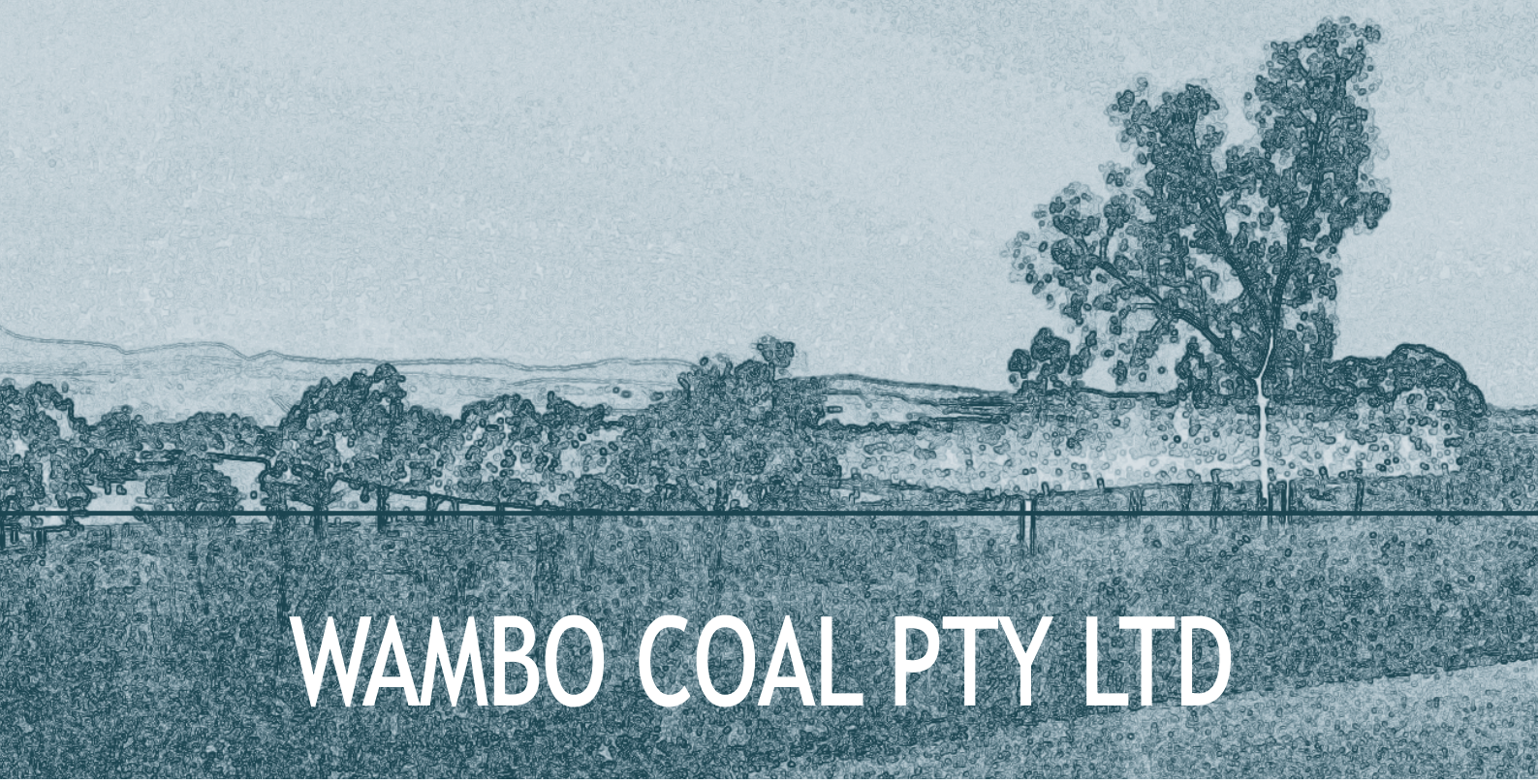

WAMBO COAL PTY LTD

NORTH WAMBO UNDERGROUND MINE MODIFICATION

ENVIRONMENTAL ASSESSMENT

APPENDIX E

FAUNA ASSESSMENT

Peabody ENERGY

niche
Environment and Heritage

North Wambo Underground Mine Modification

FAUNA ASSESSMENT

November 2012

DOCUMENT CONTROL

Business Unit	Niche Environment and Heritage, Central Coast/Hunter Office		
Project No.	1069		
Document Description	Fauna assessment to determine the ecological impacts from proposed modifications to the North Wambo Underground Mine		
	Name	**Signed**	**Date**
Supervising Manager(s)	Rhidian Harrington		9 November 2012

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Internal Review	**Name**
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Prepared for:	**Organisation**
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Front Cover Photograph: Stony Creek (bed) and escarpment foothills to the west.

EXECUTIVE SUMMARY

Niche Environment and Heritage Pty Ltd was commissioned by Wambo Coal Pty Ltd to conduct a fauna assessment to determine the ecological impacts (primarily through subsidence) of the proposed North Wambo Coal Underground Mine Modification. The extension involves two longwalls covering an approximate area of secondary workings of approximately 85 hectares (ha) near Warkworth in the Hunter Valley, New South Wales.

Fauna survey of the study area was completed in May and September 2011 and complements previous surveys conducted within and around the study area. Transects were established in representative habitat types of the study area and multiple survey techniques were applied to cover the full range of terrestrial fauna groups and potential threatened species.

Habitats within the study area consisted of cleared grazing land, regenerating and mixed aged woodland, riparian vegetation and ephemeral watercourses. The study area has been impacted previously through clearing and alterations to natural hydrology, and there were limited aquatic values present. A total of 98 vertebrate animal species were recorded during field survey comprising 68 birds, 20 mammals, six reptiles and four frogs. Six threatened species including four woodland birds and two bats, were recorded.

Given the design and location of the proposed longwalls it is anticipated that only minor impacts from subsidence would occur, such as surface cracking and minor changes to surface hydrology. Limited habitat for threatened species occurs within the Modification area and it is unlikely that there would be a significant impact from the proposal on any threatened or migratory species listed under the New South Wales *Threatened Species Conservation Act, 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*.

Subsidence impacts should be monitored and ameliorative measures employed should subsidence impacts occur.

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1 INTRODUCTION

1.1 Background

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Wambo Coal Pty Ltd (WCPL), to conduct fauna surveys throughout lands subject to future potential subsidence impacts associated with the North Wambo Underground Mine Modification (the Modification).

A suite of fauna surveys have previously been conducted throughout the study area and surrounds for similar development applications or for monitoring of rehabilitation works. These surveys were reviewed as part of this study.

1.2 Legislative Context

Wambo Coal is seeking to modify the Wambo Development Consent (DA 305-7-2003) under section 75W of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) for the North Wambo Underground Mine Modification.

Threatened fauna listed under the NSW *Threatened Species Conservation Act* 1995 (TSC Act), NSW *Fisheries Management Act* 1994 (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) that occur or potentially occur in the study area have been considered in this assessment.

1.3 The Modification and the Study Area

The Modification area is situated approximately 10 kilometres (km) west of Singleton in the Hunter Valley at Warkworth and is approximately 2 km to the southwest of the Wambo open cut coal mine (Figure 1).

The Modification involves the development of two longwall panels in the Wambo seam adjacent to the existing North Wambo Underground Mine. Access to the two longwall panels would be direct from the existing North Wambo Underground Mine (Figure 2). The Modification would use the existing surface infrastructure of the North Wambo Underground Mine.

The description of the study area for the Modification in this report includes the original proposed mine layout and surrounds. The mine layout has subsequently been refined based on mine planning considerations and is shown on Figure 2 as the Modification area. The Modification area includes the two longwall panels and the relevant extent of subsidence impacts, as provided by MSEC (2012).

The study area lies within the northern part of the Sydney Basin bioregion. The landscapes of the Study Area include the Central Hunter Foothills, which occur around the base of the escarpment to the west, and the Central Hunter Alluvial Plains, which occur around the flatter areas associated with the main drainage features.

The study area encompasses approximately 196 hectares (ha) of cleared grazing land, regenerating and mixed aged woodland, riparian vegetation and ephemeral watercourses.

Four creeks occur within the study area and surrounds, comprising three ephemeral drainage lines generally flowing from west to east into the permanent Wollembi Brook, which is immediately east

of the study area. Parts of Stony Creek and Wambo Creek occur along the edge of the study area and confluence near its southern corner, before flowing into Wollembi Brook. A part of North Wambo Creek is at the northern edge of the study area.

There are five dams located within the study area. The largest occurs in the centre of the study area. A well maintained network of access tracks and fire trails provide access to most of the study area.

Wollemi National Park occurs to the west of the study area and is part of the Blue Mountains World Heritage Area. These areas would not be impacted by the Modification.

A detailed description of the Modification and the study area is provided in the main text of the Modification Environmental Assessment.

1.4 Approach of this Assessment

The primary aim of this report is to describe and assess fauna and conservation values within the Modification area and surrounds and determine whether the Modification is likely to have a significant impact on fauna of conservation significance. A broader assessment of likely impacts from the proposal on fauna and their habitats is also provided.

An assessment of the spatial extent, nature and magnitude of subsidence impacts resulting from the Modification has been completed by MSEC (2012) (Appendix A of the Modification Environmental Assessment). The main conclusions from the MSEC 2012 report relevant to this assessment are:

- It is unlikely that Wollombi Brook or the associated alluvium would be adversely impacted as a result of the extraction of the proposed WMLW9 and WMLW10;
- North Wambo and Wambo Creeks could experience very low levels of subsidence, they are not expected to experience any measurable tilts, curvatures or strains resulting from the extraction of the proposed longwalls.
- Stony Creek could experience small additional subsidence in the vicinity of the proposed longwalls, however, this is negligible when compared with the total subsidence where the creek is located directly above the longwalls further upstream.
- The South Wambo Dam may be impacted by subsidence and therefore it will be necessary for the mine to develop management strategies for the dam, which could include lowering the water level or completely draining the dam prior to directly mining beneath it.
- Surface cracking of soils is expected to occur within the study area consistent with previous adjacent mine operations. It is not expected that there would be a hydraulic connection between the surface and seam, as none was observed after the extraction of the first four longwalls at the NWUM, which extracted directly beneath North Wambo Creek at a depth of cover of around 100 metres (MSEC 2012).

The predicted extent of physical subsidence impacts is shown on Figure 3. The original mine layout was reduced after design modifications, resulting in a significant proportion of survey effort having been conducted outside of the Modification area. This does not detract from the overall aims of this study as areas where survey was conducted are immediately adjacent to the Modification area and include areas of representative habitat. In addition, there was good survey coverage inside the Modification area.

The approach of this assessment includes the following:

- Undertake a background review of relevant literature, mapping and databases.
- Undertake habitat and targeted survey for threatened fauna that are known or considered to have the potential to occur within the study area.
- Describe the ecological values of the site in regard to fauna.
- Describe potential ecological impacts at the site in regard to fauna.
- Assess the significance of the impacts of the proposal on threatened animal species as required under the TSC Act and EPBC Act.

1.5 Expected Impacts from Proposal

Impacts on threatened species and ecological values of the Modification area have been determined using advice regarding expected subsidence impacts from the proposal as provided by WCPL and MSEC 2012. Potential impacts may include surface cracking of soils above the longwall panels and immediate surrounds and minor alterations to surface hydrology within the area depicted in Figure 2.

1.6 Definitions

The following definitions have been adopted for this assessment.

Modification Area: the area to be directly and indirectly affected by the Modification. Includes the two longwall panels and the relevant extent of subsidence impacts.

Study Area: the Modification area and surrounds. Refers to a larger area that included the original proposed mine layout which has since been refined.

Direct Impacts: those that directly affect the habitat and/or individual plants and animals and cannot be avoided or mitigated.

Indirect Impacts: those that affect species, populations or ecological communities in a manner other than through direct loss or disturbance. These can usually be avoided or mitigated.

Local Population: the population of a particular species that occurs in the study area.

Locality: the area within 10 km of the study area.

Local Occurrence: refers to the distribution of an ecological community within the study area.

2 LITERATURE REVIEW

A number of ecological studies have been undertaken previously within the study area and surrounds, along with routine ecological monitoring surveys commissioned by WCPL. The main literature relevant to the current study comprises:

- Montrose Water Storage Modification Terrestrial Fauna Assessment (Biosphere Environmental Consultants 2012);
- Wambo Development Project Environmental Impact Statement Terrestrial Fauna Assessment (Mount King Ecological Surveys 2003); and
- Annual ecological monitoring reports (e.g. HLA-Envirosciences Pty Limited 2007; RPS Harpers Somers O'Sullivan 2007, 2008, 2009).

The above literature (as well as database searches – section 3.1) has been considered in determining the likelihood of occurrence of threatened species within the study area, and generally throughout the report. A summary of the surveys and their results is included below.

2.1 Montrose Water Storage Modification – Terrestrial Fauna Assessment (Biosphere Environmental Consultants 2012)

This study was conducted as part of an Environmental Assessment for the construction of a new water storage dam situated approximately 5 km north of the current proposed longwalls. Fauna surveys of a wider study area were undertaken by Biosphere Environmental Consultants in September 2010.

Fauna surveys were conducted over five days and four nights in September 2010. Four systematic and 19 targeted survey sites were surveyed using a variety of survey techniques including, echolocation and harp trapping for bats, trapping for mammals, spotlighting, call playback, nocturnal and diurnal herpetological searches and bird surveys.

Four main habitat types were identified on which the survey effort was based. These included cleared /grassland; creek line and riparian habitats; woodland/open forest on steep hills; and woodland, including scattered trees on undulating and level land.

Ninety nine species were identified during the survey including three threatened bird species (Grey-crowned Babbler [*Pomatostomus temporalis temporalis*], Speckled Warbler [*Pyrrholaemus saggitatus*] and Varied Sitella [*Daphoenositta chrysoptera*]) and three threatened bat species (Eastern Freetail Bat [*Mormopterus norfolkensis]*, Large-eared Pied Bat [*Chalinolobus dwyeri*] and Eastern Bent-wing Bat [*Miniopterus australis*]).

2.2 Wambo Development Project Environmental Impact Statement – Terrestrial Fauna Assessment (Mt King Ecological Surveys 2003)

This study was conducted as part of a multi-faceted proposal to upgrade and expand mining activities within the WCPL mining and coal lease areas. The objectives were to determine what terrestrial fauna occupied the project area, to assess population status and habitat usage of terrestrial fauna, assess the value of vegetation types to native fauna and assess impacts on fauna.

The project area for the above project included the current study area along with additional areas surrounding it. Fauna survey occurred at 12 systematic survey sites and four incidental survey sites over 24 days from the 17 September to 18 October 2002 in drought conditions.

Fauna survey included Elliot trapping, cage trapping, spotlighting, hair tubes, bird surveys, call playback, pit trapping, herpetological searches and sand plots, as well as incidental observations.

A relatively high diversity of animals was found within the project area with 159 species recorded including ten amphibians, 15 reptiles, 117 birds and nine mammals. High diversity was attributed to the proximity of the site to Wollemi National Park and a variety of habitat types present. It was noted, however, that the number of individuals within some fauna groups was very low, including reptiles and small mammals, and that trapping rates were also very low.

Nine threatened species were recorded within the project area including eight bird species and one mammal – Brown Treecreeper (*Climacteris picumnus victoriae*), Diamond Firetail (*Stagonopleura guttata*), Glossy Black-cockatoo (*Calyptorhynchus lathmi*), Grey-crowned Babbler, Hooded Robin (*Melanodryas cucullata*), Speckled Warbler, Square-tailed Kite (*Lophoictinia isura*), Turquoise Parrot (*Neophema pulchella*) and Squirrel Glider (*Petaurus norfolkensis*).

The study highlighted potential impacts from the development, emphasising loss of vegetation and removal of habitat features as the biggest threat to threatened species. Impacts to watercourses through subsidence was suggested as a possible impact, with bed and bank erosion potentially occurring if not remedied.

2.3 Annual Ecological Monitoring Reports (e.g. HLA-Envirosciences Pty Limited 2007; RPS Harpers Somers O'Sullivan 2007, 2008, 2009)

These studies involved fauna survey using techniques similar to previous surveys. These studies have been conducted annually throughout areas of the WCPL lease areas dedicated to rehabilitation and conservation (Remnant Woodland Enhancement Program [RWEP] Areas), as well as analogous sites outside of these areas. Three main areas have been surveyed for these studies which border the west, north-west and east of the current study area. One of the main areas surveyed was east of Wollombi Brook and included habitat types that had not been surveyed in this or previous studies.

These studies have recorded a number of threatened species including the Little Eagle (*Hieraaetus morphnoides*), Gang-gang Cockatoo (Callocephalon fimbriatum), Glossy Black Cockatoo, Little Lorikeet (*Glossopitta pusilla*), Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Varied Sittella, Brown Treecreeper, Speckled Warbler, Painted Honeyeater (*Grantiella picta*), Hooded Robin, Grey-crowned Babbler, Diamond Firetail, Brush-tailed Rock-wallaby (*Petrogale penicillata*), Eastern Freetail-bat, Large-eared Pied Bat, Eastern Bentwing-bat, Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax ruepelli*) and Yellow-bellied Sheathtailed-bat (*Saccolaimus flaviventris*).

3 METHODS

3.1 Review of Materials

The context of the study area within the broader landscape was assessed to give an indication of importance in regard to movement and dispersal of fauna as well as potential impacts from the proposal on surrounding ecological features. This was completed by review of previous studies (Section 2) and natural resource mapping and aerial photography. The key source of native vegetation data was Peake (2006).

Four broad habitat types were identified within the study area, which are similar to those previously described close to the study area (e.g. Mount King Ecological Surveys 2003). These can be described as follows:

- Grassland with scattered trees and small patches (i.e. < 0.25 ha) of regenerating vegetation.
- Regenerating vegetation dominated by eucalyptus species (includes some small patches of vegetation dominated by *Allocasuarina luehmanniana* [Bull-oak]) on low lying and undulating plains.
- Regenerating and mixed age vegetation dominated by eucalyptus species on steeper hill slopes and escarpment foothills.
- Creekline and riparian habitats.

The literature and database review was used to identify threatened fauna species that could potentially occur in the study area. Database searches using a 10 km radius around the study area were conducted in August 2011. The following databases and search tools were used:

- Office of Environment and Heritage Atlas of NSW Wildlife (2011); and
- Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) Protected Matters Search Tool (2011).

3.2 Field Survey

Field surveys were undertaken throughout the study area by two ecologists over seven days from 23 to 28 May 2011 and on the 26 September 2011. Prior to surveys brief visits to the study area were conducted. The field surveys incorporated both targeted survey using established survey techniques and broad habitat-based assessment.

3.2.1 Survey Design and Effort

Four transects were established and positioned to include the main habitat types within the study area (Figure 3). Targeted survey was concentrated around the four transects using recognised survey techniques for individual fauna groups. Additional targeted surveys were conducted away from transects to increase spatial coverage of the study area and include additional habitat features.

Along each transect a combination of Elliot traps, cage traps, infrared camera traps and bat echolocation recorders were deployed. Additionally, bird surveys, spotlighting, call playback and herpetological surveys were conducted. The details of individual survey components and effort are provided in Table 1.

Table 1: Survey Effort and Details for Targeted Fauna Survey

Method	Survey Effort	Details
Elliot trapping	Twenty traps per site for four nights (80 trap nights)	A combination of Elliot A and Elliot B traps were placed at each of the four sites for four consecutive nights. Where potential feed/den trees were identified within the transect, Elliot traps were mounted to trees using a tree mount. All traps were sprayed with a honey-mixture.
Cage trapping	Average of two traps per transect for four nights (eight trap nights)	Four large cage traps targeting Spotted-tailed Quoll were placed along Transect 3, while two were placed along Transects 1 and 4. Traps were left for four consecutive nights and baited with sardines.
Infra red camera traps	Four cameras for four nights (16 trap nights)	Cameras were set up with baits laid nearby within a PVC tube containing truffle oil and a honey/oat/peanut butter mixture. The area was sprayed with honeyed water. A camera was setup at each of the four transect sites, and left for four nights.
Echolocation recording	One recorder for five nights across three sites. Two recorders for a further two hours each in September	SM2 Bat detector units were deployed at three of the four transect locations along identified flyways. Twice this survey effort as planned was prevented through malfunction of equipment.
Bird survey	Eleven hours	Twenty minute transect and point surveys though the day depending on weather, but concentrating on morning survey.
Spotlighting	Nine hours over five nights	Spotlighting targeting arboreal mammals within the study area.
Call play back	Six hours over four nights	Call play back for Powerful Owl, Barking and Masked Owls, Yellow-bellied Glider, Squirrel Glider and Koala
Herpetological Surveys	Four hours	Spotlighting around aquatic features during nocturnal survey and diurnal targeted searches under rocks, timber, logs and tree bark in identified potential habitat throughout the study area.
Frog chorus survey	Two hours	Frogs were listened for at various locations within the study area and surrounds, however there were limited locations where frogs were calling.

Habitat assessments were conducted along each transect and wherever vegetation structure or floristic qualities were unique within the study area. 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 etc.);
- presence and relative abundance of key habitat features (e.g. tree hollows, large logs, exfoliating rock, flowering resources, aquatic features);
- condition and disturbance factors; and
- vegetation age structure.

3.2.2 Survey Conditions

Weather was predominantly mild with light breezes, although there were some days of strong winds, rain and cold nights. There was moderate rainfall prior to survey. Bureau of Meteorology records from Jerry's Plains, NSW (Table 2) (http://www.bom.gov.au/climate/).

Table 2: Weather Conditions from Jerry's Plains (12 km north-west of Wambo Coal Mine) during and prior to Fauna Survey

Date	Survey Period	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	9am wind direction and speed (km/h)	3pm wind direction and speed (km/h)
20/05/2011	None	4.6	24.0	0	Calm	Calm
21/05/2011	None	4.3	24.2	0	East 7	West 4
22/05/2011	None	4.4	25.7	0	West 15	Calm
23/05/2011	2 transects traps set only	11.1	22.5	14	Calm	West 50
24/05/2011	Diurnal and nocturnal (remaining traps set)	9.2	18.4	0	West 4	South-west 15
25/05/2011	Diurnal and nocturnal	10.6	16.8	14.2	South 11	South 33
26/05/2011	Diurnal and nocturnal	9	16.8	0	Calm	North-west 7
27/05/2011	Diurnal and nocturnal	3.3	18.2	0	West 11	North-west 11
28/05/2011	Limited habitat assessment only	1.6	19.1	0	West 6	East 11
26/09/2011	Diurnal bird and herp survey, frog chorus survey and spotlighting	11.6	19.6	1.2	East 46	East 46

3.3 Threatened Species Assessment

A list of fauna that could potentially occur within the Modification area was determined from available literature and searches of relevant databases (Section 3.1) (Appendix 1). Further analysis of the likelihood of those species occurring within the Modification area was then undertaken.

Five categories for 'likelihood of occurrence' were attributed to species after considering the number and proximity of known records, presence or absence of preferred habitat features, the mobility of the species, results of field surveys and professional judgement. The categories are outlined in Table 3.

Species in the 'Known', 'High' and 'Moderate' categories were considered individually to ascertain whether there might be any potential impacts from the Modification. Any species would be subject to a formal Assessment of Significance if impacts for the species could reasonably occur from the proposal based on potential habitat use within the Modification area and an understanding of potential impacts from the proposal. This process was completed on an individual species basis (Appendix 1).

Table 3: Likelihood of Occurrence Criteria – Threatened Fauna

Likelihood rating	Criteria
Known	The species was observed within the study area during recent survey.
High	It is likely that the species inhabits or utilises habitat within the Modification area based on habitat observations, the biology of the species and/or previous survey records.
Moderate	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. There may be one or more recent records within similar habitat around the Modification area.
Low	It is unlikely that the species inhabits the study area. If present at the site the species would likely be a transient visitor. Habitat or other features of the Modification area is/are largely unsuitable.
None	The habitat within the Modification area is unsuitable for the species.

3.4 Limitations

Limitations to this study include the timing of the surveys, prevailing weather conditions and time constraints.

However, it is considered that the high level of previous survey in and around the study area, along with habitat assessments conducted during this survey has allowed for a high level of confidence in predicting the occurrence of threatened species and evaluating the ecological and conservation values within the study area.

4 RESULTS AND DISCUSSION

4.1 Habitat Assessment and Description

Habitat assessments along transects and within other parts of the study area confirmed the habitat types identified prior to survey and revealed additional information regarding habitat characteristics and the quality of habitats available within and around the Modification area.

4.1.1 Habitat within the Modification Area

The Modification area consists of habitat types that have been previously disturbed via clearing for agriculture and associated activities. Habitats primarily constitute lightly to moderately grazed grasslands with scattered mature trees and small stands of regenerating woodland; larger patches of regenerating woodland dominated by eucalyptus species and Bulloak; and a large constructed dam. A small area of ephemeral watercourse also occurs within the Modification area.

Habitats within the Modification area are generally in low to moderate condition, due to a lack of native species richness and the absence of older growth habitat components. A moderate level of resilience is apparent due to a relatively intact soil profile and low cover of weeds throughout most areas. Past land management practices have led to low densities of hollows and logs (with the exception of one or two log dumps) and there is little rocky habitat throughout the site.

Regenerating Woodland

The more densely vegetated areas of the Modification area constitute regenerating woodland with occasional large emergent remnant eucalyptus trees. The canopy and midstorey layers comprise eucalyptus species and *Allocasuarina leuhmannii* (average height of canopy along representative transect was 15-18m) (Figure 3; Plate 1). Some patches of *Melaleuca decora* also occurred. There was a sparse understorey. Vascular ground cover of forbs and grasses (predominantly *Austrodanthonia sp., Austrostipa sp., Eragrostis brownii, Microlaena stipoides*, *Bothriochloa macra, Dichondra repens* and *Centella* asiatica) was patchy and interspersed by leaf litter and bare earth.

Plate 1: Habitat along Transect 4 – regenerating woodland

Mixed Native/Exotic Derived Grassland

Much of the Modification area constitutes derived grassland, which is comprised of a mixture of native and exotic grass species with common native and exotic herbs, forbs and sedges also occurring but less frequently. Grassland areas also include low densities of scattered remnant eucalyptus trees and these provide fauna habitat in the form of tree hollows and hollow logs. Fallen timber has been removed and added to small log dumps in some instances.

Dams and Creeklines

Dams within the Modification area generally offer typical farm dam habitat with a limited expanse of shallow habitat which provides potential for algal and macrophyte growth and establishment of abundant macroinvertebrate communities (Plate 2). The large dam (South Wambo Dam) in the central part of the study area constitutes an area of woodland that has been altered to create a dam. The dam provides some areas of foraging habitat and roost trees, primarily for common waterfowl, particularly in the shallower parts of the dam. The dam was established relatively recently and therefore whilst it has potential to provide quality water bird habitat it currently lacks such areas (i.e. well established aquatic macrophyte communities).

A very small section of Stony Creek flows through the southern corner of the Modification area. This habitat is described in Section 4.1.2.

Plate 2: Grassland and dam habitat within the Modification area

4.1.2 Habitat within the Study Area (outside of Modification area)

Habitat within the remainder of the study area constituted mixed age eucalypt woodland, riparian woodland, derived grassland and regenerating woodland. The regenerating woodland and derived grassland are similar to habitats described in Section 4.1.1, whilst the remaining habitats are described below.

Mixed Age Eucalypt Woodland

Mixed age eucalypt woodland occurred in two main regions within the study area: along the escarpment foothills to the west of the Modification area and on the west-facing slope of hills to the east of Stony Creek (Plate 3). Along the escarpment foothills the condition of woodland was good with little recent disturbance, however some habitat attributes were rare or absent, indicative of historic logging and disturbance. There was thick undergrowth of *Bursaria spinosa* and other mid-storey shrubs and a moderate diversity of ground covering vegetation. Along the western facing slope of hills to the east of Stony Creek the woodland (to 20 metres [m]) was dominated by *Eucalyptus tereticornis* with a native shrub layer to 2 m over a patchy groundcover dominated by native grasses and some forbs. Both areas (escarpment foothills and hills of Stony Creek) supported moderate to low densities of hollow bearing trees and large logs there was limited outcropping rock but some minor scattered surface rock along the escarpment foothills.

Plate 3: Mixed age woodland on escarpment foothills (top) and hills of Stony Creek (bottom)

Riparian Habitats

Vegetation along Stony Creek consisted of large remnant eucalyptus trees over grassy areas (mixture of native and exotic grass species) with patches of regenerating shrubs.

The bed and banks of Stony Creek showed moderate to high levels of disturbance due to previous erosion and cattle access. There were few shallow pools along the entire length of the watercourse traversed (Plate 4). Pools present had high turbidity and nutrient loads, offering poor habitat for most aquatic fauna.

Much of the vegetation along North Wambo Creek has been cleared and grazed. The canopy species consisted of scattered mature *Eucalyptus camaldulensis* and *Casuarina cunninghamiana.* Many of the *E. camaldulensis* trees had hollows. There was a sparse mid-storey of natives and exotics, with ground cover dominated by introduced grasses. Instream vegetation was limited to *Phragmites australis* and *Typha orientalis* in two permanent pools, with some occasional fringing *Juncus usitatus* also present.

Plate 4: Riparian habitat of Stony Creek (top left) and North Wambo Creek (top right and bottom)

Dams and Creeklines

Aquatic habitat features within the study area consisted of the three degraded ephemeral creek lines (Figure 2) of Stony, Wambo and North Wambo Creeks (see also description for riparian woodland above) and farm dams with associated drainage swales.

Condition indicators and available habitat along all creeks indicated significant previous disturbance. The hydrological regime appears to have been significantly altered over time. This is evident by the limited pools in both creeks (despite relatively high rainfall in the season of survey, a moderate catchment area and geomorphic attributes of the creeks). There were some larger pools (to 1 m in depth) along Wambo Creek upstream and downstream of its confluence with Stony Creek and these pools often showed iron staining on the water surface and iron bacterial mats (Plate 5). Dam introduction, agriculture (clearing and cattle grazing), open-cut mining (in the case of North Wambo Creek) and subsidence are likely to have been responsible for the existing altered hydrological regime.

There is some occasional woody debris in both creeks where the banks are vegetated (a limited proportion of their length) and erosion of bed and bank features is moderate. The bed is primarily grass or herbs, due to the infrequent nature of flows along the creek, although some sections adjacent to pools have stones, to fine sand. In the remaining pools water quality is poor as evidenced by algal growth, high turbidity and manure with pugging (cattle hoof marks) around access points to pools. There is some macrophyte growth within the pools (thick *Typha*, *Eleocharis*, and *Phragmites* in Wambo Creek and floating *Ludwigia* in Stony Creek) and fringing growth of *Juncus usitatus*.

Plate 5: Aquatic habitats in the Study Area (Wambo Creek) showing current iron bacteria growth (left) and better habitat condition (right).

4.2 Fauna

A total of 98 vertebrate animal species were recorded during field survey comprising 68 birds, 20 mammals, six reptiles and four frogs (Table 4). Four threatened woodland birds and two threatened bats were recorded (Figure 4). The composition of species recorded is comparable to previous surveys within the locality, with slightly fewer species of frogs and reptiles. Species unrecorded in previous surveys reviewed were Red-naped Snake (*Furina diadema*), Scarlet Robin (*Petroica boodang*), Australian King Parrot (*Alisterus scapularis*), Rose Robin (*Petroica rosea*) and Bar-shouldered Dove (*Geopelia humeralis*).

The diverse bird assemblage is likely indicative of a mosaic of vegetation and habitat types across the study area and surrounds. The low number of frog and reptile species is partially attributable to the timing of the survey (outside of the breeding and calling season for most frogs and during a period of limited activity or hibernation for most reptiles). However, there is limited frog and reptile habitat within the study area due to a lack of woody debris, logs and rocky outcrops as well as degraded riparian habitats.

There was low diversity of arboreal and small ground dwelling mammals recorded, with only Brushtail Possum (*Trichosurus vulpecula*) (by far the most frequently recorded small mammal), Black Rat (*Rattus Rattus*) and House Mouse (*Mus musculus*) recorded on more than one occasion throughout the study area. This may be attributable to the low density or seasonal variability of habitat resources such as hollows, logs, flowering trees and shrubs

and fungi within the survey area. Low trap rates and diversity of small mammal species have been a feature of previous surveys.

Table 4: Fauna Observations from the North Wambo Study Area and Surrounds

Common Name	Scientific Name	Class	T1	T2	T3	T4	Opportunistic
Amphibians							
Common Eastern Froglet	*Crinia signifera*	Amphibia	H	H	H	H	
Smooth Toadlet	*Uperoleia laevigata*	Amphibia		O			
Spotted Grass Frog	*Limnodynastes tasmaniensis*	Amphibia			H		
Verreaux's Frog	*Litoria verreauxii*	Amphibia	H	H	H	O	
Reptiles							
Eastern Snake-necked Turtle	*Chelodina longicollis*	Reptilia					O
Wood Gecko	*Diplodactylus vittatus*	Reptilia		O			
Robust Ctenotus	*Ctenotus robustus*	Reptilia		O			
Eastern Water-skink	*Eulamprus quoyii*	Reptilia					O
Dark-flecked Garden Sunskink	*Lampropholis delicata*	Reptilia					O
Red-naped Snake	*Furina diadema*	Reptilia		O			
Birds							
Brown Quail	*Coturnix ypsilophora*	Aves					O
Australian Wood Duck	*Chenonetta jubata*	Aves					O
Pacific Black Duck	*Anas superciliosa*	Aves					O
Hardhead	*Aythya australis*	Aves					O
Australasian Grebe	*Tachybaptus novaehollandiae*	Aves					O
Cattle Egret	*Ardea ibis*	Aves					O
White-faced Heron	*Egretta novaehollandiae*	Aves					O
Australian Kestrel	*Falco cenchroides*	Aves					O
Wedge-tailed Eagle	*Aquila audax*	Aves					O
Purple Swamphen	*Porphyrio porphyrio*	Aves					O
Masked Lapwing	*Vanellus miles*	Aves					O
Common Bronzewing	*Phaps chalcoptera*	Aves					O
Crested Pigeon	*Ocyphaps lophotes*	Aves	O				O
Bar-shouldered Dove	*Geopelia humeralis*	Aves				C	
Galah	*Eolophus roseicapillus*	Aves	O	O			
Sulphur-crested Cockatoo	*Cacatua galerita*	Aves		H			
Crimson Rosella	*Platycercus elegans*	Aves		O	O		O
Eastern Rosella	*Platycercus eximius*	Aves	O	O			O
Red-rumped Parrot	*Psephotus haematonotus*	Aves		O			O
Australian King-Parrot	*Alisterus scapularis*	Aves	O	O			
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	Aves			H		
Tawny Frogmouth	*Podargus strigoides*	Aves			H		
Australian Owlet-nightjar	*Aegotheles cristatus*	Aves			H		
Laughing Kookaburra	*Dacelo novaeguineae*	Aves		O	H	O	

Common Name	Scientific Name	Class	T1	T2	T3	T4	Opportunistic
Rainbow Bee-eater	*Merops ornatus*	Aves	O				
White-throated Treecreeper	*Cormobates leucophaea*	Aves			O	H	
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	Aves		O			
Superb Fairy-wren	*Malurus cyaneus*	Aves	O	O,C	O	O	
Spotted Pardalote	*Pardalotus punctatus*	Aves	H		O	H	
Striated Pardalote	*Pardalotus striatus*	Aves		O			
Speckled Warbler	*Pyrrholaemus saggitatus*	Aves	O	O	O	O	O
Weebill	*Smicrornis brevirostris*	Aves			O		O
White-throated Gerygone	*Gerygone albogularis*	Aves			O		
Brown Thornbill	*Acanthiza pusilla*	Aves		O			
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	Aves					O
Yellow Thornbill	*Acanthiza nana*	Aves		O	O		
Yellow-faced Honeyeater	*Lichenostomus chrysops*	Aves			O		
White-plumed Honeyeater	*Lichenostomus penicillatus*	Aves			O		
Lewin's Honeyeater	*Meliphaga lewinii*	Aves					O
Noisy Miner	*Manorina melanocephala*	Aves	O	O		O	
Red Wattlebird	*Anthochaera carunculata*	Aves		H			
Eastern Yellow Robin	*Eopsaltria australis*	Aves		O			
Jacky Winter	*Microeca fascinans*	Aves			O		O
Rose Robin	*Petroica rosea*	Aves			O	O	
Scarlet Robin	*Petroica boodang*	Aves				O	
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	Aves			H		O
Golden Whistler	*Pachycephala pectoralis*	Aves		O	O		
Rufous Whistler	*Pachycephala rufiventris*	Aves				H	
Grey Shrike-thrush	*Colluricincla harmonica*	Aves		O	O	O	
Magpie-lark	*Grallina cyanoleuca*	Aves	O	O			
Grey Fantail	*Rhipidura albiscapa*	Aves		O	O	O	
Willie Wagtail	*Rhipidura leucophrys*	Aves	O	O		O	
Grey Butcherbird	*Cracticus torquatus*	Aves	H		O		
Pied Butcherbird	*Cracticus nigrogularis*	Aves	O	O			
Australian Magpie	*Cracticus tibicen*	Aves	H	H	H	H	
Pied Currawong	*Strepera graculina*	Aves			H		H
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	Aves		H	H		
Olive-backed Oriole	*Oriolus sagittatus*	Aves					H
Australian Raven	*Corvus coronoides*	Aves	O	H	H	H	
White-winged Chough	*Corcorax melanorhamphos*	Aves	O	H	O	O	
Common Starling	*Sturnus vulgaris**	Aves					O
Welcome Swallow	*Hirundo neoxena*	Aves					O
Fairy Martin	*Petrochelidon ariel*	Aves					O
Silvereye	*Zosterops lateralis*	Aves			O		

Common Name	Scientific Name	Class	T1	T2	T3	T4	Opportunistic
Rufous Songlark	*Cincloramphus mathewsi*	Aves			H		E
Mistletoebird	*Dicaeum hirundinaceum*	Aves	O				
Red-browed Finch	*Neochmia temporalis*	Aves	O	O,C	O	O	
Double-barred Finch	*Taeniopygia bichenovii*	Aves	O	O	O		O
Mammals							
Yellow-footed Antechinus	*Antechinus flavipes*	Mammalia			T		
Brown Antechinus	*Antechinus stuartii*	Mammalia			T		
Common Wombat	*Vombatus ursinus*	Mammalia	IO	C,IO	IO		
Sugar Glider	*Petaurus breviceps*	Mammalia			H		
Glider (incisions)	*Petaurus sp.*	Mammalia			IO	IO	
Common Brushtail Possum	*Trichosurus vulpecula*	Mammalia	IO	S,C	S	S	
Eastern Grey Kangaroo	*Macropus giganteus*	Mammalia	O	O	O,C	O	
Euro	*Macropus robustus*	Mammalia	O				
Red-necked Wallaby	*Macropus rufogriseus*	Mammalia	O	O	O	O	
Swamp Wallaby	*Wallabia bicolor*	Mammalia			C		
Eastern Freetail-bat	*Mormopterus norfolkensis*	Mammalia					E
Unidentified Mormopterus	*Mormopterus 'Species 4'*	Mammalia					E
Large-eared Pied Bat^	*Chalinolobus dwyeri*	Mammalia					E
Gould's Wattled Bat	*Chalinolobus gouldii*	Mammalia					E
Chocolate Wattled Bat	*Chalinolobus morio*	Mammalia					E
Little Forest Bat	*Vespadelus vulturnus*	Mammalia					E
House Mouse	*Mus musculus**	Mammalia	T	C		C,T	
Black Rat	*Rattus rattus**	Mammalia		T,C			
Red Fox	*Vulpes vulpes**	Mammalia		O			
Brown Hare	*Lepus capensis**	Mammalia					O
European cattle	*Bos taurus**	Mammalia	O	O		O	

Notes:
- Nomenclature consistent with CSIRO (2006) *CSIRO List of Australian Vertebrates A Reference with Conservation Status*

* Introduced species
Opport. = opportunistic
bolded = listed as vulnerable under the NSW TSC Act
^ = listed as vulnerable under the Commonwealth EPBC Act
O = observed; H = Heard; IO = indirect observation; C = Camera Trap; T = Elliot Trap; S = Detected with Spotlight; E = echolocation recording.

4.3 Threatened Species

Database searches revealed previous records (Atlas of NSW Wildlife 2011) or potential habitat (SEWPaC Protected Matters Search Tool 2011) for 47 threatened fauna species listed under the TSC Act or the EPBC Act within a 10 km radius of the study area (Appendix 1).

Of the 47 threatened species:

- six are known from the study area based on the fact that they were recorded during this survey;
- nine are considered to have a high chance of occurring as they have previously been recorded in the vicinity of the study area or due to numerous surrounding records;
- fifteen are considered to have a moderate chance of occurring;
- sixteen are considered to have a low chance of occurring; and
- one is considered to have no chance of occurring.

The high number threatened species that have been recorded within and in the vicinity of the study area reflects the intensive level of fauna survey within the study area and surrounds over the past decade, mostly due to mining proposals and monitoring programs.

In addition, the study area is next to a large reserve network in Wollemi National Park and the wider Blue Mountains World Heritage Area, and is situated between the coastal plains and escarpment with a high diversity of available habitats and vegetation from grassland to mixed aged forest.

Six threatened species recorded by this study include:

- Brown Treecreeper (eastern subspecies) listed as vulnerable under the TSC Act;
- Speckled Warbler listed as vulnerable under the TSC Act;
- Scarlet Robin listed as vulnerable under the TSC Act;
- Grey-crowned Babbler listed as vulnerable under the TSC Act;
- Eastern Free-tail Bat listed as vulnerable under the TSC Act; and
- Large-eared Pied Bat listed as vulnerable under the TSC Act and EPBC Act.

None of the 30 species with a moderate to known likelihood of occurring within the study area are expected to be impacted by the proposal given the anticipated minor subsidence impacts (Section 5).

5 IMPACT ASSESSMENT

5.1 General Ecological Impacts

Potential Surface Disturbance Impacts

The Modification would use the existing surface infrastructure of the North Wambo Underground Mine. Vehicular movements within the study area would be limited to those required for monitoring and general site maintenance activities. The only surface infrastructure that would be required are water bores to drain the voids of previous underground workings above the proposed longwalls. These bores would be located within already cleared farmland and would not require any vegetation clearance or disturbance to important fauna habitat.

Potential Subsidence Impacts

A subsidence assessment for the Modification has been undertaken by MSEC (2012) (Appendix A of the Modification Environmental Assessment). Potential impacts discussed below are based upon findings within MSEC 2012.

The potential impacts are expected to include surface cracking of soils over the Modification area and minor surface hydrological changes. It is not expected that there would be a hydraulic connection between the surface and seam, as none was observed after the extraction of the first four longwalls at the NWUM, which extracted directly beneath North Wambo Creek at a depth of cover of around 100 metres (MSEC 2012). Therefore, it is not expected that impacts will be sufficient in magnitude to alter soil moisture levels such that the existing vegetation communities and habitats within the study area would be significantly altered.

Subsidence impacts to South Wambo Dam may necessitate its drainage to manage such impacts. Drainage of the dam would impact existing ecological values discussed in section 4.1.1. Subsidence impacts and indirect impacts of subsidence, such as dewatering of South Wambo Dam, should be monitored and ameliorative measures employed where appropriate. It is understood that monitoring of subsidence impacts will be part of environmental management activities performed by WCPL within the study area.

Ecological Considerations

Given the extent and magnitude of impacts described above, the Modification is not expected to have significant adverse impacts on available fauna habitats within the study area. In addition, the Modification would not have any adverse impact on movement of vertebrate fauna species throughout the landscape or cause fragmentation of vegetation within the study area. No habitat within or around the Modification constitutes critical habitat for threatened fauna species. Indirectly, subsidence may lead to drainage of the South Wambo Dam, or it may require draining due to safety concerns. Although the dam doesn't currently contain habitat for any threatened species known from the locality, habitat for threatened waterbird species (fringing and emergent vegetation) may develop with time. If the dam held water constantly for two or more years from the present and

was drained after that time period, it would be necessary to determine whether suitable habitat for threatened waterbirds had developed within the dam prior to it being drained.

5.2 Impacts on Threatened Species

A total of 30 threatened fauna species listed under the TSC Act and/or the EPBC Act were identified as having a moderate to known potential to occur within the Modification area (Appendix 1). Six of these species were recorded by the fauna surveys, namely Brown Treecreeper (eastern subspecies), Grey-crowned Babbler (eastern subspecies), Speckled Warbler and Scarlet Robin, Eastern Freetail-bat and Large-eared Pied Bat.

The potential impacts of the Modification on fauna and their habitats are described in Section 5.1. Impacts to threatened species from the Modification would be confined to indirect impacts to habitat features or foraging resources used within the Modification area. It is expected that such impacts would be negligible as habitat features commonly used within the Modification area by threatened species (e.g. regenerating woodland) are not prone to the anticipated minor subsidence impacts.

On this basis, there is no need to refer the Modification under the EPBC Act.

5.3 Conclusion

No threatened fauna or their habitats, are likely to be significantly impacted by the proposed Modification. This assessment is based on predicted impacts from the proposal described in Section 5.1.

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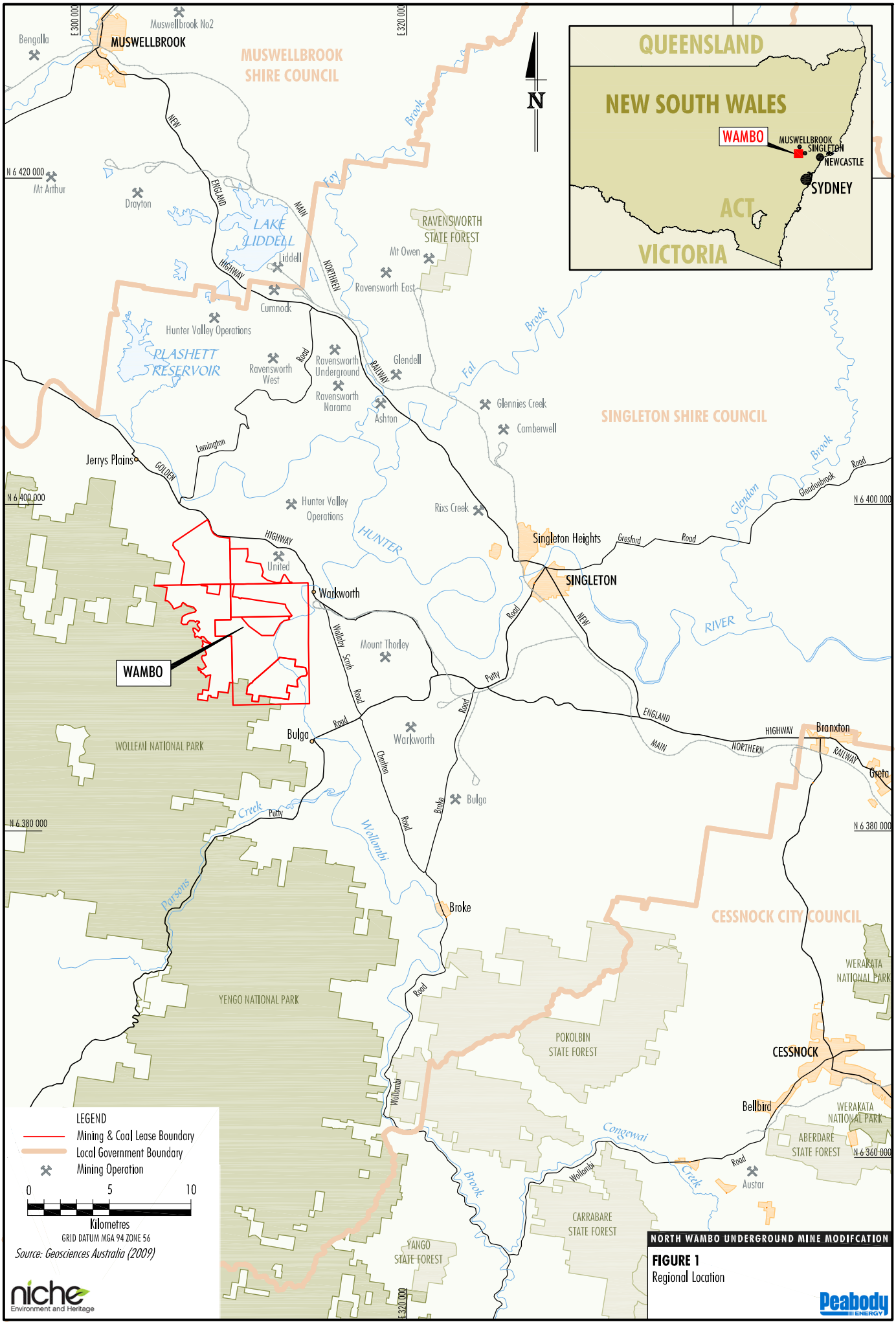
FIGURES



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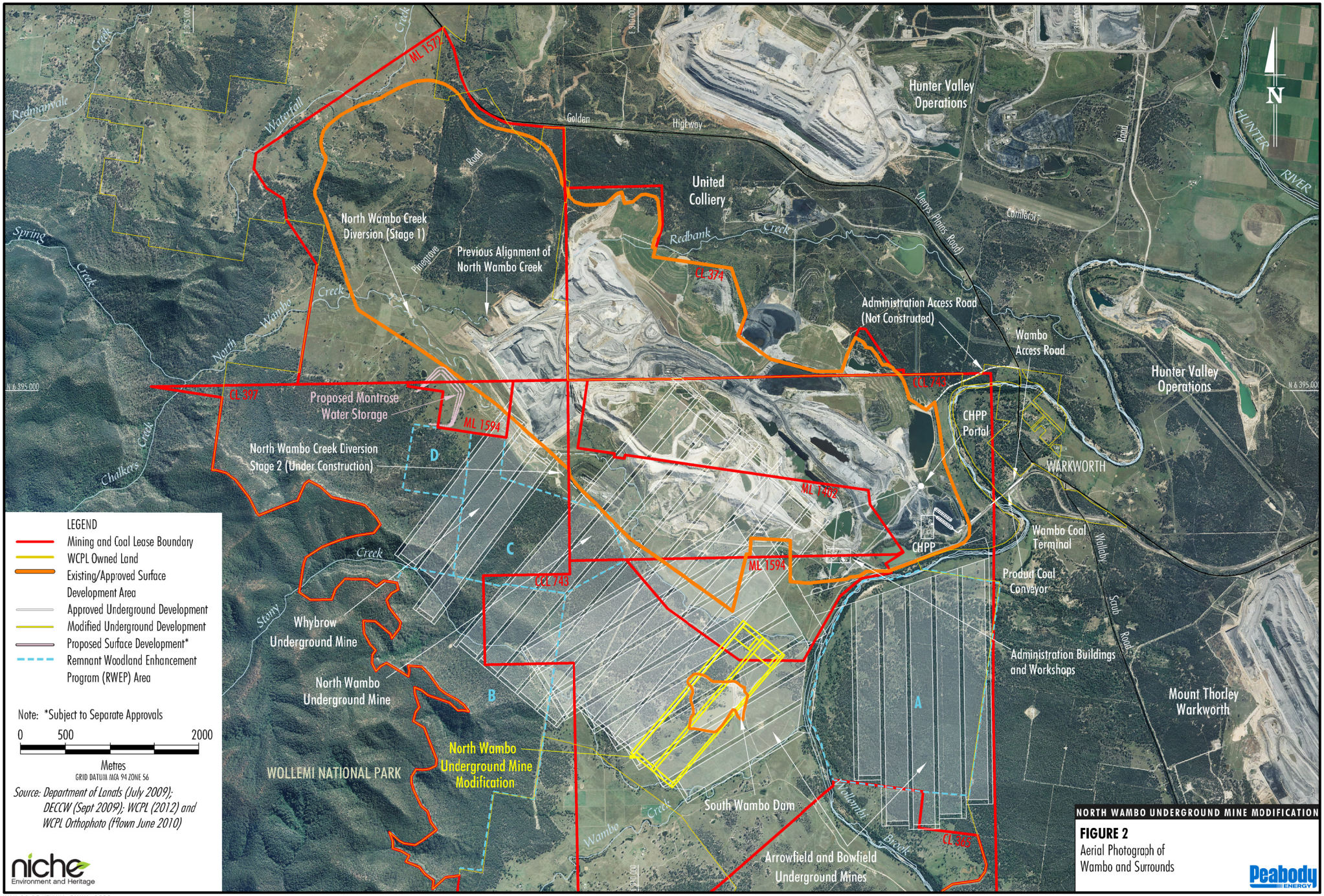

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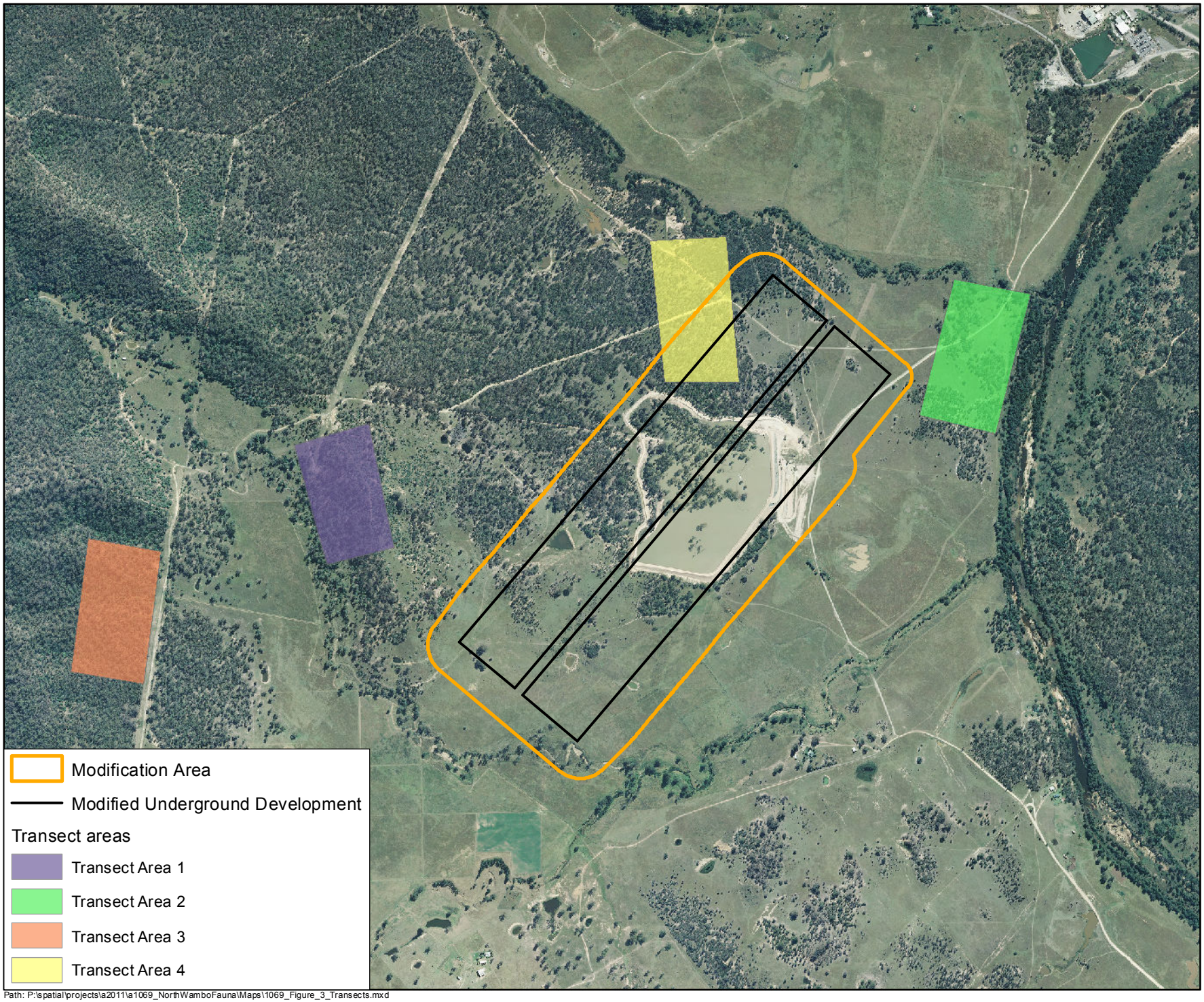

Figure 3: Transect Areas Established for Trapping and other Survey Methods

1069 North Wambo Fauna Assessment

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Project Mgr: RH

Date: 27/08/2012

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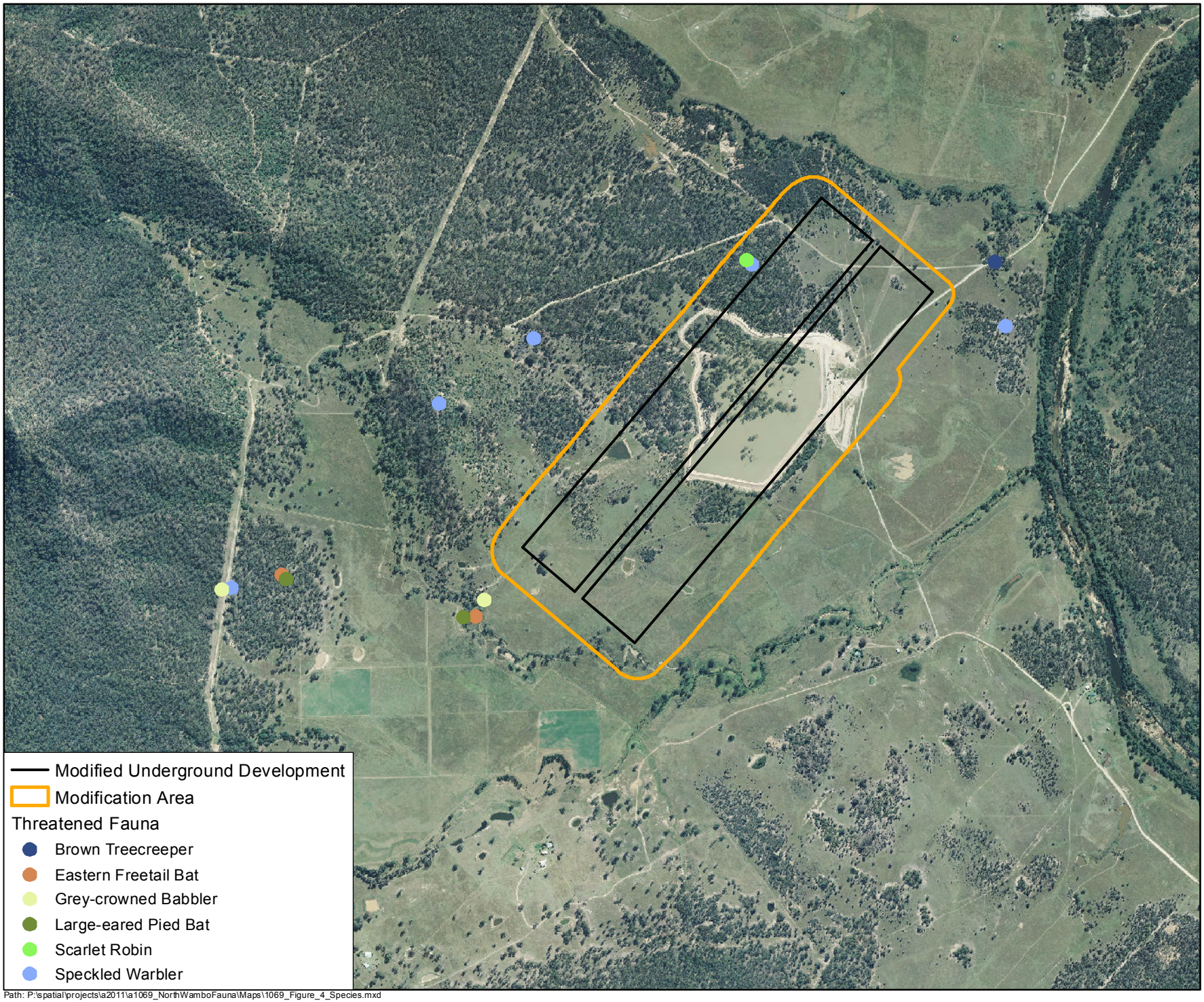

Figure 4: Threatened Species Recorded during the North Wambo Modification Project

1069 North Wambo Fauna Assessment

Drawn by: RJ

Project Mgr: RH

Date: 29/08/2012

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APPENDICES

Appendix 1: Likelihood of Occurrence Tables for Threatened Fauna within the Modification Area

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Giant Burrowing Frog *Heleioporus australiacus*	V	V	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks. Can also occur within shale outcrops within sandstone formations. In the southern part of its range can occur in wet and dry forests, montane sclerophyll woodland and montane riparian woodland (Daly 1996). Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water (OEH 2011).	Low – not recorded during current or previous surveys, or within 10 kilometres (km) radius of the Modification area. Inappropriate habitat.
Giant Barred Frog *Mixophyes iteratus*	E	E	Coast and ranges from south-eastern Queensland to the Hawkesbury River in New South Wales (NSW). North-eastern NSW, particularly the Coffs Harbour-Dorrigo area (OEH 2011). The Southern Barred Frog occurs in uplands and lowlands in rainforest and wet sclerophyll forest, including farmland.	Low - not recorded during current or previous surveys, or within a 10 km radius of the Modification area.
Green and Golden Bell Frog *Litoria aurea*	V	E	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 (OEH 2011).	Low - not recorded during current or previous surveys, or within 10 km radius of the Modification area.
Booroolong Frog *Litoria booroolongensis*	E	E	The Booroolong Frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. It has disappeared from much of the Northern Tablelands, however several populations have recently been recorded in the Namoi catchment. Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses (OEH 2011).	Low - not recorded during current or previous surveys, or within database searches.
Littlejohn's Tree Frog *Litoria littlejohni*	V	V	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 (Barker 1995). Prefers rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation (Barker 1995). Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats (OEH 2011).	Low – not recorded during current or previous surveys, or within 10 km radius of the Modification area. Inappropriate habitat.
Broad-headed Snake *Hoplocephalus bungaroides*	V	E	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.	No – inappropriate habitat.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Spotted Harrier *Circus assimilis*	-	V	The Spotted Harrier occurs throughout the Australian mainland, except in densly forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (OEH 2011).	Moderate – not recorded during previous surveys and only one record within 10 km of the Modification area. Modification area provides some foraging habitat none of which would be impacted by the predicted subsidence impacts.
Little Eagle *Hieraaetus morphnoides*	-	V	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	High - numerous previous records around the Modification area. Negligible potential impacts only anticipated by subsidence.
Australian Painted Snipe *Rostratula australis*	V	E	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 (OEH 2011).	Low – Not recorded during current or previous surveys within a 10 km radius of the Modification area.
Glossy Black-cockatoo *Calyptorhynchus lathami*	-	V	Inhabits forest with low nutrients, characteristically with key *Allocasuarina* spp. Tends to prefer drier forest types (NSW National Parks and Wildlife Service [NPWS] 1999) with a middle stratum of allocasuarina below eucalyptus or angophora. Often confined to remnant patches in hills and gullies (Higgins 2002). Breed in hollows stumps or limbs, either living or dead.	Moderate – recorded around the Modification area during previous surveys. Negligible potential impacts only due to anticipated subsidence.
Gang-gang Cockatoo *Callocephalon fimbriatum*	-	V	In summer, the species occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (Higgins 2002). Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest (Forshaw 1981). In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (OEH 2011). It requires tree hollows in which to breed (Gibbons 1997).	High – recorded during previous surveys around the Modification area. Negligible potential impacts due to anticipated subsidence.
Little Lorikeet *Glossopsitta pusilla*	-	V	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes (NSW Scientific Committee 2011).	Moderate - numerous previous records around Modification area. Negligible potential impacts due to anticipated subsidence.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Turquoise Parrot *Neophema pulchella*	-	V	Occurs in open woodlands and eucalypt forests with a ground cover of grasses and under storey of low shrubs. Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies (Higgins 2002). Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies that are moist (Higgins 2002).	Moderate - numerous previous records around Modification area. Negligible potential impacts due to anticipated subsidence.
Swift Parrot *Lathamus discolor*	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability (Pizzey 1999).	Moderate – not recorded during previous surveys. Two records within a 10 km radius of the Modification area. Negligible potential impacts due to anticipated subsidence.
Sooty Owl *Tyto tenebricosa*	-	V	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 m. Nests and roosts in hollows of tall emergent trees, mainly eucalypts (Higgins 2002) often located in gullies. Nests have been located in trees 125 to 161 centimetres in diameter (OEH 2011).	Moderate – not recorded during previous surveys and only one record within 10 km of the Modification area. Limited foraging habitat only. Negligible potential impacts due to anticipated subsidence.
Masked Owl *Tyto novaehollandiae*	-	V	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead (Higgins 2002). Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet (OEH 2012).	Moderate – recorded around Modification area during previous surveys. Modification area provides limited foraging habitat only. Negligible potential impacts due to anticipated subsidence.
Powerful Owl *Ninox strenua*	-	V	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within Red Turpentine in tall open forests and Black She-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials (Gibbons 1997). Nest trees for this species are usually emergent with a diameter at breast height of at least 100 centimetres (cm).	Moderate –recorded around Modification area during previous surveys and one database record only. Modification area provides limited foraging habitat only. Negligible potential impacts due to anticipated subsidence.
Barking Owl *Ninox connivens*	-	V	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 (Pizzey, 1997).	Moderate – not recorded during current or previous surveys. One database record within a 10 km radius of the Modification area. Limited foraging habitat only. Negligible potential impacts due to anticipated subsidence.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Brown Treecreeper *Climacteris picumnus victoriae*	-	V	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 (OEH 2011).	Known – recorded during current surveys. Also recorded during previous surveys. Negligible potential impacts due to anticipated subsidence.
Speckled Warbler *Pyrrholaemus saggitatus*	-	V	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 (OEH 2011).	Known - recorded several times during the current surveys and locally common. Negligible potential impacts due to anticipated subsidence.
Regent Honeyeater *Xanthomyza phrygia*	E	E	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).	Moderate – not recorded during previous surveys. Numerous records within a 10 km radius of the Modification area. Negligible potential impacts due to anticipated subsidence.
Painted Honeyeater *Grantiella picta*	-	V	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 (OEH 2011).	Moderate - numerous previous records around Modification area. Negligible potential impacts due to anticipated subsidence.
Hooded Robin *Melanodryas cucullata cucullata*	-	V	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 (OEH 2011).	High - numerous previous records around Modification area (locally common). Negligible potential impacts due to anticipated subsidence.
Flame Robin *Petroica phoenicea*	-	V	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border (OEH 2011). The species is also found in Tasmania. The preferred habitat in summer includes eucalyptus forests and woodland, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January (Morcombe 2004).	Moderate – limited records within 10 km of Modification area. Negligible potential impacts due to anticipated subsidence.
Scarlet Robin *Petroica boodang*	-	V	The Scarlet Robin's range includes all state capitals. Occurs in forests, woodlands; and heavier vegetation when breeding. During autumn and winter occurs in more open and cleared areas. It has dispersive or locally migratory seasonal movements. Is conspicuous in open and suburban habitats (Morcombe 2004).	Known – recorded in Modification area during current survey. Negligible potential impacts due to anticipated subsidence.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	-	V	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (OEH 2011).	Known – recorded during current surveys. Numerous previous records around Modification Area (locally common). Negligible potential impacts due to anticipated subsidence.
Varied Sittella *Daphoenositta chrysoptera*	-	V	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia (Higgins and Peter 2002). Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature eucalypts with hollows (OEH 2011).	High - numerous previous records around Modification area.
Diamond Firetail *Stagonopleura guttata*	-	V	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 (OEH 2011).	High – recorded during previous surveys around Modification Area. Negligible potential impacts due to anticipated subsidence.
Spotted-tailed Quoll (South-east Mainland Population) *Dasyurus maculatus maculatus*	E	V	Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage.	Moderate – not recorded during previous surveys but some records within a 10 km radius of the Modification area. Limited foraging habitat only. Negligible potential impacts due to anticipated subsidence.
Brush-tailed Phascogale *Phascogale tapoatafa*	-	V	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west to the divide (OEH 2011). Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest (OEH 2011).	Low - not recorded during current or previous surveys. Single recent record within 10 km of the Modification area.
Koala *Phascolarctos cinereus*	-	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall (OEH 2011).	Low – not previously recorded around Modification area. Sparse feed trees in Modification area.
Yellow-bellied Glider *Petaurus australis*	-	V	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. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria (OEH 2011).	Low - numerous records within a 10 km radius of the Modification area but all to the west of the Modification area in more consolidated habitat. Not recorded during previous surveys and limited habitat in Modification area. Negligible potential impacts due to anticipated subsidence.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Squirrel Glider *Petaurus norfolcensis*	-	V	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range (Suckling 1998). Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias (Quin 1993). There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps (OEH, 2011). Within a suitable vegetation community at least one species should flower heavily in winter and one species of Eucalypt should be smooth barked (Menkhorst 2001).	Low – records within 10 km radius of the Modification area but not recorded during previous surveys and limited available habitat within Modification area. Negligible potential impacts due to anticipated subsidence.
Brush-tailed Rock-wallaby *Petrogale penicillata*	V	E	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices (OEH 2011).	Low – records within 10 km of the Modification area. Inappropriate habitat within Modification area.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	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 although some individuals may travel up to 70 km (OEh 2011).	High – multiple previous records. Negligible potential impacts due to anticipated subsidence.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	-	V	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn (OEH 2011).	High – previously recorded during surveys. Negligible potential impacts due to anticipated subsidence.
Eastern Freetail-bat *Mormopterus norfolkensis*	-	V	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits (Churchill 1998).	Known – multiple previous records. Negligible potential impacts due to anticipated subsidence.
Little Bent-wing Bat *Miniopterus australis*	-	V	Coastal north-eastern NSW and eastern Queensland (Churchill 2008). Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel hundreds of kilometres from feeding home ranges to breeding sites (OEH 2011). The Little Bentwing-bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects (OEH, 2011).	Moderate – one record during previous surveys. Low densities likely. Not recorded during current surveys. Negligible potential impacts due to anticipated subsidence.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis*	-	V	Broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Roost in caves and man made habitats and under road culverts (OEH, 2011).	High – recorded during previous surveys. Negligible potential impacts due to anticipated subsidence.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range (Hoye 1995). Can also be found on the edges of rainforests and in wet sclerophyll forests (Churchill 2008). This species roosts in caves and mines in groups of between 3 and 37 individuals (Churchill 2008).	Known –recorded in this survey and one record nearby. Negligible potential impacts due to anticipated subsidence.
Greater Long-eared Bat *Nyctophilus timoriensis*	V	V	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland (OEH 2011). Roosts in tree hollows, crevices, and under loose bark.	Low - not recorded during current or previous surveys, or within 10 km radius of Modification area.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	-	V	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high (Churchill 2008). Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor (Menkhorst 1995). This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites (Menkhorst 1995).	Low – Species records are further west of the Modification area in different habitat. Unsuitable habitat.
Large-footed Myotis *Myotis macropus*	-	V	Occurs in most habitat types as long as they are near permanent water bodies, including streams, lakes and reservoirs. Commonly roost in caves, but can also roost in tree hollows, under bridges and in mines (Richards 1995, Churchill 1998).	Moderate – one regional record nearby, so would likely use the Modification area only infrequently, if at all. Not recorded during recent surveys. Negligible potential impacts due to anticipated subsidence.
Greater Broad-nosed Bat *Scoteanax rueppellii*	-	V	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m (Churchill 2008). In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat (OEH 2011). This species roosts in hollow tree trunks and branches (Churchill 2008).	High – multiple previous records. Negligible potential impacts due to anticipated subsidence.

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
Eastern Cave Bat *Vespadelus troughtoni*	-	V	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. 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.	Low –Records well outside of Modification area and not recorded in current or previous surveys.
New Holland Mouse *Pseudomys novaehollandiae*	V	-	Coastal heath and dry sclerophyll forest and woodland (OEH 2011).	Low – Not previously recorded within a 10 km radius of Modification area.
Hastings River Mouse *Pseudomys oralis*	E	E	A patchy distribution spanning the Great Dividing Range from the Hunter Valley, south of Mt Royal, north to the Bunya Mountains near Kingaroy in south-east Queensland, at elevations between 300 m and 1100 m (OEH 2011). A variety of dry open forest types with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops. Nests may be in either gully areas or ridges and slopes. They eat seeds, leaves, insects and fungi.	Low - Not recorded during current or previous surveys, or within 10 km radius of Modification area.

Notes:

- CE = Critically Endangered; E, E1 = Endangered; V = Vulnerable.
- Nomenclature consistent with CSIRO (2006) *CSIRO List of Australian Vertebrates A Reference with Conservation Status*
- Highlighted species were found during current survey. Fauna that are exclusively dependant on marine environments, including near shore environments, were removed from the table.
- Threatened species status under the NSW *Threatened Species Conservation Act, 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at July 2012)

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