of *Acacia bynoeana*.
Introduce disease that may cause the species to decline, or	There is the potential for machinery to result in the spread of *Phytophthora cinnamomi*. However, mitigation measures such as vehicle wash downs would be undertaken to reduce the potential for any impacts to *Acacia bynoeana.*
Interfere substantially with the recovery of the species.	The Project is unlikely to interfere substantially with the recovery of the species as the species was not recorded during the current survey, no known populations should be impacted by the Project and potential habitat is relatively extensive in the locality.
Conclusion	The Project is unlikely to significantly impact *Acacia bynoeana* as : • the species was not recorded during the current or previous surveys in the Study Area • Potential habitat is relatively extensive in the locality • No known populations should be impacted by the Project • Mitigation measures such as weed management would be implemented to reduce impacts to potential habitat.

Grevillea parviflora subsp. parviflora	
Vulnerable Species	**Significant Assessment Criteria**
Background	*Grevillea parviflora* subsp. *parviflora* was recorded during the current and previous surveys at the following locations within the Study Area: ▪ Within and immediately surrounding the proposed and previous REA footprints ▪ Bushland to the east of Charlies Point Road ▪ Within the Anthony Road property owned by Tahmoor Coal ▪ At the site of the ventilation shafts ▪ Along Fire Road 5 in the Upper Nepean State Conservation Area. It is likely that the records within the REA, and area immediately surrounding the REA and to the east of Charlies Point Road are part of the same population given the proximity of all records and occupancy and connectivity of similar habitat. The total estimated count of *Grevillea parviflora* subsp. *parviflora* recorded during the current survey that would be directly impacted by the Project is 491 individuals – the majority of these occurring along the proposed powerline corridors The REA population extends to the east of Charlies Point Road and is likely to include an additional 10,000 plants based on approximately the presence of about 20.0 ha of suitable habitat. Furthermore, it should be noted that another site containing a population of the species within the tens of thousands of individuals was recorded within land owned by Tahmoor Coal located off Ashby Close, Bargo. This population would not be impacted by the Project.
Is this population an important population?	The population recorded within the surface infrastructure development footprint and immediate surrounds, should be regarded as an 'important population' as: 1. It is a key source population for breeding or dispersal. It is likely that the population is a key source population for breeding and dispersal given the size of the population and the extensive distribution in the locality. Sites of particular significance for *Grevillea parviflora* subsp. *parviflora* would 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 (SEWPaC 2013). The population recorded fits this description. 2. It is a population that is necessary for maintaining genetic diversity. The population is very large and likely to contain a significant proportion of the genetic diversity of the species. It is likely that this population has distinct genetic differentiation from the northern populations of the species that occur in the Hunter Valley. 3. The population is near the limit of the species range. The population is at or near the southern limit of the range for the species which is identified as Bargo (SEWPaC 2013). Given its size and distribution, the population of *Grevillea parviflora* subsp. *parviflora* in the locality is considered to be an important population.
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	

Grevillea parviflora subsp. parviflora	
Vulnerable Species	**Significant Assessment Criteria**
Lead to a long-term decrease in the size of an important population of a species	*Grevillea parviflora* subsp. *parviflora* is unlikely to be impacted by subsidence, as the species does not occur within areas that are sensitive to subsidence-related impacts (eg. bed of watercourses, ridgelines). The habitat within Dry Sclerophyll Forest vegetation may be exposed to subsidence cracking of the soil, however such an impact is unlikely to result in significant changes to floristics and composition that may impact upon *Grevillea parviflora* subsp. *parviflora*. The Project would impact approximately 5.1 ha of known habitat and approximately 491 individuals of *Grevillea parviflora* subsp. *parviflora*. During the field survey, *Grevillea parviflora* subsp. *parviflora* was also recorded to the east of Charlies Point Road which occurs outside of the development footprint. The individuals recorded within the surface infrastructure footprint area and to the east of this area are likely to constitute the same population. The area of potential habitat mapped to the east of Charlies Point Road is approximately 20 ha, and based on population counts equates to approximately 10,000 individuals of *Grevillea parviflora* subsp. *parviflora*. The Project would impact upon approximately 5 per cent of the localised distribution of this species which is considered to be part of a much larger (important) population of *Grevillea parviflora* subsp. *parviflora*. Despite the losses that would occur from the Project, the remaining 95 percent of the population is considered viable and not likely to decline over time as a result of the Project. Measures to mitigate potential indirect impacts as a result of the Project will be implemented (as detailed in section 10 of the BAR) to ensure the remaining population is not affected.
Reduce the area of occupancy of an important population	The Project would reduce the area of occupancy of an important population by approximately 5 percent.
Fragment an existing important population into two or more populations	At present, the local distribution of this species is already fragmented by Charlies Point Road and the existing REA operations. The Project footprint surrounding the existing REA would result in increased distances between known records of individuals within the population. Many of the individuals to be removed occur within the proposed powerline corridor. Given the continuity of suitable habitat surrounding these corridors, it is likely that the species is present throughout the adjacent habitat.
Adversely affect habitat critical to the survival of a species	The Project is unlikely to adversely affect habitat critical to the survival of the species as: ▪ The Project would result in the removal of approximately 5.1 hectares of known habitat. A further 20 hectares of known habitat (supporting an estimated 10,000 individuals) on the east of Charlies Point Road would not be impacted by the Project. ▪ A larger population of *Grevillea parviflora* subsp. *parviflora* that occurs outside of the Study Area within land owned by Tahmoor Coal would not be impacted by the Project. This population is likely to be in the tens of thousands. ▪ A population within the Wirrimbirra Reserve in Bargo is informally protected, and Niche has recorded a population within the Nepean State Conservation Area off Avon Dam Road. Both these populations occur within the locality and would not be impacted by the Project.

Grevillea parviflora subsp. parviflora	
Vulnerable Species	**Significant Assessment Criteria**
Disrupt the breeding cycle of an important population	The following is known about the breeding cycle of *Grevillea parviflora* subsp. *parviflora*: ▪ Biology and ecology of the species is poorly known, though it is believed that the species lives between 25–60 years (D. Keith pers.comm. cited in Benson and McDougall 2000). ▪ Flowering occurs in April, May and between July and December. The flowers are insect pollinated. One to two seeds are released at maturity (Benson & McDougall 2000) but have limited seed dispersal, probably of less than 2 m (DSEWPaC 2013) ▪ Plants are capable of suckering or regenerating from a rootstock (NSW DECC 2005p). Sucker stems usually occur in patches close to the parent plant (DSEWPaC 2013). ▪ After fire or other disturbance, regeneration can occur from both the rhizomes and seed in the soil seedbank. However, after fire, adult plants are killed and seedling recruitment is uncommon (Benson & McDougall 2000). ▪ Little is known about the production and viability of seed, seed predation or germination rates and requirements. Much of the current knowledge of *Grevillea parviflora* subsp. *parviflora* is based on general observations (DSEWPaC 2013). It is unlikely the Project would affect the lifecycle of the remaining population due to the following: ▪ The Project would remove approximately 491 individuals from the local population. The remaining 9,509 plants within the population would not be impacted by the Project. ▪ The Project would impact upon 5 percent of the important population. The remaining 95 percent of the population is considered viable and not likely to decline over time as a result of the Project. ▪ The Project is unlikely to result in the loss of any known pollinators of the species. ▪ A large population recorded within the Upper Nepean State Conservation Area would not be impacted by the Project. A population count has not been conducted, but it likely to exceed over a thousand individuals. Similarly the population recorded within Tahmoor Coal owned land off Ashby Close in Bargo would not be impacted. ▪ Subsidence is unlikely to cause any significant impact to the species. *Grevillea parviflora* subsp. *parviflora* is located within the dry sclerophyll forests away from creek and watercourses. It is unlikely subsidence would impact all areas that the species occupies.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project would impact approximately 5.1 ha of known habitat. The species is common within the Shale Sandstone Transition Forest in the locality which covers a much larger area (2,947 ha). This is supported by the large populations within the Upper Nepean State Conservation Area near Avon Dam Road, and the Bargo Colliery Land off Ashby Close, Bargo. Overall, the Project would lead to a decline in the total number of plants within the population and a reduction in the total available habitat for the species. The proportion of the estimated population that would not be affected by the Project is substantial (95 percent). It is unlikely that the Project would lead to a decline in the overall species.

Grevillea parviflora subsp. parviflora	
Vulnerable Species	**Significant Assessment Criteria**
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is the potential for the Project to result in an increase in invasive species that may occur within areas of potential habitat. However, mitigation measures such as the implementation of a weed management plan would be undertaken as part of the Project. This would reduce the potential for any impacts on the retained habitat of *Grevillea parviflora* subsp. *parviflora.*
Introduce disease that may cause the species to decline, or	There is the potential for machinery to result in the spread of *Phytophthora cinnamomi*. However, mitigation measures such as vehicle wash downs would be undertaken to reduce the potential for any impacts to *Grevillea parviflora* subsp. *parviflora*.
Interfere substantially with the recovery of the species.	The Project would result in the loss of 5 percent of an important population. However, the species is relatively common within the locality, with populations in the tens of thousands recorded within the Nepean State Conservation Area and land owned by Tahmoor Coal located to the west of Bargo. These populations would not be impacted by the Project.
Conclusion	The Project is unlikely to result in a significant impact to *Grevillea parviflora* subsp. *parviflora* as: ▪ The proposed disturbance would result in direct impacts to 491 plants within an important population, however over 10,000 plants would not be impacted by the Project and would remain viable. ▪ Larger populations supporting tens of thousands of plants would not be impacted by the Project. The populations located within the Nepean State Conservation Area and within Tahmoor Coal land to the west of Bargo would not be impacted by the Project. ▪ The species is unlikely to be impacted by subsidence. ▪ Mitigation measures proposed would reduce the likelihood of indirect impacts to the retained proportion of the important population within the Study Area and surrounds.

Persoonia bargoensis	
Vulnerable Species	**Significant Assessment Criteria**
Background	*Persoonia bargoensis* was recorded at various locations during the field survey including: ▪ A total of 692 individuals of *Persoonia bargoensis* were recorded within and adjacent to the surface infrastructure area. The bulk of the population occurs to the north and south of the REA and will not be affected by the Project ▪ Individuals recorded along Anthony Road ▪ Individuals recorded along Fire Roads off Ashby Close in Bargo Approximately 8 individuals of *Persoonia bargoensis* would be directly impacted by the Project, including approximately 23.57 hectares of potential habitat. Potential habitat includes: Shale Sandstone Transition Forest.
Is this population an important population?	The population (being defined as the broader local population, not just those individuals recorded within the Study Area) should be regarded as an 'important population' if: 1. It is a key source population for breeding or dispersal - Given that the species is restricted in distribution to a very small area, it is likely that the 692 individuals form part of a population of this species which is a key source, and perhaps the only source, population for breeding and dispersal of this species. 2. It is a population that is necessary for maintaining genetic diversity - Again, given that the species is restricted in its entire distribution to very small areas it is likely that the 692 individuals recorded form part of a population that is necessary for maintaining genetic diversity for the species. 3. The population is near the limit of the species range - The population is at the limit of the range for the species which is identified above with northern, southern, eastern and western limits at Picton and Douglas Park, Yanderra, Cataract River and Thirlmere. Given its size and distribution, the local population of *Persoonia bargoensis* is considered to be an important population.
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	Approximately 23.57 hectares of potential habitat would be impacted by the Project. Potential habitat includes Shale Sandstone Transition Forest. *Persoonia bargoensis* is unlikely to be impacted by subsidence, as the species does not occur along ridgelines or close to waterways. The woodland and forest environments that it inhabits are not water dependent, and therefore subsidence is unlikely to impact the species. The Project would result in the loss of eight known individuals as a result of the clearing required for the proposed works. Despite the losses that would occur from the Project, the remaining population, a further 684 plants, is considered viable and not likely to decline over time as a result of the Project.
Reduce the area of occupancy of an important population	The Project would directly impact approximately 8 individuals of *Persoonia bargoensis* for the Project. This is approximately 1.2 per cent of the important population.

Persoonia bargoensis	
Vulnerable Species	**Significant Assessment Criteria**
Fragment an existing important population into two or more populations	At present, the local distribution of this species is fragmented by Charlies Point Road and the existing REA operations. The Project would result in the removal of 8 individuals at the southern end of the known records in the Study Area within the proposed powerline corridor and vent shaft sites Given the continuity of suitable habitat surrounding these corridors, it is likely that the species is present throughout the adjacent habitat.
Adversely affect habitat critical to the survival of a species	The Project is unlikely to adversely affect habitat critical to the survival of the species as: ▪ The Project would result in the removal of approximately 8 plants within the population. This is a reduction of 1.2 percent of the important population. The remaining 986 percent of the population would not be impacted by the Project and therefore would not result in extinction of the population. ▪ Based on previous mapping (Tozer 2006), the area of potential habitat in the locality is approximately 10,653 hectares, comprising of Sydney Hinterland Transition Woodland (2698.70 hectares) and Cumberland Shale Sandstone Transition Forest (573 hectares) (Tozer et al. 2006). The Project would result in the removal of approximately 0.2 per cent of potential habitat in the locality.
Disrupt the breeding cycle of an important population	The following is known about the life cycle of *Persoonia bargoensis* (DEC 2005): ▪ Grows in woodland to dry sclerophyll forest, on sandstone and clayey laterite on heavier, well-drained, loamy, gravelly soils of the Hawkesbury Sandstone and Wianamatta Shale in the catchments of the Cataract, Cordeaux and Bargo Rivers. ▪ Local populations are very small (mostly less than eight plants) and scattered, with a total population likely to be less than 250 (in 1999). The species appears to be associated with disturbance margins such as the edge of fire trails, possibly because of more light, less root competition, factors regulating the breaking of dormancy, or a factor relating to dispersal agents. The species is fire-sensitive and appears to need a minimum fire frequency of 10-15 years between fires. ▪ The longevity of *Persoonia bargoensis* is likely to be approximately 20 years. ▪ Flowering occurs mainly in summer (Blombery and Maloney 1992) but can extend into autumn (Douglas pers. obs.). ▪ Primarily pollinated by native bees (Bernhardt and Weston 1996). ▪ Plants are likely to be killed by fire and recruitment is solely from seed. ▪ Like most Geebungs this species seems to benefit from the reduced competition and increased light available on disturbance margins including roadsides. The Project is likely to result in a disruption to the breeding cycle of the species, given 1.2 percent of the population would be removed. This is unlikely to result in changes to the seed bank for the population in the long-term. The remaining 99 percent of the population would provide seed source which would not lead to extinction of the species within the locality.
Modify, destroy, remove or isolate or decrease the	As described above, the Project would result in the loss of approximately 1.2 percent of the population. The Project would not isolate or decrease the availability or quality of the remaining habitat for this species to the extent that the species is likely to decline.

Persoonia bargoensis	
Vulnerable Species	**Significant Assessment Criteria**
availability or quality of habitat to the extent that the species is likely to decline	
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is limited potential for the Project to result in an increase in invasive species within the REA and elsewhere where any surface infrastructure would be developed. The Project involves the implementation of good environmental practice including vehicle hygiene and development of a weed management plan. Further, the current REA activities and the exploration activities undertaken to date have not resulted in high number of invasive species establishing within the habitat for this vulnerable species.
Introduce disease that may cause the species to decline, or	There is the potential for machinery to result in the spread of *Phytophthora cinnamomi*. However, mitigation measures such as vehicle wash downs would be undertaken to reduce the potential for any impacts to *Persoonia bargoensis*.
Interfere substantially with the recovery of the species.	The Project would result in the loss of a relatively large number of individuals of this species and also 23.57 ha of known habitat. The impact of the Project on the important population would not extend beyond the Study Area and would therefore not interfere with the recovery of the species elsewhere in the locality.
Conclusion	The Project is considered unlikely to result in a significant impact to *Persoonia bargoensis* based on the following: ▪ The important population would be reduced by only 1.2 percent based on the removal of eight of 692 known plants. ▪ The seed bank and viability of the population are unlikely to be impacted by the removal of 1.2 percent of the individuals in the population.

Persoonia glaucescens	
Vulnerable Species	**Significant Assessment Criteria**
Background	*Persoonia glaucescens* was not recorded during the current field surveys. A record of the species, obtained from the OEH Atlas of NSW Wildlife, occurs within the southern portion of proposed REA. This individual was not detected during the survey at the coordinates obtained from OEH. Approximately 23.57 haof potential habitat would be removed as part of the disturbance associated with the Project. Potential habitat includes Shale Sandstone Transition Forest.
Is this population and important population?	No population has been mapped as occurring within the Project footprint.
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	*Persoonia glaucescens* has not been recorded in the Study Area and thus the Project would not impact upon a known important population.
Reduce the area of occupancy of an important population	The Project would not impact upon an important population. Approximately 23.57 ha of potential habitat would be impacted by the Project. Potential habitat includes Shale Sandstone Transition Forest and Upper Georges Sandstone Woodland., approximately 14,000 hectares of similar potential habitat is mapped as occurring within the locality (Tozer et al. 2006). The Project would reduce the area of potential habitat within the locality by less than 1 percent.
Fragment an existing important population into two or more populations	The Project would not impact any known individuals of *Persoonia glaucescens.* The Project may result in some fragmentation of potential habitat as a result of vegetation clearance within the surface infrastructure area. 23.57 ha of potential habitat will be removed within the powerline corridors, the ventilation shaft sites and also along the southern and western edge of the existing REA. Habitat surrounding these area and the area bound by the powerline corridor would remain intact providing potential habitat for the species and connectivity across the broader landscape. Subsidence is unlikely to result in fragmentation of habitat for *Persoonia glaucescens.*
Adversely affect habitat critical to the survival of a species	The Project is unlikely to adversely affect habitat critical to the survival of the species as: ▪ *Persoonia glaucescens* was not recorded within the development footprint during the current survey. ▪ Subsidence is unlikely to impact on potential habitat for the species, as the species does not occur within habitat types that are sensitive to changes due to subsidence (eg. creek beds, groundwater dependent ecosystems etc.).
Disrupt the breeding cycle of an	The threatened species profile lists the following about the lifecycle of *Persoonia glaucescens:* ▪ Grows in woodland to dry sclerophyll forest on clayey and gravely laterite.

Persoonia glaucescens	
Vulnerable Species	**Significant Assessment Criteria**
important population	▪ Preferred topography is ridge-tops, plateaux and upper slopes. Aspect does not appear to be a significant factor. ▪ Within its habitat, *Persoonia glaucescens* is generally rare and the populations are linear and fragmented. Under ideal circumstances, the species can be locally common, though such conditions are very rare. ▪ Plants are killed by fire and recruitment is solely from seed. ▪ Like most Persoonia species this species seems to benefit from the reduced competition and increased light available on disturbance margins including roadsides. ▪ The Project is unlikely to have an adverse impact on the breeding cycle of *Persoonia glaucescens* due to the following: ▪ The Project would not impact upon any known individuals of *Persoonia glaucescens.* ▪ No important population was recorded. The Project is unlikely to result in the loss of any known pollinators of the species. The species does not occur within and/or is not likely to be reliant on the vegetation communities or habitats that may be adversely impacted by subsidence.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project would impact approximately 23.57 ha of potential habitat. Based on previous mapping (Tozer 2006), the area of potential habitat in the locality is approximately 14,000 ha, comprising of Cumberland Shale Sandstone Transition Forest and Upper Georges River Sandstone Woodland. The Project would result in the removal of less than 1 per cent of potential habitat in the locality. Given the species was not recorded within the development footprint during the current survey, and the extent of potential habitat is relatively extensive, it is unlikely the Project would modify, destroy, remove or isolate the availability of quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is limited potential for the Project to result in an increase in invasive species within the REA and elsewhere where any surface infrastructure would be developed or exploration activities would be undertaken. However, the Project also involves the implementation of good environmental practice including vehicle hygiene and development of a weed management plan. Further, the current REA activities and the exploration activities undertaken to date have not resulted in high number of invasive species establishing within the habitat for this vulnerable species.
Introduce disease that may cause the species to decline, or	There is the potential for machinery to result in the spread of *Phytophthora cinnamomi*. However, mitigation measures such as vehicle wash downs would be undertaken to reduce the potential for any impacts to *Persoonia bargoensis.*

Persoonia glaucescens	
Vulnerable Species	**Significant Assessment Criteria**
Interfere substantially with the recovery of the species.	No known individuals of this species would be removed by the Project. Approximately 23.57 haof potential habitat would be removed by proposed surface infrastructure. The impact of the Project would not extend beyond the Study Area and would therefore not interfere with the recovery of the species elsewhere in the locality.
Conclusion	The Project would not result in a significant impact to *Persoonia glaucescens* due to the following: ▪ No individuals of *Persoonia glaucescens* were recorded within the disturbance area. ▪ *Persoonia glaucescens* does not occur within habitat that would be impacted by subsidence. ▪ The habitat for *Persoonia glaucescens* is relatively extensive within the locality.

Persoonia hirsuta	
Vulnerable Species	**Significant Assessment Criteria**
Background	During the current field survey, no records for *Persoonia hirsuta* were recorded. The species is relatively conspicuous and unlikely to remain undetected during the current and previous field surveys. Approximately 23.57 hectares of potential habitat would be removed as part of the disturbance associated with the Project. Potential habitat to be impacted includes Shale Sandstone Transition Forest.
Is this population and important population?	No population has been mapped as occurring within the Project footprint.
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	The Project would not impact upon an important population.
Reduce the area of occupancy of an important population	The Project would not impact upon an important population. Approximately 23.57 ha of potential habitat would be impacted by the Project. Potential habitat includes Shale Sandstone Transition Forest and Upper Georges Sandstone Woodland; approximately 14,000 hectares of similar potential habitat is mapped as occurring within the locality (Tozer et al. 2006). The Project would reduce the area of potential habitat within the locality by less than 1 percent.
Fragment an existing important population into two or more populations	The Project would not impact any known individuals of *Persoonia hirsuta*. The Project may result in some fragmentation of potential habitat as a result of vegetation clearance within the surface infrastructure area. 23.57 ha of potential habitat will be removed within the powerline corridors, the ventilation shaft sites and also along the southern and western edge of the existing REA. Habitat surrounding these area and the area bound by the powerline corridor would remain intact providing potential habitat for the species and connectivity across the broader landscape. Subsidence is unlikely to result in fragmentation of habitat for *Persoonia hirsuta*.
Adversely affect habitat critical to the survival of a species	The Project is unlikely to adversely affect habitat critical to the survival of the species as: ▪ *Persoonia hirsuta* was not recorded within the development footprint during the surveys. ▪ Subsidence is unlikely to impact on potential habitat for the species, as the species does not occur within habitat types that are sensitive to changes due to subsidence (eg. creek beds, groundwater dependent ecosystems etc.).
Disrupt the breeding cycle of an important population	The threatened species profile lists the following about the lifecycle of *Persoonia hirsuta*: ▪ The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. ▪ It is usually present as isolated individuals or very small populations. ▪ Plants are killed by fire and recruitment is solely from seed. The Project is unlikely to have an adverse impact on the breeding cycle of *Persoonia hirsuta* due to the following: ▪ The Project would not impact upon any known individuals of *Persoonia hirsuta*.

Persoonia hirsuta	
Vulnerable Species	**Significant Assessment Criteria**
	▪ No important population was recorded. ▪ The Project is unlikely to result in the loss of any known pollinators of the species. ▪ The species does not occur within and/or is not likely to be reliant on the vegetation communities or habitats that may be adversely impacted by subsidence.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project would impact approximately 23.57 ha of potential habitat. Based on previous mapping (Tozer 2006), the area of potential habitat in the locality is approximately 14,000 hectares, comprising of Cumberland Shale Sandstone Transition Forest and Upper Georges River Sandstone Woodland. The Project would result in the removal of less than 1 per cent of potential habitat in the locality. Given the species was not recorded within the development footprint during the current survey, and the extent of potential habitat is relatively extensive, it is unlikely the Project would modify, destroy, remove or isolate the availability of quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is a limited potential for the Project to result in an increase in invasive species within the REA and elsewhere where any surface infrastructure would be developed, or exploration activities would be undertaken. However, the Project also involves the implementation of good environmental practice including vehicle hygiene and development of a weed management plan. Further, the current REA activities and the exploration activities undertaken to date have not resulted in a high number of invasive species establishing within habitat of this vulnerable species.
Introduce disease that may cause the species to decline, or	There is the potential for machinery to result in the spread of *Phytophthora cinnamomi*. However, mitigation measures such as vehicle wash downs would be undertaken to reduce the potential for any impacts to *Persoonia hirsuta*.
Interfere substantially with the recovery of the species.	No known individuals of this species would be removed by the Project. Approximately 23.57 ha of potential habitat would be removed by proposed surface infrastructure. The impact of the Project would not extend beyond the Study Area and would therefore not interfere with the recovery of the species elsewhere in the locality.
Conclusion	The Project would not result in a significant impact to *Persoonia hirsuta* due to the following: ▪ No individuals of *Persoonia hirsuta* were recorded within the disturbance area. ▪ *Persoonia hirsuta* does not occur within habitat that would be impacted by subsidence. ▪ The habitat for *Persoonia hirsuta* is relatively extensive within the locality.

Pomaderris brunnea	
Vulnerable Species	**Significant Assessment Criteria**
Background	A population of *Pomaderris brunnea* was recorded along Teatree Hollow Creek during the current survey. Over 300 individuals were recorded within the gully environment of Teatree Hollow Creek. The species has also been previously recorded in creeklines at Wirrimbirra Sanctuary (Bargo) (SEWPAC 2013). The Wirrimbirra population contained 900 plants in the late 1980s (SEWPAC 2013). Together, these local records are likely to form a local population of the species totalling at least 1,235 individuals. Whilst *Pomaderris brunnea* occurs within a gully environment adjacent to Teatree Hollow Creek, it is highly unlikely subsidence would result in die back of the population due to the following: ▪ Teatree Hollow Creek undergoes extensive periods of dryness, thus the species unlikely to be affected by any potential creek surface cracking or changes to groundwater as a result of subsidence. ▪ Much of the population was recorded on the top of middle banks of Teatree Hollow Creek and not within areas inundated with water. Thus any changes to the water regime are unlikely to result in impacts to the population. ▪ Die back of vegetation from gas emissions may occur as a result of the Project, however based on previous experience in the Southern Coalfields, the likelihood of this occurring is low, and any impacts would be isolated and localised. Given the population does not occur within the bed of the creek, and is largely positioned away from the lower banks, die back from gas emissions is unlikely.
Is this population an important population?	The population (being defined as the broader local population, not just those individuals recorded within the Study Area) should be regarded as an 'important population' if: ▪ It is a key source population for breeding or dispersal: The individual plants within Teatree Hollow Creek, Dogtrap Creek and Hornes Creek are likely to form part of a broader population within the Wirrimbirra Nature Sanctuary. Together this population is likely to be locally important for dispersal and breeding. ▪ It is a population that is necessary for maintaining genetic diversity: The population is likely to contain a significant proportion of the genetic diversity of the species within the locality. It is likely that this population has distinct genetic differentiation from other populations of this species. ▪ The population is near the limit of the species range: The local records of this species are not at the limit of the species range. The population of *Pomaderris brunnea* recorded within Teatree Hollow is considered to be part of an important population for the species.
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	The Project footprint would result in the removal of 1 plant from the important population. The individual to be removed occurs within the western powerline corridor and was the only individual recorded along that corridor. Given the extent of suitable habitat and known records (at least 300) within Teatree Hollow Creek, Hornes Creek and Dogtrap Creek, the removal of 1 individual (representing 0.3 percent of the recorded population) is considered unlikely to lead to a long-term decrease in the size of th important population. Subsidence is unlikely to result in a decrease in the population of the species as:

Pomaderris brunnea	
Vulnerable Species	**Significant Assessment Criteria**
	▪ *Pomaderris brunnea* is not a strictly water dependent species. It does not occur in the watercourse. It occurs in moist forest communities and gullies often near water. ▪ Teatree Hollow Creek experiences periods of dryness. Whilst it is a possibility that subsidence can result in loss of water from watercourses, the population of *Pomaderris brunnea* in the Study Area is already exposed to such conditions. ▪ Teatree Hollow Creek has been previously mined beneath. No declines in the population have been previously observed. ▪ Any vegetation die back from gas emissions is likely to be isolated and localised. Based on previous experience in the Southern Coalfields, it is unlikely that any gas emissions would cause significant impact to the vegetation. The Project is therefore unlikely to result in a long-term decrease in size of an important population.
Reduce the area of occupancy of an important population	The Project footprint will result in the removal of 1 individual but will not reduce the total area of occupancy of the population. Mitigation measures would prevent indirect impacts to the important population.
Fragment an existing important population into two or more populations	The Project will result in the removal of 1 individual which appears as an outlier to the main population which occurs along the creek to the north-west of the surface infrastructure area. Given its prevalence along other creeks in the north-west of the Study Area, it is considered likely that the species occurs in greater numbers in habitat adjacent to the record in the western powerline corridor, and that this individual is part of a large, local population. Thus the removal is considered unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	The Project is unlikely to adversely affect habitat critical to the survival of the species as: ▪ Only 1 of about 300 known individuals within the Study Area would be impacted by the development. ▪ Mitigation measures proposed would prevent indirect impacts to the remaining population. ▪ Potential habitat for the species is unlikely to be significantly impacted by the Project and associated subsidence. ▪ The species is found within the Wirrimbirra Sanctuary which occurs within the locality (SEWPaC 2013). This population is unlikely to be impacted by the Project.
Disrupt the breeding cycle of an important population	The following is known about the breeding cycle of *Pomaderris brunnea*: ▪ The species is expected to live for 10-20 years, while the minimum time to produce seed is estimated to be 4-6 years ▪ Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. ▪ Flowers appear in September and October. The Project is unlikely to disrupt the breeding cycle of an important population as: ▪ One individual of the important population would be cleared. ▪ Mitigation measures would prevent indirect impacts. ▪ The Project is unlikely to impact known dispersal or reproduction mechanisms.

Pomaderris brunnea	
Vulnerable Species	**Significant Assessment Criteria**
	▪ The Project is unlikely to result in changes to the fire regime for the species as appropriate fire regimes will be implemented in the Tahmoor Coal Bushfire Management Plan.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The species occurs in the Sydney region of the Central Coast of NSW, east of Tamworth on the Northern Tablelands of NSW, and in the East Gippsland region of Victoria. In NSW, the species was originally considered endemic to the Sydney Hawkesbury Sandstone region. It is found on the Colo River, the Nepean River floodplain at Menangle, in creeklines at Wirrimbirra Sanctuary (Bargo) and on the Hawkesbury River. The distribution may extend into the southern section of Yengo National Parks along major creeklines and floodplains. The Wirrimbirra population contained 900 plants in the late 1980s. (source: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16845) The Project is unlikely to result in such a decrease in habitat that the species is likely to decline. The important population would not be cleared, and as such, a viable seedbank would be maintained.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is the potential for the Project to result in an increase in invasive species that may occur within areas of potential habitat. However, mitigation measures such as the implementation of a weed management plan would be undertaken as part of the Project. This would reduce the potential for any impacts on the habitat of *Pomaderris brunnea*.
Introduce disease that may cause the species to decline, or	There is the potential for machinery to result in the spread of *Phytophthora cinnamomi*. However, mitigation measures such as vehicle wash downs would be undertaken to reduce the potential for any impacts to the remaining *Pomaderris brunnea* population.
Interfere substantially with the recovery of the species.	A National Recovery Plan for *Pomaderris brunnea* was developed in 2011. The overall objective of recovery is to minimise the probability of extinction of *Pomaderris brunnea* in the wild and to increase the probability of populations becoming self-sustaining in the long term. The Project would result in direct impacts to 1 individual within the recorded population of at least 300. Mitigation measures are proposed to minimise and prevent impacts to the species. It is unlikely that the direct impacts to *Pomaderris brunnea* as a result of the Project would interfere substantially with the recovery of the species.
Conclusion	The Project is considered unlikely to result in a significant impact to *Pomaderris brunnea*

Leucopogon exolasius	
Vulnerable Species	**Significant Assessment Criteria**
Background	No *Leucopogon exolasius* were recorded during the extensive field surveys throughout the Study Area. The species is relatively conspicuous when not in flower and was unlikely to remain undetected during targeted surveys within the disturbance footprint. Furthermore, the species is unlikely to be impacted by subsidence given the species occurs within the following vegetation communities: Shale Sandstone Transition Forest and Upper Georges River Sandstone Woodland, Western Sandstone Gully Forest and Sydney Hinterland Transition Woodland. These vegetation communities are not reliant solely on groundwater dependency, and any surface cracking within the communities is unlikely to result in measurable species composition changes to areas of potential habitat for *Leucopogon exolasius.* Furthermore, the species typically occurs on the slopes of gullies away from the riparian zone of creeks. Thus any subsidence related impacts to hydrology are unlikely to impact habitat for the species.
Is this population and important population?	No population has been mapped as occurring within the Project footprint.
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	The Project would not impact upon an important population.
Reduce the area of occupancy of an important population	The Project would not impact upon an important population.
Fragment an existing important population into two or more populations	The Project would not impact any known individuals of *Leucopogon exolasius.* The Project would not impact an important population.
Adversely affect habitat critical to the survival of a species	The Project is unlikely to adversely affect habitat critical to the survival of the species as: ▪ Leucopogon exolasius was not recorded within the development footprint or broader study area during targeted survey. ▪ Subsidence is unlikely to impact on potential habitat for the species, as the species does not occur within habitat types that are sensitive to changes due to subsidence (eg. creek beds, groundwater dependent ecosystems etc.).
Disrupt the breeding cycle of an important population	No important population occurs within the Study Area, as such, the breeding cycle would not be impacted.

Leucopogon exolasius	
Vulnerable Species	**Significant Assessment Criteria**
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Based on previous mapping (Tozer 2006), the area of potential habitat in the locality is over 20,000 ha, comprising of Cumberland Shale Sandstone Transition Forest, Western Sandstone Gully Forest, Upper Georges River Sandstone Woodland and Sydney Hinterland Transition Woodland. The Project would result in the removal of less than 1 per cent of potential habitat in the locality. However, it should be noted that this habitat is marginal at best given the species was not recorded. Given the species was not recorded within the development footprint during the current survey, and the extent of potential habitat is relatively extensive, it is unlikely the Project would modify, destroy, remove or isolate the availability of quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	There is a limited potential for the Project to result in an increase in invasive species within the REA and elsewhere where any surface infrastructure would be developed or exploration activities would be undertaken. However, the Project also involves the implementation of good environmental practice including vehicle hygiene and development of a weed management plan. Further, the current REA activities and the exploration activities undertaken to date have not resulted in high number of invasive species establishing within the habitat for this vulnerable species.
Introduce disease that may cause the species to decline, or	There is the potential for machinery to result in the spread of *Phytophthora cinnamomi*. However, mitigation measures such as vehicle wash downs would be undertaken to reduce the potential for any impacts to *Leucopogon exolasius*.
Interfere substantially with the recovery of the species.	No known individuals of this species would be removed by the Project. Approximately 23.57 ha of potential habitat would be removed by proposed surface infrastructure. The impact of the Project would not extend beyond the Study Area and would therefore not interfere with the recovery of the species elsewhere in the locality.
Conclusion	The Project would not result in a significant impact to *Leucopogon exolasius* due to the following: ▪ No individuals of *Leucopogon exolasius* were recorded within the disturbance area. ▪ *Leucopogon exolasius* does not occur within habitat that would be impacted by subsidence. ▪ The habitat for *Leucopogon exolasius* is relatively extensive within the locality.

***Hoplocephalus bungaroides* Broad-headed Snake**	
Vulnerable Species	**Address of Criteria**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:	
Lead to a long-term decrease in the size of an important population of a species	The Broad-headed Snake has not been recorded in the Study Area during current or previous surveys, nor has the species previously been recorded within the Study Area. No known local population of the Broad-headed Snake is therefore known to occur within the Study Area. The closest records obtained from BioNet is a record approximately four km to the west of the Study Area along the ridgeline of the Bargo River, and a record six km to the south along the Avon River. These areas differ from the Study Area as they contain extensive deep incised gullies and cliff lines. These areas are also within conservation lands managed by NSW NPWS and WaterNSW respectively. Given the species was not detected during targeted surveys, and the absence of records, it is highly unlikely that habitat exists within the surface infrastructure area footprint. Furthermore, the habitat to be cleared is situated away from rocky outcrops which the species is known to occupy, so movement into the surface infrastructure footprint to use hollow-bearing trees is unlikely. Potential habitat for the species is also quite limited within the Study Area. The Broad-headed Snake is known to be selective in its selection of rock outcrops for habitat. The Broad-headed Snake is known to occupy ridgelines facing north or west, as the species relies upon specific thermal conditions that are only attained in such ridgelines. These outcrops must have limited to no shading from the woodland canopy, again to allow penetration of high levels of sunlight. Finally, the outcrop must also include suitable rock exfoliations, which take the form of thin layers of rock resting directly on larger rock and without sand or debris between the layers (Pringle et al. (2003), Webb and Shine (1994) and Webb and Shine (1998a, 1998b & 1998c). Within the Study Area, suitable potential habitat is limited to a number of cliff line habitats along the valleys of the, the Bargo River, Dogtrap Creek and Hornes Creek. However, based on traverses throughout these areas during the field survey, areas of suitable rock exfoliation are quite limited. As discussed in section 8.4.2, MSEC (2020) predict that a small number of cliffs may be subject to the impacts of subsidence, which are more likely to be impacted if directly mined beneath. MSEC (2020) states that any impacts to the cliffs that are directly mined beneath, are expected to affect between 3 to 5 percent of the total length of the cliffs. One cliff in the Study Area would be mined beneath. Based on this prediction, the length of the cliffs along Dogtrap Creek that may be impacted by subsidence equates to a length of approximately two (2) metres. Whilst there is always the possibility that the rocky outcrops of the cliff could be potential habitat for the species, the likelihood of suitable exfoliating rock habitat occurring within this relatively small area of cliff line, is quite low. Furthermore, the likelihood of subsidence impacting the precise exfoliating rock habitat for which a Broad-headed Snake resides is considered to be low. As such, it is considered unlikely that the Broad-headed Snake would be subject to impacts that would lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Subsidence impacts as a result of the Project are likely to cause some minor and isolated rock falls and cracking as detailed above. This may impact only a minimal area of potential habitat for the species (about 2 m of cliff line within the Study Area). 14 hollow-bearing trees (which the species may utilise) would be impacted by the Project in the surface infrastructure area. It is highly unlikely isolated/minor subsidence impacts would reduce the area of occupancy of an important population, should it occur.

Hoplocephalus bungaroides Broad-headed Snake	
Vulnerable Species	**Address of Criteria**
Fragment an existing important population into two or more populations	Based on previous mine subsidence predictions, subsidence impacts associated within the Project could cause rock falls and surface cracking. Given the species has not been recorded during the surveys and only one previous record occurs in the locality, it is unlikely fragmentation of an important population would occur.
Adversely affect habitat critical to the survival of a species	No critical habitat has been listed for the species on the EPBC Act Register of Critical Habitat. Given that the species has not been recorded in the Study Area despite targeted surveys and the lack of previous records in the locality, the Study Area is not likely to support habitat critical to the survival of the Broad-headed Snake.
Disrupt the breeding cycle of an important population	The following is known about the breeding cycle of the Broad-headed Snake (DEC 2005): ▪ Preferred habitat is centred on the communities occurring on the Triassic sandstone of the Sydney Basin. ▪ The sites where they occur are typified by exposed sandstone outcrops and benching and in these locations the vegetation is mainly woodland, open woodland and/or heath. ▪ Seasonally occupies distinctive microhabitats within these broader habitat types. They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer. ▪ Nocturnal to crepuscular (active at dusk) and is an 'ambush predator', preying predominantly on lizards, particularly Lesueurs Velvet Geckos, at least during the cooler months. ▪ During this time the species can be found frequenting exposed sandstone ridgetops where it refuges under exfoliating sheets of sandstone resting on naked rock or within crevices. These refuges often have a predominantly west to north westerly aspect. This aspect effect is thought to provide thermoregulatory advantage and maximises temperature levels for the peak feeding periods of early evening. ▪ During the warmer months of the year they become arboreal frequenting tree hollows and undergo a presumed dietary shift to small mammals, although crepuscular arboreal skinks (*Eulamprus tenuis*) have also been reported in the diet of summer captured individuals (G. Turner 1998 unpublished). ▪ They give birth to live young (ovoviviparous) The Project is unlikely to disrupt the breeding cycle of an important population due to the following: ▪ Subsidence impacts are likely to be minimal and isolated. Only small scale impacts to surface rock and potential habitat are considered likely to occur. ▪ The species has not been previously recorded in the Study Area. ▪ The species was not recorded during surveys undertaken to date. ▪ The majority of potential habitat for the species is unlikely to be impacted by the Project (23 of 24 cliff lines within the Study Area unlikely to be impacted (MSEC 2020) and hollow-bearing trees are likely present throughout woodland/forest habitat within the Study Area) ▪ Hollow-bearing trees outside of the surface infrastructure area would not be impacted by subsidence. ▪ Food sources are unlikely to be impacted by the Project.

Hoplocephalus bungaroides Broad-headed Snake	
Vulnerable Species	**Address of Criteria**
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	It is unlikely that the Project would result in the loss of habitat to the extent that the species is likely to decline. Based on previous subsidence predictions (MSEC 2020) localised and isolated rock falls and surface cracking may occur. Within the Study Area, this may affect about 2 m of cliff line. This is unlikely to significantly reduce the extent and quality of potential habitat such that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	It is unlikely the Project would introduce invasive species that are harmful to the species habitat. Potential key habitat for the species is located away from proposed surface works.
Introduce disease that may cause the species to decline, or	It is unlikely the Project would introduce disease that is harmful to the species. The potential habitat for the species is located away from proposed surface works.
Interfere substantially with the recovery of the species.	The Project is unlikely to substantially interfere with the recovery of the species. Degradation of breeding habitat through subsidence impacts is likely to be isolated and insignificant when compared to the availability of potential habitat in the Study Area.
Conclusion	The proposed action is unlikely to have a significant impact on the Broad-headed Snake due to the following: ▪ The species was not recorded during targeted survey. ▪ An important population is unlikely to be present within the Study Area given the lack of records, and non-detection during survey. ▪ Clearing associated with the surface infrastructure is unlikely to result in a decline of important habitat for the species. ▪ Subsidence related impacts to habitat are likely to be minor and isolated.

Phascolarctos cinereus (Koala	
Criteria (Vulnerable Species)	**Address of Criteria**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The Koala was not recorded during the field surveys despite targeted surveys including spotlighting and scat surveys. However, a record of the Koala by OEH exists within the Study Area. Potential habitat in the Study Area is widespread however is likely to be more concentrated toward the far west of the Study Area within vegetated land that is extensive along the Bargo River. Approximately 17.26 ha of potential foraging habitat would be cleared for the surface infrastructure. Given the species has not been detected during targeted surveys, and no populations are known in the area, it is unlikely that a population exists within the Study Area. Furthermore, habitat for the Koala is unlikely to be significantly impacted by subsidence. Therefore, it is considered unlikely the Project would affect a population in the long-term.
Reduce the area of occupancy of the species	It is unlikely that the Project would reduce the area of occupancy of the Koala as: ▪ Subsidence impacts within the Study Area are anticipated to be localised and minor and unlikely to impact any potential habitat for the Koala ▪ No populations of the Koala are known to occur within the Study Area ▪ No populations of the Koala are known to occur within the area of potential habitat to be cleared by the Project ▪ Potential habitat for the Koala is relatively extensive within the Locality. The Locality includes the Nepean State Conservation Area, vegetated corridors along the Bargo River to the west of the Study Area, and land managed by Water NSW.
Fragment an existing population into two or more populations	It is unlikely that the Project would fragment an existing population of the Koala as: ▪ Subsidence impacts within the Study Area are anticipated to be localised and minor and unlikely to impact any potential habitat for the Koala ▪ No populations of the Koala are known to occur within the Study Area ▪ No populations of the Koala are known to occur within the area of potential habitat to be cleared by the Project ▪ Vegetation clearance as a result of the surface works will result in some fragmentation of habitat, however the species has not been recorded during targeted fauna survey.
Adversely affect habitat critical to the survival of a species	No critical habitat has been listed for the species on the EPBC Act Register of Critical Habitat. The Study Area is not likely to support habitat critical to the survival of the Koala given the species is more likely to utilise the extensive vegetation west and south of the Study Area which adjoins the Nepean State Conservation Area, Conservation land managed by Water NSW and vegetation along the Bargo River.

Phascolarctos cinereus (Koala	
Criteria (Vulnerable Species)	**Address of Criteria**
Disrupt the breeding cycle of a population	The following is known about the breeding cycle of the Koala (DEC 2005): ▪ Home range size varies with quality of habitat, ranging from less than 2 ha to several hundred hectares in size. ▪ Generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. ▪ Animals reach sexual maturity at two years and although breeding can occur yearly, this does not generally occur (DECC 2008). ▪ Diet is primarily comprised of eucalypt leaves. Koalas have been observed to feed on 70 eucalypt and 30 non-eucalypt species. However, in any one area, koalas feed almost exclusively on a small number of preferred species which vary widely on a regional, local and possibly seasonal basis (DECC 2008). ▪ Some groundcover vegetation and other features such as hollow logs, are also useful to provide shelter while on the ground and refuge in extreme weather conditions (DECC 2008). ▪ Studies have shown that koala activity was greater in structurally diverse forest with the majority of trees 25.5-80 diameter at breast height (dbh), or 50–80 cm dbh. (DECC 2008) ▪ The recovery plan (DECC 2008) lists koala food species for different regions. None of the primary food tree species listed for the central coast management area were recorded in the area to be disturbed for surface infrastructure. However secondary food tree species *E. eugenioides* and -supplementary food species *E. globoidea* were recorded in the Study Area. The Project is unlikely to have an adverse effect on the species ability to breed successfully due to the following: ▪ Subsidence impacts to potential habitat would be localised and minor and unlikely to result in impacts to the Koala habitat. ▪ Habitat features within the Study Area are likely to be extensive and not all areas of potential habitat would be impacted by the Project. ▪ No known population occurs within the Study Area. ▪ No Koalas were recorded within the area to be disturbed for surface infrastructure.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The species has not been previously recorded in the surface area footprint. Approximately 17.26 ha of potential habitat would be impacted by surface infrastructure. Habitat is unlikely to be impacted by subsidence. It is unlikely that the Project would result in the loss of habitat to the extent that the species is likely to decline as over >20,000 ha of potential foraging/breeding habitat has been mapped by Tozer et al (2006) as occurring within the locality (including: Shale Sandstone Transition Forest, Upper Georges River Sandstone Woodland, Western Sandstone Gully Forest).
Result in invasive species that are harmful to a critically endangered or endangered species becoming	A biodiversity management plan would be implemented as part of the Project which would propose weed control measures to minimise impacts to adjacent bushland. It is unlikely that the Project would result in an increase in feral pest activity that may impact potential Koala habitat.

Phascolarctos cinereus (Koala	
Criteria (Vulnerable Species)	**Address of Criteria**
established in the critically endangered or endangered species' habitat	
Introduce disease that may cause the species to decline, or	It is unlikely that the Project would result in the introduction of a disease that may cause the species to decline.
Interfere substantially with the recovery of the species.	The Project is unlikely to interfere substantially with the recovery of the species as: ▪ A population is unlikely to occur within the surface infrastructure footprint where loss of habitat through native vegetation clearing would occur. ▪ Habitat is unlikely to be impacted by subsidence given the species may utilise a range of vegetation. Furthermore, feed trees are unlikely to be significantly impacted as a result of subsidence.
Conclusion	The proposed action is unlikely to have a significant impact on the Koala due to the following: ▪ The species was not recorded in the Study Area despite targeted survey. ▪ No important populations are known to occur within the Study Area. ▪ Habitat to be removed is relatively extensive throughout the locality. ▪ Subsidence is unlikely to result in impacts to potential habitat for the species.

Chalinolobus dwyeri (Large-eared Pied Bat)	
Criteria (Vulnerable Species)	**Address of Criteria**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	Although the Large-eared Pied Bat was not detected during the survey, there is one record of the species within the north of the broader Subsidence Study Area. Several other records occur adjacent to the Bargo River to the north and north-east of the Subsidence Study Area and also along the Nepean River to the south of the Subsidence Study Area. The Large-eared Pied Bat may utilise caves and rocky crevices for roosting and breeding habitat but forages nearby in woodland or forested habitat (DERM 2011).The National Recovery Plan for the species (DERM2011) notes that all records of the species are within several kilometres of cliff lines or rocky terrain and that sandstone cliffs and fertile wooded valley habitat within close proximity of each other should be considered habitat critical to the survival of the Large-eared Pied Bat. According to MSEC (2020), a total of 24 cliffs are located within the Study Area. The cliffs may provide roosting habitat for the species. The cliffs are generally located within the valleys of the Bargo River, Dogtrap Creek and Hornes Creek. Given the proximity of the cliff line along the Bargo River, to the surface infrastructure area (within two km), and the proximity of local records of the species, the species is considered likely to utilise the Study Area, including the surface infrastructure area, for foraging habitat. A total of 17.26 ha of forested habitat will be removed within the surface infrastructure area. As detailed in MSEC (2020), most (23 out of a total of 24) cliffs will not be directly mined beneath. These include the cliffs along the Bargo River and Hornes Creek, which are all located outside the extents of the proposed longwalls. The cliffs that occur outside of the area directly above longwalls, are predicted to experience very low levels of vertical subsidence and are not expected to experience any substantial conventional tilts, curvatures or strains (MSEC 2020). The likelihood of cliff instabilities along the Bargo River and Hornes Creek has been assessed by MSEC (2020) using case studies where previous longwall mining has occurred close to but not directly beneath cliffs. The case studies have indicated that very minor rock falls have been observed outside the extracted goaf areas of longwall mining in the Southern Coalfield, although there have been no recorded large cliff instabilities. These case studies are supported by previous impacts from mining at Tahmoor, Appin and Tower Collieries, which have not experienced any large instabilities beyond the extent of the longwall mining area (MSEC 2020). Based on the MSEC (2020) predictions and previous experience in the Southern Coalfields, it is unlikely that potential roosting habitat for the Large-eared Pied Bat within the cliffs to be directly mined beneath would be impacted by large scale instabilities which may destroy this potential habitat. As discussed in MSEC (2020), previous experience in the Southern Coalfield has indicated that cliffs which are directly mined beneath may exhibit instabilities. The one cliff that occurs above the longwalls and may exhibit instabilities occurs along Dogtrap Creek and is 55 metres long and 10 metres high. There is the potential for the cliffs to support roosting habitat for the Large-eared Pied Bat. It is predicted by MSEC (2020) that the cliff to be undermined could experience the full range of predicted subsidence movements, and based on previous experience in the southern coalfields that there is a moderate to likely probability that rock falls and cliff instabilities would occur somewhere

Chalinolobus dwyeri (Large-eared Pied Bat)	
Criteria (Vulnerable Species)	**Address of Criteria**
	along this cliff line. MSEC (2020) states that any impacts to the cliffs that are directly mined beneath, are expected to affect between 3-5 % of the total length of the cliffs. Based on this prediction, the length of the cliff along Dogtrap Creek that may be impacted by subsidence is relatively small (about 2.75 metres). Given the relatively small length of the cliff line that would potentially be impacted by subsidence, the probability that roosting habitat would be impacted is very low. Even more unlikely is that subsidence would result in impacts to a crevice in which a roosting population of Large-eared Pied Bat is present, particularly given no caves are known to occur above the longwalls. As such, , it is unlikely that the species would be impacted by subsidence related impacts. The vegetation clearance required within the surface infrastructure area will impact on 17.26 ha of potential foraging habitat for the species. Given the extent of potential foraging habitat available within the surrounding landscape the low likelihood of impacts as a result of subsidence, it is considered unlikely that the Project would lead to a long term decrease in the size of a population.
Reduce the area of occupancy of the species	It is unlikely that the Project would reduce the area of occupancy of the Large-eared Pied Bat as: ▪ Subsidence impacts within the Study Area are anticipated to be localised and minor. ▪ Not all potential habitat within the Study Area would be impacted by subsidence and clearing associated with the Project. ▪ Not all habitat features are likely to be impacted by subsidence e.g. logs, tree hollows.
Fragment an existing population into two or more populations	It is unlikely that the Project would fragment an existing population of the Large-eared Pied Bat as: ▪ Subsidence impacts within the Study Area are anticipated to be localised and minor; ▪ The species is relatively mobile and the extent of vegetation clearing is unlikely to significantly fragment habitat.
Adversely affect habitat critical to the survival of a species	No critical habitat has been listed for the species on the EPBC Act Register of Critical Habitat. The Study Area is not likely to support habitat critical to the survival of the Large-eared Pied Bat given the species is more likely to utilise the extensive deeper gullies of the Bargo River.
Disrupt the breeding cycle of a population	The following is known about the breeding cycle of the Large-eared Pied Bat (DEC 2005): ▪ 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*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. ▪ Found in well-timbered areas containing gullies. ▪ The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy. ▪ Likely to hibernate through the coolest months. It is uncertain whether mating occurs early in winter or in spring. The Project is unlikely to have an adverse effect on the species ability to breed successfully due to the following:

Chalinolobus dwyeri (Large-eared Pied Bat)	
Criteria (Vulnerable Species)	**Address of Criteria**
	▪ Subsidence impacts to potential habitat would be localised and minor. ▪ Habitat features within the Study Area are likely to be extensive and not all areas of potential habitat would be impacted by the Project. ▪ Not all habitat features are likely to be impacted by subsidence e.g. logs, tree hollows.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The species has not been previously recorded in the surface area footprint. Approximately 17.26 ha of potential habitat would be impacted by the surface infrastructure development. Subsidence impacts to potential habitat are likely to be minor and isolated. It is unlikely that the Project would result in the loss of habitat to the extent that the species is likely to decline as over >20,000 ha of potential foraging/breeding habitat has been mapped by Tozer et al (2006) as occurring within the locality (including: Shale Sandstone Transition Forest, Upper Georges River Sandstone Woodland, Western Sandstone Gully Forest).
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	A biodiversity management plan would be implemented as part of the Project which would include weed control measures to minimise impacts to adjacent bushland. It is unlikely that the Project would result in an increase in feral pest activity that may impact potential Large-eared Pied Bat habitat.
Introduce disease that may cause the species to decline, or	It is unlikely that the Project would result in the introduction of a disease that may cause the species to decline.
Interfere substantially with the recovery of the species.	The Project is unlikely to interfere substantially with the recovery of the species as: ▪ An important population is unlikely to occur within the surface infrastructure footprint where loss of habitat through native vegetation clearing would occur. ▪ Impact as a result of subsidence toward potential habitat is likely to be isolated rock falls, and surface rock cracking. As such, all habitat is unlikely to be impacted by the Project.
Conclusion	The proposed action is unlikely to have a significant impact on the Large-eared Pied Bat due to the following: ▪ The species was not recorded in the Study Area despite targeted trapping survey. ▪ No important populations are known to occur within the Study Area. ▪ Habitat to be removed is relatively extensive throughout the locality. ▪ Subsidence related impacts are likely to be relatively isolated and minor in nature.

Petauroides volans (Greater Glider)	
Criteria (Vulnerable Species)	**Address of Criteria**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The Greater Glider was not recorded during the field surveys despite targeted survey, however the species has been recorded along the Bargo River approximately 1.3 km to the north of the Study Area. Potential habitat in the Study Area occurs along the gullies of the Bargo River River. No known habitat for the species would be impacted by the proposed surface infrastructure, and thus would not lead to a long-decrease of a population of the species. Furthermore, subsidence would not result in the loss of hollow bearing trees, nor decrease the amount of suitable eucalypt forest habitat that a population could utilise. Thus, subsidence would not result in a long-term decrease in the size of any potential population.
Reduce the area of occupancy of the species	It is unlikely that the Project would reduce the area of occupancy of the Greater Glider as: ▪ The species does not occur within the area proposed to be cleared for surface infrastructure. ▪ Subsidence is unlikely to impact upon habitat for this species eg. tree hollows, tall eucalypt forest.
Fragment an existing population into two or more populations	It is unlikely that the Project would fragment an existing population of the Greater Glider as: ▪ Subsidence impacts within the Study Area are anticipated to be localised and minor. These potential impacts would not result in fragmentation of potential habitat. ▪ The species does not occur within the area proposed to be cleared for surface infrastructure, and thus unlikely to result in fragmentation of an important habitat.
Adversely affect habitat critical to the survival of a species	No critical habitat has been listed for the species on the EPBC Act Register of Critical Habitat. The Study Area is not likely to support habitat critical to the survival of the Greater Glider given the species is more likely to utilise the extensive deeper gullies of the Bargo River.
Disrupt the breeding cycle of a population	The following is known about the breeding cycle of the Greater Glider (Threatened Species Scientific Committee 2016): ▪ The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. ▪ It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers ▪ During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees ▪ Home ranges are typically relatively small (1−4 ha) ▪ Females give birth to a single young from March to June. ▪ Sexual maturity is reached in the second year. ▪ Longevity has been estimated at 15 years, so generation length is likely to be 7−8 years. ▪ The relatively low reproductive rate may render small isolated populations in small remnants prone to extinction The Project is unlikely to have an adverse effect on the species ability to breed successfully due to the following:

Petauroides volans (Greater Glider)	
Criteria (Vulnerable Species)	**Address of Criteria**
	▪ Subsidence impacts to potential habitat are highly unlikely. ▪ Habitat features within the Study Area are likely to be extensive and not all areas of potential habitat would be impacted by the Project. ▪ The Project would not result in the clearing of likely habitat for the species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The species has not been recorded in the surface infrastructure footprint despite targeted survey. However the species has been recorded along the Bargo River approximately 1.3 km to the north of the Study Area. Potential habitat in the Study Area occurs along the gullies of the Bargo River and Nepean River. No known habitat for the species would be impacted by the proposed surface infrastructure. Furthermore, subsidence would not result in the loss of hollow bearing trees, nor decrease the amount of suitable eucalypt forest habitat that a population could utilise. Thus, the Project is unlikely to reduce the habitat utilised by a population to an extent that the species would decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	The Project would implement a biodiversity management plan which would propose weed control measures to minimise impacts to adjacent bushland. It is unlikely that the Project would result in an increase in feral pest activity that may impact potential Greater Glider habitat.
Introduce disease that may cause the species to decline, or	It is unlikely that the Project would result in the introduction of a disease that may cause the species to decline.
Interfere substantially with the recovery of the species.	The Project is unlikely to interfere substantially with the recovery of the species as: ▪ An important population is unlikely to occur within the surface infrastructure footprint where loss of habitat through native vegetation clearing would occur. ▪ Habitat for the species is unlikely to be impacted by subsidence.
Conclusion	The proposed action is unlikely to have a significant impact on the Greater Glider due to the following: ▪ The species was not recorded in the Study Area despite targeted survey. ▪ No important populations are known to occur within the Study Area. ▪ Habitat to be removed for the surface infrastructure is unlikely to be utilized by the Greater Glider. ▪ Subsidence related impacts are likely to be relatively isolated and minor in nature. Subsidence would not impact habitat available for the species.

Grey-headed Flying-fox	
Criteria (Vulnerable Species)	**Address of Criteria**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The Grey-headed Flying-fox was not recorded during the current field survey, however it is likely the species would utilised the Study Area for foraging habitat. No known camp sites exist within the area proposed for surface infrastructure or within the Study Area. Approximately 23.57 hectares of potential foraging habitat would be cleared for the surface infrastructure, however potential habitat is widespread throughout the locality. Given the species has not been detected during the current survey, and no populations are known in the area, it is unlikely that an important population exists within the Study Area. Furthermore, habitat features for the Grey-headed Flying-fox are unlikely to be impacted by subsidence.
Reduce the area of occupancy of the species	It is unlikely that the Project would reduce the area of occupancy of the Grey-headed Flying-fox as: ▪ Subsidence within the Study Area are unlikely to impact upon habitat for the species. ▪ No known camp sites occur within the Study Area. ▪ An important population does not occur within the Study Area.
Fragment an existing population into two or more populations	It is unlikely that the Project would fragment an existing population of the Grey-headed Flying-fox as: ▪ Subsidence impacts within the Study Area are anticipated to be localised and minor. ▪ The species is relatively mobile and vegetation clearing is unlikely to significantly fragment habitat.
Adversely affect habitat critical to the survival of a species	No critical habitat has been listed for the species on the EPBC Act Register of Critical Habitat.
Disrupt the breeding cycle of a population	The following is known about the breeding cycle of the Grey-headed Flying-fox (DEC 2005): ▪ Occur 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. ▪ Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. ▪ Annual mating commences in January and conception occurs in April or May; a single young is born in October or November. ▪ Site fidelity to camps is high; some camps have been used for over a century. ▪ Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km.

Grey-headed Flying-fox	
Criteria (Vulnerable Species)	**Address of Criteria**
	▪ Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. ▪ Also forage in cultivated gardens and fruit crops. It is uncertain whether mating occurs early in winter or in spring. The Project is unlikely to have an adverse effect on the species ability to breed successfully due to the following: ▪ Subsidence is unlikely to impact habitat for the Grey-headed Flying Fox. ▪ Habitat features within the Study Area are likely to be extensive and not all areas of potential habitat would be impacted by the Project.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The species has not been previously recorded in the surface area footprint. Approximately 23.57 hectares of potential foraging habitat would be impacted by the REA development footprint. Habitat is relatively extensive throughout the locality. Subsidence is unlikely to result in impacts to foraging habitat. The species is unlikely to decline due to the Project.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	The Project would implemented a biodiversity management plan which would propose weed control measures to minimise impacts to adjacent bushland which is foraging habitat for the species. It is unlikely that the Project would result in an increase in feral pest activity that may impact potential Grey-headed Flying-fox.
Introduce disease that may cause the species to decline, or	It is unlikely that the Project would result in the introduction of a disease that may cause the species to decline.
Interfere substantially with the recovery of the species.	The Project is unlikely to interfere substantially with the recovery of the species as: ▪ An important population is unlikely to occur within the surface infrastructure footprint where loss of habitat through native vegetation clearing would occur. ▪ Impact to habitat as a result of subsidence is unlikely.
Conclusion	The proposed action is unlikely to have a significant impact on the Grey-headed Flying-fox due to the following: ▪ The species was not recorded in the Study Area despite targeted trapping survey. ▪ No important populations are known to occur within the Study Area. ▪ Habitat to be removed is relatively extensive throughout the locality. ▪ Habitat would not be impacted by subsidence.

BIRDS **Endangered species: Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Xanthomyza phrygia)***	
Criteria (Critically Endangered and Endangered Species)	**Address of Criteria**
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	Neither of these species were recorded during the current survey, nor have they been previously recorded in the Study Area. It is unlikely subsidence associated with the Project would impact potential habitat associated with these species. Furthermore, the proposed surface infrastructure would remove approximately 23.57 ha of native vegetation. Despite the loss of this native vegetation, the Project is unlikely to lead to a long-term decrease in the size of a population due to the following: ▪ It is unlikely a population of either of these species exist in the Study Area, as neither of the species were recorded during the current or previous surveys. ▪ Extensive potential habitat surrounding the Study Area would not be impacted by the Project.
Reduce the area of occupancy of the species	The impact of the Project may reduce native vegetation by 23.57 hectares. Potential habitat immediately adjacent to the Study Area is extensive which extends into Nepean State Conservation Area, and Conservation Lands managed by Water NSW. It is unlikely that the loss of native vegetation as a result of surface infrastructure associated with the Project would reduce the area of occupancy of either of these bird species. Furthermore, no populations of these species have been recorded in the Study Area.
Fragment an existing population into two or more populations	Neither of the species are likely to have populations reliant upon the Study Area. Whilst the Project would result in some fragmentation, the species are mobile and therefore unlikely to be impacted by fragmentation.
Adversely affect habitat critical to the survival of a species	No critical habitat has been listed for these species on the EPBC Act Register of Critical Habitat. As these species have not been recorded in the Study Area, the potential habitat within the Study Area is not likely to represent habitat critical to the survival of these species.
Disrupt the breeding cycle of a population	The Project is unlikely to disrupt the breeding cycle of a population as: ▪ Neither of these species are likely to have populations reliant upon the Study Area. ▪ The species have not been recorded in the Study Area. Thus a population of these species is unlikely to occur. ▪ The species are mobile and likely to move to other areas of potential habitat. ▪ Potential habitat immediately adjacent to the Study Area is extensive.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to	The Project would remove and decrease approximately 23.57 ha of native vegetation associated with the surface works for the Project. It is unlikely that the Project would result in the loss of habitat to the extent that the species is likely to decline as extensive potential habitat occurs within the locality.

BIRDS **Endangered species: Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Xanthomyza phrygia)***	
Criteria (Critically Endangered and Endangered Species)	**Address of Criteria**
the extent that the species is likely to decline	
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	There is the potential for the Project to result in an increase in invasive species such as introduced weeds into adjacent habitat. However, mitigation measures such as the implementation of a weed management plan would be carried out. This would reduce the potential for any impacts of the habitat of these species.
Introduce disease that may cause the species to decline, or	It is unlikely the Project would introduce disease that would cause these species to decline.
Interfere substantially with the recovery of the species.	The Project is unlikely to substantially interfere with the recovery of the species as neither have been recorded in the Study Area. No known habitat for these species occurs in the Study Area.
Conclusion: The proposed action is unlikely to have a significant impact on Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Xanthomyza phrygia).*	

BIRDS **Migratory species: Cattle Egret, Great Egret, Fork-tailed Swift, Regent Honey Eater, Rainbow Bee-eater, Satin Flycatcher.**	
Criteria (Migratory Species)	**Address of Criteria**
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	The impact of the Project may reduce potential habitat by 23.57 ha. Potential habitat immediately adjacent to the Study Area is extensive and is part of a corridor of vegetation along the Bargo River, Nepean State Conservation Area and land managed by Water NSW. It is unlikely that the loss of potential habitat within the Study Area would reduce the area of a population of any of these bird species. Whilst the Project would result in some fragmentation, the species are mobile and therefore unlikely to be impacted by fragmentation. It is unlikely that the Project would result in the loss of habitat to the extent that the species are likely to decline as over 20,000 hectares of potential habitat occurs within the locality.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	There is the potential for the Project to result in an increase in invasive species such as introduced weeds into adjacent habitat. However, mitigation measures such as the implementation of a weed management plan would be implemented. This would reduce the potential for any impacts of the habitat of the species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The Project is unlikely to disrupt the breeding cycle of an important population as: ▪ None of these species are likely to have ecologically significant proportions of the population reliant upon the Study Area; ▪ The species have not been recorded in the Study Area. Thus an ecologically significant proportion of the population of any of these species is unlikely to occur. ▪ The species are mobile and likely to move to other areas of potential habitat. ▪ Potential habitat immediately adjacent to the Study Area is extensive.
Conclusion: The proposed action is unlikely to have a significant impact on Cattle Egret, Great Egret, Fork-tailed Swift, Regent Honey Eater, Rainbow Bee-eater, and Satin Flycatcher.	

Appendix 9. Credit profile for development

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 12/12/2019 Time: 1:43:11PM Calculator version: v4.0

Major Project details

Proposal ID:	0112/2019/5018MP
Proposal name:	5315 Tahmoor South Project (2019)
Proposal address:	Tahmoor Coal Pty Ltd P.O. Box 100 Tahmoor NSW 2573
Proponent name:	Tahmoor Coal Pty Ltd
Proponent address:	
Proponent phone:	
Assessor name:	Luke Baker
Assessor address:	
Assessor phone:	
Assessor accreditation:	0112

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	23.57	1,084.17
Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	14.20	398.00
Total	37.77	1,482

Credit profiles

1. Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (HN556)

Number of ecosystem credits created	1,084
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (HN556) Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (HN513) Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (HN604)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion, (HN564)

Number of ecosystem credits created	398
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion, (HN564) Yellow Bloodwood - ironbark shrubby woodland of the dry hinterland of the Central Coast, Sydney Basin Bioregion, (HN612)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Koala	Phascolarctos cinereus	17.26	449
Bargo Geebung	Persoonia bargoensis	8.00	616
Large-eared Pied Bat	Chalinolobus dwyeri	17.26	224
Brown Pomaderris	Pomaderris brunnea	1.00	15
Brown Pomaderris	Pomaderris brunnea	0.00	15
Southern Myotis	Myotis macropus	17.26	380
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	491.00	6,874
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	0.00	6,874
Eastern Pygmy-possum	Cercartetus nanus	17.26	345
Eastern Cave Bat	Vespadelus troughtoni	17.26	224

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Contact Us

Niche Environment and Heritage
02 9630 5658
info@niche-eh.com

NSW Head Office – Sydney
PO Box 2443 North Parramatta
NSW 1750 Australia

QLD Head Office – Brisbane
PO Box 540 Sandgate
QLD 4017 Australia

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Illawarra
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Newcastle
Mudgee
Port Macquarie
Brisbane
Cairns

Our services

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Terrestrial
Freshwater
Marine and coastal
Research and monitoring
Wildlife Schools and training

Heritage management
Aboriginal heritage
Historical heritage
Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals
Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Environmental offsetting
Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)